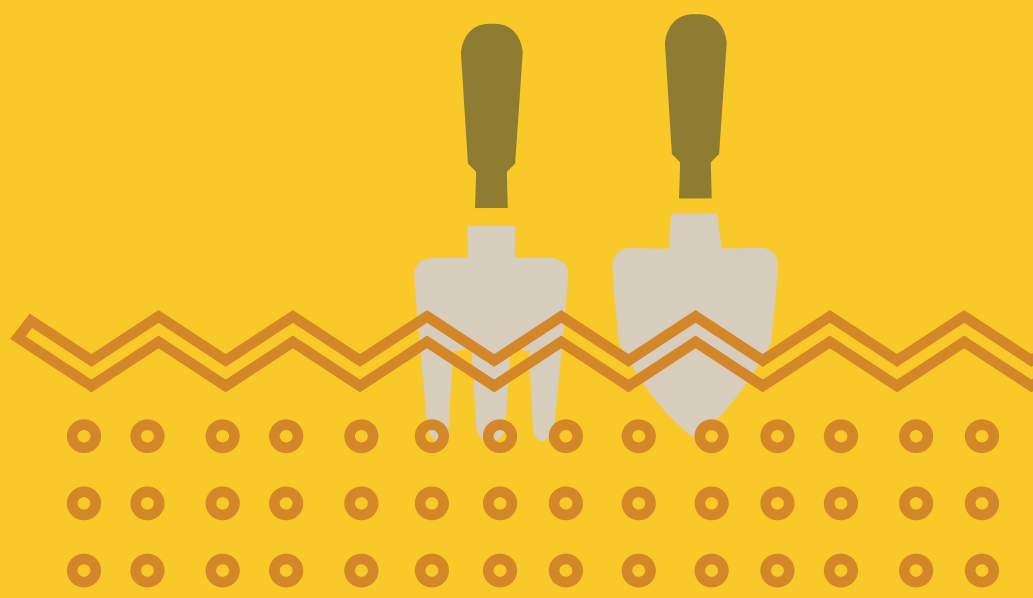
The Outdoor Garden Classroom

Hands-On STEM Teaching Curriculum, Pre-K-5

Fourth Grade Lessons 4

Energy in the Garden
(2nd Edition)



THE OUTDOOR GARDEN CLASSROOM

Hands-On STEM Teaching Curriculum, Pre K-5

Lessons are to Nevada State and Next Generation Science Standards

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The Outdoor Garden Classroom: Hands-On STEM Curriculum K-5 was funded by The American Honda Foundation and created by teachers from the Clark County School District in Southern Nevada in Association with Green Our Planet and Three Square.

The **American Honda Foundation** helps meet the needs of American society in the areas of youth and scientific education by awarding grants to nonprofits, while strategically assisting communities in deriving long-term benefits. Since 1984, the American Honda Foundation has awarded more than $32 million to organizations serving over 115 million people in every state in the U.S.

Green Our Planet is a nonprofit, 501(c)(3) organization established in 2013. Its mission is to raise money for green projects worldwide via its crowdfunding platform and to educate the public about the most pressing environmental issues facing the planet today. Green Our Planet's overall goal is to help conserve, protect, and improve the environment through funding green projects and through education, which includes STEM, nutrition and conservation education in K-12 schools. In 2013, Green Our Planet launched its "Outdoor Garden Classroom Program" in Las Vegas, Nevada, which is designed to help schools fund and use outdoor vegetable gardens as "hands-on" classrooms. For more information on Green Our Planet and its programs, please visit *www.greenourplanet.org*.

Three Square's mission is to provide wholesome food to hungry people, while passionately pursuing a hunger-free community. Three Square combines food banking (warehousing canned and boxed goods), food rescue (obtaining surplus or unused meats, bread, dairy and produce from hospitality and grocery outlets), and ready-to-eat meals as the most complete food solution for Southern Nevada. Three Square works with more than 1,300 partner sites in the Southern Nevada community. Three Square distributed more than 30 million pounds of food, the equivalent of more than 25 million meals.

Achieving Excellence Through Education. The vision of Clark County, in conjunction with the Clark County School District, is to provide a safe, supportive environment which enables each student to acquire knowledge, skills and values necessary to a lifelong learner and to become a responsible, contributing member of our changing society.

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A NOTE ON THE SECOND (REVISED) EDITION

Since its release in October, 2014, the Outdoor Garden Classroom Hands-On STEM Teaching Curriculum has been used at an increasingly greater number of schools. During the 2014-2015 school year, 63 teachers at 15 CCSD schools provided feedback on their use of the curriculum with their students. The feedback and improvements they suggested were used by five of the original teachers who created the curriculum so that the 2nd edition could be revised and improved. In addition, the curriculum was extended into Pre-K. Further improvements occurred in the summer of 2015 when nutritional facts were added to the lessons for grades 1 through 5. The nutritional facts are aligned to Nevada State Standards and are tied to the information in each science lesson. Also added to this edition are "Brain Breaks" that occur every 15 minutes. These consist of vigorous exercise breaks that are connected to gardening. For example, students might jump up and down while picking imaginary apples from a tree or students might pretend to dig holes in the ground in order to transplant vegetables. Grades 3, 4, and 5 also now have worksheets and a "lesson map" added to them, so that teachers can more easily plan out the teaching of each lesson.

In subsequent years, the OGC curriculum will continue to be revised based on further teacher feedback. In this way, the lessons can continually be improved so that they become a "living curriculum." A special thanks to all of the teachers who contributed to this revised 2nd edition!

TEACHER FEEDBACK—LET US HEAR FROM YOU!

Teacher feedback is welcome—we want to hear from you about your experiences using this curriculum so that the lessons can be continually improved! All feedback can be left at: **lessons.greenourplanet.org**

Click on the tab at top that says " Teacher Feedback."

Teachers and administrators can also contact us directly at:
info@greenourplanet.org

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Fourth grade students will focus on natural systems by observing patterns in nature and explore the flow of energies, inputs, and outputs in the school garden setting. Students will then apply these experiential observations to mapping their school garden, neighborhood fruit and nut trees, and regional food-shed. Then, students will explore climate analogs and compare native practices of agriculture and design to understand the importance of seed-saving and growing reliable regionally adapted varieties of plants. Fourth graders will partner with first graders to carry out seed-saving. Students will also participate in Chef to School Program where local chefs come into the school and prepare a menu around food harvested by the 4th graders from the garden.

SEPTEMBER I OCTOBER

Lesson 1 - Patterns
Lesson 2 - Fibonacci – The Nature of Numbers
Lesson 3 - Biomimicry
Lesson 4 - Networks of Life

Nevada State Standards:

N.5.A.7: Students know observable patterns can be used to organize items and ideas.
N.5.A.3, N.5.A.6: Students will predict future events based on patterns in nature.
L.5.8.1: Students know plants and animals have structures that enable them to grow, reproduce, and survive.
L.5.8.2: Students know living things have predictable life cycles.
L.5.D: Students understand that living things can be classified according to physical characteristics, behaviors, and habitats.

Next Generation Standards:

4-LS1.A: Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.
4-LS1-2: Students will be able to describe a system in terms of its components and their interconnectedness.
4-ESS1-1: Students will learn that patterns can be used as evidence to support an explanation.
4-PS4-1: Similarities and differences in patterns can be used to sort and classify natural phenomena.
4-PS4-3: Similarities and differences in patterns can be used to sort and classify designed products.
4-PS4-2: Cause and effect relationships are routinely identified.

Overview

Students will explore patterns found in nature, including the mathematics of nature. Students will explore the concept of biomimicry. Students will explore interconnections through analysis of elements.

NOVEMBER I DECEMBER

Lesson 5 – Interconnections of Elements
Lesson 6 – Photosynthesis
Lesson 7 – The Element of Water in the Desert

Nevada State Standards:

N.5.A.1: Students know conducting careful investigations, recording data, and communicating the results in an accurate method make scientific progress.
N.5.A.3: Students know how to draw conclusions from scientific evidence.
N.2.A.1, N.5.A.2: Students describe objects and phenomena through written and spoken language, numbers and labeled drawings.
N.5.A.7: Students know observable patterns can be used to organize items and ideas. Students record patterns in nature.
(4)1.1: Generate investigative questions based on observations and interactions with objects, organisms and phenomena.
(4)1.2: Use science notebook entries to develop, communicate, and justify descriptions, explanations, and predictions.
(4) 1.3: Create and use labeled illustrations, graphs, and charts to convey ideas, record observations and make predictions.
(4)1.7: Identify observable patterns to organize items and ideas and make predictions.

Next Generation Standards:

4-PS4-1: Similarities and differences in patterns can be used to sort and classify natural phenomena
4-PS4-2: Cause and effect relationships are routinely identified.
4-PS4-3: Generate and compare multiple solutions that use patterns to transfer information.
4-PS3-1: Use evidence to construct an explanation relating energy being transferred in various ways and between objects.
4-PS3-2: Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
4-PS3-4: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
4-ESS2-1: Cause and effect relationships are routinely identified, tested, and used to explain change.

Overview

Students will explore interconnections through analysis of elements. Students will explore the photosynthesis system, from the basic concept, to naming and identifying the elements and creating experiments showing the variables involved in photosynthesis. The students will explore the aspects of droughts: what is a drought, what are the contributing factors of a drought and ways to conserve during a drought.

JANUARY I FEBRUARY

Lesson 8 – Power of a Raindrop
Lesson 9 – Soil Erosion
Lesson 10 – Mapping It Out

Nevada State Standards:

E.5.A.2: Evaluate the interactions between processes in the water cycle.

NV State Social Studies:

H2.4.3: Identify explorers and settlers in pre-territorial Nevada.
G5.4.2: Identify spatial patterns on a map of Nevada, i.e. deserts, mountains, and population.
G5.4.4: Utilize different types of Nevada maps, i.e. population and physical maps, to understand spatial distribution.
G6.4.1: Describe the distinguishing features of historical regions in Nevada, i.e. Native American tribal territories, pioneer trails, and settlement areas.
G 8.4.1: Describe ways physical environments affect human activity in Nevada using historical and contemporary examples.

Next Generation Standards:

4-PS3-3: Ask questions and predict outcomes about the changes in energy that occur when objects collide.
4-PS3-4: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
4-ESS2-1: Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
4-ESS1-1: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in landscapes over time.
4-ESS2-2: Analyze and interpret data from maps to describe patterns of Earth's features.

Overview

Students will explore the concept of erosion: what is erosion, how it occurs, what are the effects of erosion on land, and ways to avoid erosion. Students will be introduced to the different types of maps and uses of the various types of maps. They will compare and contrast historical and contemporary maps.

MARCH I APRIL I MAY

Lesson 11 – Saving Seeds
Lesson 12 – Chef Program
Lesson 13 – Preserving the Harvest

Nevada State Standards:

(4)1.2 Use science notebook entries to develop, communicate, and justify descriptions, explanations, and predictions.
(4)1.5 Identify, gather, and safely use tools (magnet, thermometer, and lens) and materials needed in investigations.

History

H1.4.3 Describe the lifestyles of Nevada's Native American cultures.
H3.4.1 Compare and/or contrast their daily lives with children in Nevada's past.

Health

(4)3.3 Plan a healthy menu emphasizing ethnic foods.

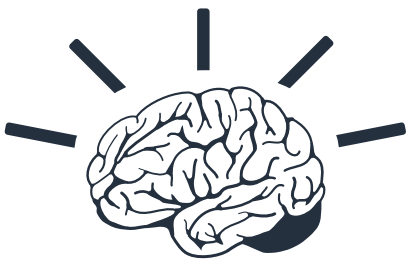
Next Generation Standards:

4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
RI.4.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

Overview:
Students will realize the importance of seeds as an important part in the life cycle of a plant. Students will learn how to harvest and store seeds. Students will save seeds from the garden for the next season. This is a crucial yet often missing element in the education of the life cycle of a plant. Seed saving allows students to select varieties of plants that thrive well in your garden and will help reduce overall costs in future years. Students will research varieties of edible plants that thrive well in the Mojave Desert. They will explore the diets and methods of food acquisition and preservation of the regional Native tribes. Students will have the opportunity to partner with a local professional chef to design a menu and prepare a meal.

Lesson One

Patterns



BRAIN BREAKS!

1. Plant Partners Teacher will give class a plant part (seed, root, stem, leaves, flower). Students turn to a partner and go back and forth naming vegetables harvested from that part of the plant. Repeat until partners can no longer name vegetables from that plant part.

2. Apple, Watermelon, Banana (rock, paper, scissors) Students play rock, paper, scissors replacing rock with apple, paper with watermelon and scissors with banana. Play as many rounds as possible in given time frame.

3. Garden Taboo Teacher plays music. When music stops students pair up. Teacher calls out a garden topic such as fruit. Partner A has to describe any fruit they want to their partner without saying the name. Partner B has to try and guess what their partner is describing.

4. Syllable Snacks Teacher will call out a number (1-4). Students work with a partner to come up with garden vocabulary words that contain that number of syllables. Partner A will begin by naming a vocabulary word with the given number of syllables; partner B will go next. They will alternate until one partner can no longer name a vocabulary word with the given number of syllables.

5. Fruit/Veggie Knock Students will work with a partner and touch knuckle to knuckle (veggie) and palm to palm (fruit) in a given sequence. Teacher will name the sequence to the class (Ex: veggie, veggie, fruit) and students will have to use the given hand gestures to complete the sequence. Teacher will increases the number of movements with each round (Ex: Round 1-veggie, veggie, fruit. Round 2-fruit, veggie, veggie, fruit).

6. Fruit/Veggie Match Students will stand. Teacher will name a fruit or vegetable and students will have to touch that part of the body corresponding to the part of the plant that the fruit or vegetable grows from (roots-feet, stem-legs, leaves-body, flowers-head). Teacher will call out and play the game “Simon says” going a little faster with each round.

7. Plant Part Finger Hop Students touch thumb to thumb, pointer to pointer, middle to middle, ring to ring, pinkie to pinkie as they say the plant part finger hop chant (seeds, roots, stems, leaves, flowers). Teacher will randomly call out a plant part, students will have to touch the corresponding fingers. Teacher will repeat, increasing the pace with each round.

8. The Harvester Students will stand and squat (harvest) with a shovel in hand. They will shovel the dirt over alternating shoulders like a farmer. Students will work at their own pace “harvesting” for the given time frame.

9. Apple Squat Students will stand and begin by squatting. They will then stand up on one foot, hop twice saying “apple, apple” then return to a squat. Repeat with increasing speed each round and alternating feet.

10. Fruit Freeze Teacher will randomly call out different fruits and vegetables. If the teacher calls out a veggie, students have to jog (or march) in place, if teacher calls out a fruit, students have to freeze.

11. Garden Guess Students will work with a partner. Partner A will silently think of a fruit or vegetable. Partner B can ask three questions about what their partner is thinking. After three questions, partner B has to guess the fruit or vegetable. They will then switch roles, and partner B will silently think of a fruit or vegetable and partner A gets to ask questions and guess. Repeat as many times as possible in the given time frame.

OVERVIEW

Students will explore patterns found in nature.

OBJECTIVES

- Students will explore patterns found in nature.
- Students will observe, identify and classify patterns.
- Students will learn that patterns are describable, repeatable, predictable, and infinite in variety.

STANDARDS

Nevada State Standards

N.5.A.7 Students know observable patterns can be used to organize items and ideas.

N.5.A.3, N.5.A.6 Students will predict future events based on patterns in nature.

L.5.8.1 Students know plants and animals have structures that enable them to grow, reproduce, and survive.

L.5.8.2 Students know living things have predictable life cycles.

L.5.D Students understand that living things can be classified according to physical characteristics, behaviors, and habitats.

Next Generation Standards:

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

4-LS1.A Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

4-LS1-2 Students will be able to describe a system in terms of its components and their interconnectedness.

4-ESS1-1 Students will learn that patterns can be used as evidence to support an explanation.

TEACHER INFORMATION

All forms of life are constructed in patterns. There are forms in nature that reoccur on a regular basis. Some of the patterns seen throughout nature are spirals, branching (fractals), waves, and lobes. Other patterns often seen are the sphere, the circle, and the pyramid. Each pattern serves a function. For example, spirals create physical strength and allow for a maximization of space. Patterns are everywhere!

TIME

Two 60-minute sessions.

QUESTION

- What constitutes a pattern?
- What patterns are found in nature?
- Do patterns have a purpose?

MATERIALS

- Handout from Permaculture for Beginners' Guide: (See Below)
  http://www.permaculturenews.org/files/permaculture_beginners_guide_extract.pdf
- A variety of natural objects: pinecones, seashells, branches, photos of rivers, ocean waves, leaves, rocks, seed pods, etc.
- Magnifying glasses
- Science journals
- Worksheet: Patterns in Nature

PROCEDURES

- Day 1

1. Brainstorm with the class what constitutes a pattern. Record answers.

2. Have students list as many types of patterns as they can think of, then share with the class.

3. Show the various items that have been brought in by the teacher.
   - Ask students to compare and contrast the various objects. This can be done in small groups.
   - Discuss and define functions. Ask, "What function do you think patterns have?"

4. The class will then go out into the garden for a 'walk about.' This involves the students observing as many patterns as they can find in the garden. They are to record their findings.

- Day 2

1. Return to the classroom to discuss their findings of patterns, either in whole group or in small groups.

2. Show examples of patterns again.

3. Ask the question, "Why are patterns evident in nature?" or "Why does nature use patterns? What is the reason for the pattern?

- This could be used as an outgoing question or as research for the next lesson.

6. Complete worksheet *Patterns in Nature.*

7. As a whole group, complete Venn-Diagrams comparing and contrasting spirals, branches and lobes, waves.

8. Closure: Show photos of Georgia O'Keeffe and her vision of nature.

- What patterns did she discover and paint?
- How could you do something similar?

ASSESSMENT

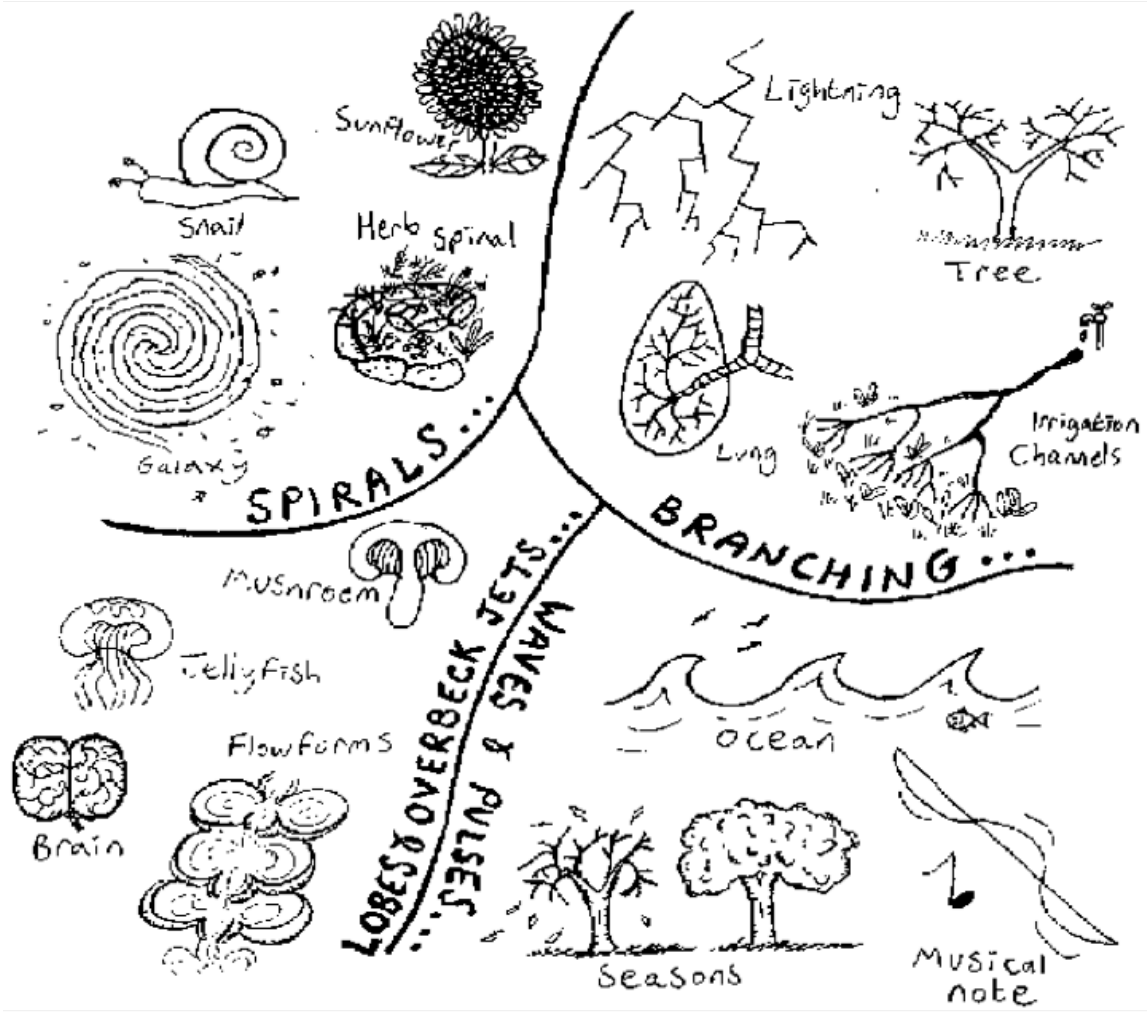
Science journals, student worksheet and group discussion participation.

ADAPTATIONS

- Use tangrams to make patterns.
- Discuss and create tessellations.
- Study M.C. Escher and his techniques of patterning.
- Study Georgia O'Keeffe and her vision of nature.
- "What else could you use a band aid for?"
- "How many ways can you use a:
  - handkerchief
  - umbrella
  - pumpkin
  - and so on
- Squiggle stories:
  - Draw a 'squiggle" on a page. Kids then incorporate the 'squiggle' into a pattern, then create a picture and a story for the picture.
- "Spot It" Game: card game where participants find the common picture,

Resources

http://teachers.net/lessons/posts/3245.html
kids.nationalgeographic.com/kids/photos/gallery/patterns-in-nature
http://www.pbs.org/thebotanyofdesire/pdf/Botany_of_Desire_Lesson_Plan_Beauty.pdf
http://sciencenetlinks.com/lessons/a-matter-of-pattern/
http://sciencenetlinks.com/lessons/



From: Graham Burnett: Permaculture for Beginners Guide

DIGGING DEEPER

- Use tangrams to make patterns.
- Discuss and create tessellations.
- Study M.C. Escher and his techniques of patterning.
- Georgia O'Keeffe study and her vision of nature.

DID YOU KNOW?

- You can find patterns EVERYWHERE! You can see the many patterns in the human body: our lungs have the branching patterns, the spiral pattern is inside our ears.
- Patterns are designed to be space and energy efficient.

NUTRITION FACTS

- Patterns can be observed in diets as well, the modern diet is seeing a pattern shift to diets high in saturated fat, sugars, and refined foods and low in fiber; many scientists consider this pattern in diet to be associated with many diseases.

STANDARDS FOR LESSON 1 LESSON MAP

NG: 4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

NG: 4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

NG: 4-ESS1-1 Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.

Math 4.OA.C.5 Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself.

LESSON 1 LESSON MAP

Lesson 1: Patterns

Day 1

- 5 senses
- Scientific Observation
- What is a pattern?
- Define function

Day 2

- Show examples of items/ pictures with patterns (handout)
- Venn Diagram to compare/contrast
- Discuss 4 basic patterns

Day 3

- Find patterns in Outdoor Classroom
- Log in Journal

Day(s) 2

Math Preview patterns for January

Students must identify unique features of a pattern other than the rule

Starting with____ given the rule _____ what are the next 5 numbers?

Day(s) _____

Literacy

Draw a squiggly, students make squiggle into a design, write a story for the picture Write about the functions of each pattern in pamphlet style

Literacy connection: Garden from A-Z: Poetry Inspired by Nature by Karen Trout

Day(s) _____

Science/Social Studies Extension
Why does nature use patterns?
see worksheet, *Patterns in Nature*

Garden Observation

Name:_____ Date: _____

PATTERNS IN NATURE

There seems to be unlimited patterns in the world but in fact, there are only a few. However, those few have infinite or countless variations. Think about a fingerprint for a minute. There are only two kinds of fingerprint - spiral and concentric lobes. However, no two fingerprints are the same.

Patterns are things that are arranged following a rule or rules. Patterns in nature form when there is pressure between two objects. For example, waves form in the ocean due to low pressure areas of air interacting with water. That event (usually expressed as a spiral) comes into contact with the water. As the wave reaches the shore, the pressure between the land and water increases and disrupts the wave pattern so you start to get cresting waves. Waves provide movement.

Nature uses branching patterns to collect and distribute energy and materials, the way roots and branches of a tree collect and distribute sun, water, and nutrients. That's why many garden paths are in a branching pattern; we're collecting and distributing water, food, mulch, compost materials, and so on. Lobe patterns can increase surface area and exposure. It provides surfaces for exchange at the edge, where two things meet. The edge is the most important part of a system. Spirals are usually patterns of growth and flow. Spirals can increase space and add strength to a shape.

1.What are patterns? Where do they occur? Name at least 2 examples. _____

_____

_____

2.Are patterns made in nature? Explain. _____

_____

_____

3.What is the function of a wave? Name two examples. _____

_____

_____

4.What is the function of a branch? Name two examples. _____

_____

_____

5.What is the function of a spiral? Name two examples. _____

_____

_____

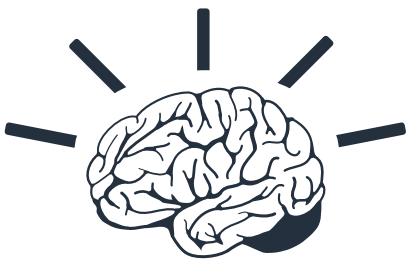
6.What is the function of a lobe? Name two examples. _____

_____

_____

Lesson Two

Fibonacci Numbers: The Nature of Numbers



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OVERVIEW

Students will explore the mathematics of nature.

OBJECTIVES

- Students will learn that mathematical patterns are evident in nature.
- Students will learn that patterns are describable, repeatable, predictable and infinite in variety.
- Students will learn that patterns help us understand the world around us.
- Students will learn there are links between all living and non-living things that can be expressed in mathematical formulas.

STANDARDS

Nevada State Standards

N.5.A.7 Students know observable patterns can be used to organize items and ideas.

N.5.A.3, N.5.A.6 Students will predict future events based on patterns in nature.

L.5.8.1 Students know plants and animals have structures that enable them to grow, reproduce, and survive.

L.5.8.2 Students know living things have predictable life cycles.

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Next Generation Standards:

4-PS4-1 Similarities and differences in patterns can be used to sort and classify natural phenomena.

4-PS4-3 Similarities and differences in patterns can be used to sort and classify designed products.

4-PS4-2 Cause and effect relationships are routinely identified.

LS1-1 and 4-LS1-2 A system can be described in terms of its components and their interactions.

4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.

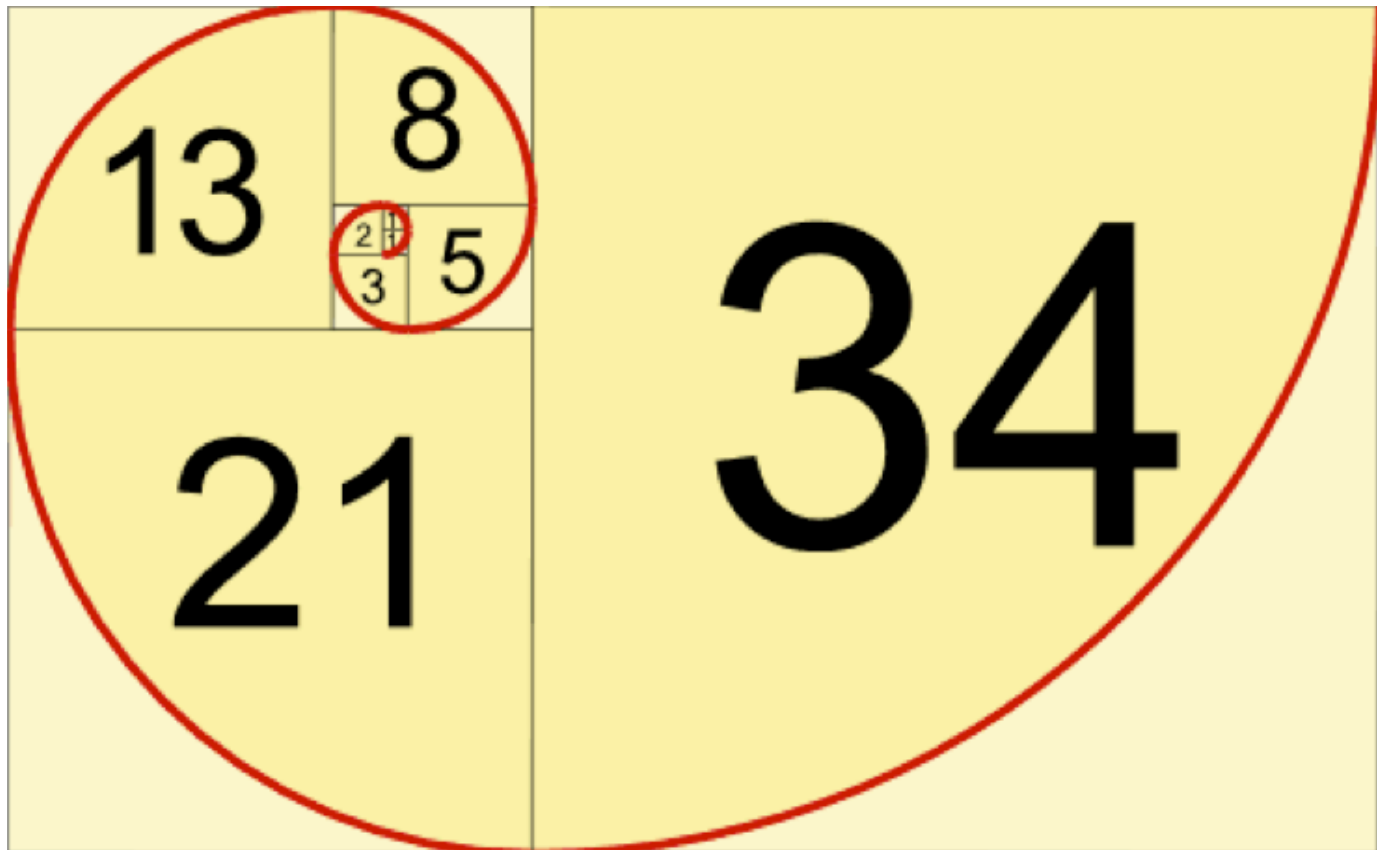
TEACHER INFORMATION

The Fibonacci numbers are Nature's numbering system. They appear everywhere: from the leaf arrangement on a stem, to the pattern of florets in a flower (example the center of a sunflower), to the scales on a pineapple, to the mathematical equation for a nautilus shell. These numbers can be applied to everything from the proportions of

the human body to the growth of every living thing. A young Italian man discovered these numbers while observing nature and the reproduction of rabbits. The Fibonacci sequence of numbers is: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, and 55... The next number in the sequence is found by adding up the two numbers before it:

- 2 is found by adding 1 + 1
- 3 is found by adding 1 + 2
- 5 is found by adding 2 + 3
- And so on and so on forever

Using the Fibonacci numbers can make a spiral. See below:
When you make squares with those widths, you get a nice spiral:



From: http://www.mathsisfun.com/numbers/fibonacci-sequence.html

The book: *Blockhead - The Story of Fibonacci* by Joseph D'Agnese and John O'Brien is a great and fun book to read to the class.

TIME

Three 60-minute sessions.

QUESTION

- How are nature and mathematics related?

MATERIALS

- You Tube Video: *Nature of Numbers* - http://www.youtube.com/watch?v=kkGeOWYOFoA
- Book: *Blockhead - The Story of Fibonacci* by Joseph D'Agnese and John O' Brien
- Examples of patterns found in nature (example: pinecones, shells, seedpods, etc.)
- Graph paper
- Rulers
- Science Journals
- Student Worksheets

PROCEDURES

- Day 1

1. Give the students time to write the question and their answers in their science journals.

2. Briefly discuss the answers with a partner or as a whole group.

3. Watch the You Tube Video, *Nature of Numbers*.

4. Class discussion of the video. Repeat the video after the discussion. Pause to make connections.

5. Students might want to rethink their answers to the initial question. Give them time to modify their answers.

- Day 2

1. Write the Fibonacci numbers on the board. Ask the students to solve the pattern.

2. In a whole group, determine the equation to pattern.

3. Have the students see how high they can go with the numbers in 30 seconds.

7. Ask the following questions and discuss:

   - In what way do you think the Fibonaccio numbers are important?
   - How were the Fibonacci numbers created?

8. Introduce and Read the Book: *Blockhead-The Story of Fibonacci.*

   - Highlight the age of Fibonacci and how he was treated in school.

9. Students can either discuss in a small group or write a summary in their science journals.

10. Using the graph paper, students will draw a spiral using the Fibonacci numbers.

- Day 3

11. Go out into the garden to find other examples of Fibonacci numbers. Also, have students complete the worksheet, “Fibonacci Numbers.”

12. Students will draw and record their findings in science journals.

13. Recap the lesson as a whole group.

ASSESSMENT

- Science journal entries:
  - Initial question/answer
  - Summary of the story
  - Fibonacci entries from observations
- Graphing of the spiral
- Student Worksheet, “Fibonacci Numbers”

ADAPTATIONS

- Use tangrams to make patterns.
- Discuss and create tessellations.
- Study M.C. Escher and his techniques of patterning.
- “Spot It” Game: card game where participants find the common picture.
- Have students find other ways the Fibonacci numbers have been used, either by man or by nature.
- Students take the rabbit example from the book *Blockhead*: draw/explain his findings.
- As a continuation of the lesson, the Fibonacci numbers can be used to explain plants. For example, petals on the flowers, seed heads, leaf arrangements, cactus spines, florets on vegetables. Students can explore this concept further.
- Watch the video: “Doodling in Math” Part 1, 2, or 3 to expand on the lesson OR to continue more lessons:
  - http://www.youtube.com/watch?v=ahXIMUkSXX0
  - http://www.youtube.com/watch?v=IOIP_Z_-0Hs
  - http://www.youtube.com/watch?v=14-NdQwKz9w

DIGGING DEEPER

- "Spot It" Game: card game where participants find the common picture.
- Have students find other ways the Fibonacci numbers have been used either by man or by nature.
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  - http://www.youtube.com/watch?v=ahXIMUkSXX0 Doodling in Math: Spirals, Fibonacci and Being a Plant (1of 3)
  - http://www.youtube.com/watch?v=lOIP_Z_-0Hs Doodling in Math: Spirals, Fibonacci and Being a Plant (2 of 3)
  - http://www.youtube.com/watch?v=14-NdQwKz9w Doodling in Math: Spirals, Fibonacci and Being a Plant (3 of 3)

DID YOU KNOW?

- Fibonacci was only 12 and his classmates thought he was dumb because he daydreamed all the time.
- EVERYTHING in the Universe can be described in mathematical terms.

NUTRITION FACTS

- The USDA Food Patterns were developed to help people meet dietary guidelines recommendations; the guidelines identify daily amounts of foods to eat from five major food groups and subgroups.

STANDARDS FOR LESSON 2 LESSON MAP

NG: 4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.

ELA Reading RL.4.2 determine a theme of a story, drama, or poem from details in the text; summarize the text.

ELA Speaking and Listening SL.4.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.

SL.4.1c Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of other.

ELA Writing W.4.1b Provide reasons that are supported by facts and details.

Math 4.OA.C.5 Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself.

LESSON 2 LESSON MAP

Lesson 2: Fibonacci Numbers

Day 1

- Overarching question "How are nature and mathematics related?"
- Response in journals/discussion, video *Nature of Numbers*
- Procedure 1-5

Day 2

- Write equation for Fibonacci numbers and go over book and discuss
- Procedure 6-10

Day 3

- Garden observation and recording in science journals
- Procedure 11-13

Day(s) 2

Math given a rule
generate a pattern

Tangrams-patterns and symmetry

Create their own piece to tessellate on individual level, and create a piece to create whole class tessellations

Day(s) _____

Literacy Summarizing

Summarize other non-fiction texts about important people in math and engineering

Literacy connection
Summarizing non-fiction texts

Tree map

Book *Blockhead: The Story of Fibonacci* by Joseph D'Agnese

Day(s) _____

Science/Social Studies Extension
Orally present summaries of other important people in the fields of mathematics and engineering

Research current events about people making a difference in math and engineering. What is the pattern of change? What traits and ethics are repeated in the people researched or read about?

Garden Observation

Name:_____ Date: _____

FIBONACCI NUMBERS AND PATTERNS IN NATURE

1. A pattern is _____.

2. Write the missing Fibonacci Numbers 0, 1, 1, 2, 3, 5, ___, ____, ____

3. What is the rule of the pattern? _____.

4. Does math appear in nature? _____

5. Does nature follow patterns? _____

6. What four patterns are found in nature?

Pattern	1.	2.	3.	4.
Illustration				
Function/ Purpose				

7. Which pattern is best represented by the Fibonacci Number pattern? _____

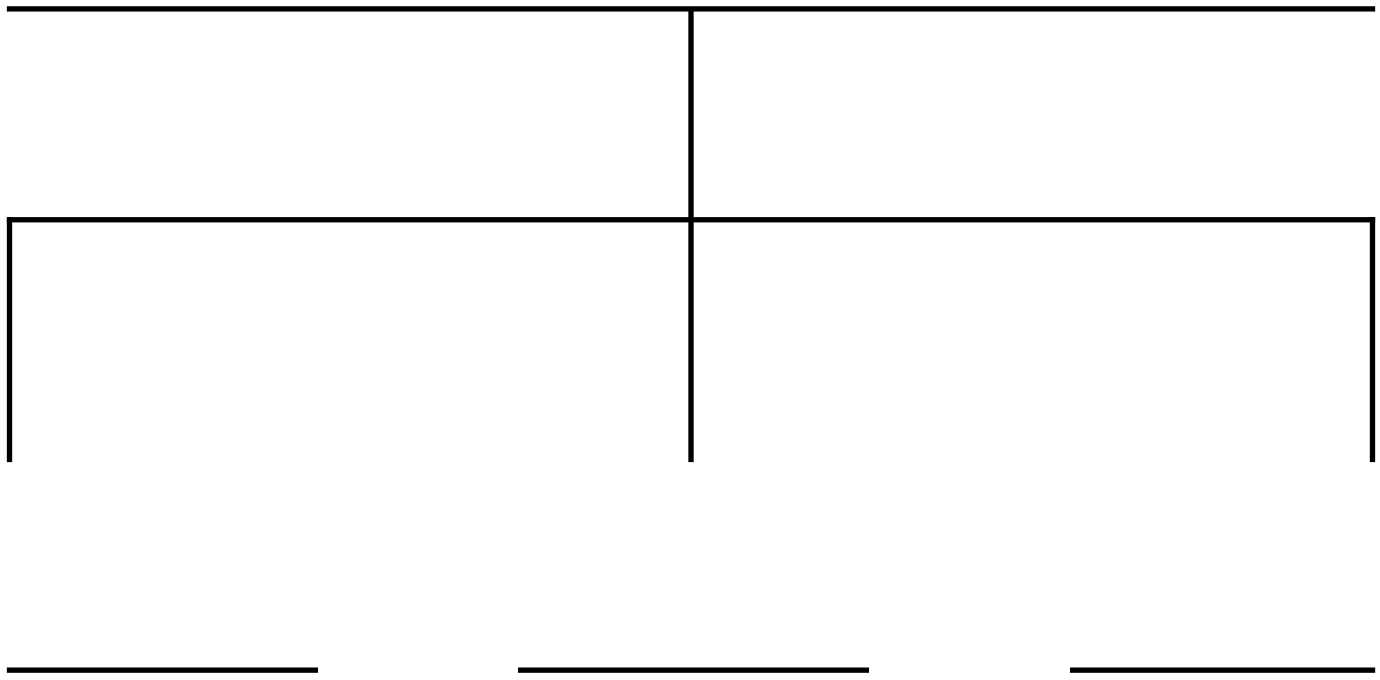
8. Find 2 examples in the garden of spirals and find 2 examples of an item that contains a Fibonacci number.

Spirals	Fibonacci Number

9. Bonus: Draw the Fibonacci Golden Rectangle by yourself!

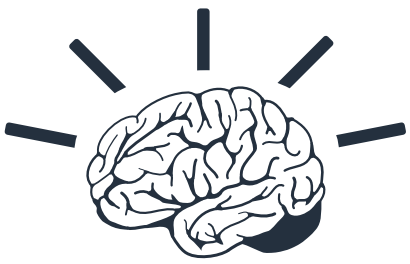
Name:_____ Date: _____

TREE MAP



Lesson Three

Biomimicry Part 1



BRAIN BREAKS!

1. Plant Partners Teacher will give class a plant part (seed, root, stem, leaves, flower). Students turn to a partner and go back and forth naming vegetables harvested from that part of the plant. Repeat until partners can no longer name vegetables from that plant part.

2. Apple, Watermelon, Banana (rock, paper, scissors) Students play rock, paper, scissors replacing rock with apple, paper with watermelon and scissors with banana. Play as many rounds as possible in given time frame.

3. Garden Taboo Teacher plays music. When music stops students pair up. Teacher calls out a garden topic such as fruit. Partner A has to describe any fruit they want to their partner without saying the name. Partner B has to try and guess what their partner is describing.

4. Syllable Snacks Teacher will call out a number (1-4). Students work with a partner to come up with garden vocabulary words that contain that number of syllables. Partner A will begin by naming a vocabulary word with the given number of syllables; partner B will go next. They will alternate until one partner can no longer name a vocabulary word with the given number of syllables.

5. Fruit/Veggie Knock Students will work with a partner and touch knuckle to knuckle (veggie) and palm to palm (fruit) in a given sequence. Teacher will name the sequence to the class (Ex: veggie, veggie, fruit) and students will have to use the given hand gestures to complete the sequence. Teacher will increases the number of movements with each round (Ex: Round 1-veggie, veggie, fruit. Round 2-fruit, veggie, veggie, fruit).

6. Fruit/Veggie Match Students will stand. Teacher will name a fruit or vegetable and students will have to touch that part of the body corresponding to the part of the plant that the fruit or vegetable grows from (roots-feet, stem-legs, leaves-body, flowers-head). Teacher will call out and play the game “Simon says” going a little faster with each round.

7. Plant Part Finger Hop Students touch thumb to thumb, pointer to pointer, middle to middle, ring to ring, pinkie to pinkie as they say the plant part finger hop chant (seeds, roots, stems, leaves, flowers). Teacher will randomly call out a plant part, students will have to touch the corresponding fingers. Teacher will repeat, increasing the pace with each round.

8. The Harvester Students will stand and squat (harvest) with a shovel in hand. They will shovel the dirt over alternating shoulders like a farmer. Students will work at their own pace “harvesting” for the given time frame.

9. Apple Squat Students will stand and begin by squatting. They will then stand up on one foot, hop twice saying “apple, apple” then return to a squat. Repeat with increasing speed each round and alternating feet.

10. Fruit Freeze Teacher will randomly call out different fruits and vegetables. If the teacher calls out a veggie, students have to jog (or march) in place, if teacher calls out a fruit, students have to freeze.

11. Garden Guess Students will work with a partner. Partner A will silently think of a fruit or vegetable. Partner B can ask three questions about what their partner is thinking. After three questions, partner B has to guess the fruit or vegetable. They will then switch roles, and partner B will silently think of a fruit or vegetable and partner A gets to ask questions and guess. Repeat as many times as possible in the given time frame.

OVERVIEW

Students will explore the concept of biomimicry - the design and production of materials, structures, and systems that are modeled on biological entities and processes.

OBJECTIVES

- Students will learn the term ‘biomimicry’.
- Students will explore various examples of biomimicry.
- Students will learn how the patterns of nature impact human life.

STANDARDS

Nevada State Standards

N.5.A.7 Students know observable patterns can be used to organize items and ideas.

N.5.A.3, N.5.A.6 Students will predict future events based on patterns in nature.

L.5.8.1 Students know plants and animals have structures that enable them to grow, reproduce, and survive.

L.5.8.2 Students know living things have predictable life cycles.

L.5.D Students understand that living things can be classified according to physical characteristics, behaviors, and habitats.

Next Generation Standards:

4-LS1.A Structure and Function Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

4-LS1-2 Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. Students will be able to describe a system in terms of its components and their interconnectedness.

4-ESS1-1 Students will learn that patterns can be used as evidence to support an explanation. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

TEACHER INFORMATION

The term biomimicry is made from ‘bio,’ meaning 'life,' and ‘mimicry,’ meaning 'imitating.' In other words, biomimicry is the observation and mimicry of natural systems in nature. Engineers, scientists and inventors solve problems and create ‘new’ things using this system. Leonardo de Vinci (1452-1519) studied birds and their flight while he was designing his flying machines. The Wright brothers also observed birds in flight while designing their planes. Other examples of biomimicry are:

- Observing the lotus leaf under a microscope to discover why it doesn't absorb water. This led to the invention of water/dirt repellent fabric and paint.
- After going out for a walk with his dog in the woods, George de Mestral observed the burrs that had attached themselves to his dog and himself. They were not easily removed. After closer inspection, Mestral discovered a small hook and loop on the burr that kept them from falling off. He worked many years to perfect Velcro, using a cotton fabric at first. He finally stumbled upon the use of nylon. His Velcro was not readily accepted by the fashion world when first introduced. It wasn't until NASA became interested in the material for space travel that Velcro 'caught on'.
- The examples are endless. To learn more, explore biomimicry on the web or read Janine Benyus' book, *Biomimcry*.

TIME

Four 30 minute sessions.

QUESTION

What is a human invention that nature didn't invent first?

MATERIALS

- Poem from the Book: *Biomimicry* by Janine Benyus (provided below)
- Examples of biomimicry (photos or actual items).
  Refer to http://biomimicry.org/asknature/ for support.
- Science Journals

PROCEDURES

- Day 1

1. Have students reflect on the question and answer in their science journals.
   - Students can then share their answer with a partner or in a small group.
2. Group discussion of the answers.

- Day 2

1. Read the 'Biomimicry' poem by Janine Benyus:

Nature runs on sunlight.
Nature uses only the energy it needs.
Nature fits form to function.
Nature recycles everything.

Nature rewards cooperation.
Nature banks on diversity.
Nature demands local expertise.
Nature curbs excesses from within.
Nature taps the power of limits.

BOOK: *Biomimicry* by Janine M. Benyus

2. Have students discuss thoughts on the poem. This can be done in a whole group or in small groupst.

- Day 3

1. Each student/small group takes one line from the reading and explains the line, (including vocabulary) and then provides an example of the line that is found in nature. This can be done in the garden.

  - For example: “Nature recycles everything.” Students show example(s) found in nature where recycling naturally occurs e.g dead leaves provide nourishment for the soil.
  - Complete Worksheet: 'Biomimicry Worksheet.'

- Day 4

1. Research products that have been inspired by nature. For example: Velcro, water repellent fabric, Kevlar, adhesives, etc.

ADAPTATIONS

- What are some problems that we are facing (local, garden, community, nation, globe)? How might nature solve the problems?
- BOOK: *Gaia’s Garden*: Chapter, “Work with Nature, Not Against it”
- Companion planting
- Integrated Pest Management: working with nature to solve pest problems in the garden.
- Introduce the concept of the herb spiral, how it is effective for growing a large number of plants in such a small space. (Concept of packing efficiently)
- Other natural space savers: hives…. Can be also an extension in Lesson #4 BIOMIMICRY
- Redesign something found in nature: for example: a tree, a leaf, etc.
- Watch the Ted Talk by Janine Benyus - http://www.ted.com/talks/janine_benyus_biomimicry_in_action

DIGGING DEEPER

- What are some problems that we are facing (local, garden, community, nation, globe)? What would nature do to solve the problem?
- BOOK: Gaia's Garden: Chapter, "Work with Nature, Not Against it"
- Research Companion planting.
- Integrated Pest Management: working with nature to solve pest problems in the garden.
- Introduce the concept of the herb spiral, how it is effective for growing a large number of plants in such a small space. (Concept of packing efficiently)
- Other natural space savers: hives…. Can be also an extension in Lesson #4 BIOMIMICRY
- Redesign something found in nature: for example: a tree, a leaf, etc.

DID YOU KNOW?

- Many things people have invented were designed by nature first: Velcro, ceramics, water repellant materials, adhesives, and Kevlar.
- People have also created adhesives that mimic the fascinating and sticky surface of gecko or lizard's five-toed feet.
- Radar and sonar navigation technology as well as medical imaging was inspired by the echolocation abilities of bats.
- Also, the solar cells that make up solar panels are designed to mimic the way leaves collect energy from the sun.
- Did you know that Velcro® was invented after a man took a very close look at those little prickly seeds that stick to your clothing when you walk though a field.
- Water filters are designed like animal cell membranes that let certain things pass through while others are kept out.
- Also, though planes do not flap their wings like birds, their shapes and the principles of keeping a plane in flight are the same as bird wings.
- The best solar panel is a leaf.

NUTRITION FACTS

- Recommended amounts in the USDA Food Patterns occur at 12 levels, ranging from 1,000 calories to 3,200 calories. Patterns at 1,000, 1,200, and 1,400 calorie levels meet the needs of children 2-8 years, patterns at or above 1,600 calories meet needs for adults and children ages 9 years and older.
- See the food pattern chart here: http://www.cnpp.usda.gov/sites/default/files/usda_food_patterns/USDAFoodPatternsSummaryTable.pdf

STANDARDS FOR LESSON 3 LESSON MAP

NG: LS1.A. Structure and Function Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. Patterns can be used as evidence to support an explanation.

ELA Reading RI.4.5 Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.

RL.4.10 By the end of the year, read and comprehend literature, including stories, dramas, and poetry, in the grade 4–5 text complexity band proficiently, with scaffolding as needed at the high end of the range.

ELA Speaking and Listening SL.4.4 Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

ELA Writing W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic.

W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.

W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.

Math 4.MD.A.3 Apply the area and perimeter formulas for rectangles in real world and mathematical problems

LESSON 3 LESSON MAP

Lesson 3: Biomimicry

Day 1

- Answer and discussion of over arching question “What is a human invention that nature didn’t invent first?”
- Procedure 1-2

Day 2

- Discussion of poem Biomimicry including vocabulary
- Procedure 3-4

Day 3

- Line analysis in garden
- Procedure 5

Day 4

- Research
- Procedure 6

Day(s) 2

Math herbal spiral large number of plants in small space

Packing efficiently

Connection to calculating area (worksheet below)

Day(s) _____

Literacy Research inventions inspired by nature, and using nature to solve problems. Pest Management, working with nature to solve pest problems.

Book *Biomimicry poem* by Janine Benyus

Biomimicry by Dora Lee

Day(s) _____

Science/Social Studies Extension Use garden observations and how plants solve their own problems:

Extension How has nature created structures that help animals as well as plants survive?

Animal adaptations.

Redesign something found in nature: for example: a tree, a leaf, etc.

What are some problems that we are facing (local, garden, community, nation, globe)? What would nature do to solve the problem?

Name:_____ Date: _____

FINDING AREA IN THE OUTDOOR CLASSROOM

1. The principal wasn't happy about the animals coming into the outdoor classroom. She decided to build a fence around it. How much fencing material would be needed to go all the way around the outdoor classroom?

2. To keep students cool while enjoying the outdoor classroom Mrs. Moreno decided to add a canopy above ¼ of the garden where teacher instruction takes place. How large of a piece of cloth would she need to cover the area?

3. The 4th grade students wanted to plant marigolds all around the edge of their planter box to protect their fruits and vegetables. How many inches around the planter box will they cover with marigolds? (1 foot = 12 inches)

4. After planting the marigolds the students wanted to know how much space was left for their other plants if the marigolds take up about an inch of space once they bloom. How much space is left for the other plants?

Word Part: Prefix/Root	Predication	Meaning/Illustration
bio-		
mimi		

Vocabulary

7. Biomimicry _____

8. Invention _____

Brainstorm What people made inventions do you think were inspired by nature?

Read the following text excerpt about biomimicry: Adapted from: http://biomimicry.org/what-is-biomimicry/

Humans are **clever** (smart), but without intending to, we have created massive **sustainability** (living within our limits) problems for future generations. Fortunately, solutions to these global challenges are all around us.

Biomimicry is an approach to innovation (invention) that seeks sustainable (long lasting) solutions to human challenges by emulating nature's time-tested patterns and strategies. The goal is to create products, processes, and policies—new ways of living—that are well-adapted to life on earth over the long haul.The core idea is that nature has already solved many of the problems we are grappling (struggling) with. Animals, plants, and microbes are the perfect builders. They have solutions to their problems that do not lead to waste, pollution, or design fails. If their inventions did waste, pollute, or fail, these organisms would not survive.

1. Read the following examples of biomimicry and brainstorm the possible inventions:

	Example	What problem could this solve?	Invention
	We generally think of termites as destroying buildings, not helping design them. But the Eastgate Building, an office complex in Harare, Zimbabwe, has an air conditioning system modeled on the self-cooling mounds of termites that maintain the temperature inside their nest to within one degree, day and night (while the temperatures outside swing from 42 °C to 3 °C).		
	Have you ever noticed a mosquito bite (or two or three) that seemingly appeared out of nowhere? It turns out that the tip of the mosquito's mouth is composed of several moving parts that work into skin with the minimum of fuss–and the minimum of pain.		

2. In teams of two: Find something in nature that inspires your team. Draw a design for an invention that incorporates biomimicry. Then, write an informative description that states the following three elements:

a. What element from nature inspired your invention?

b. What problem is your invention solving?

c. How does your invention work?

Bonus How do biomimicry and sustainability connect?

Name:_____ Date: _____

INVENTION GRAPHIC ORGANIZER

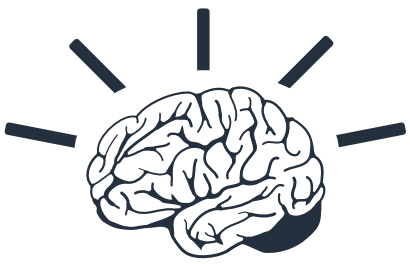
Invention:

Problem or issue being solved:

Inspiration found in nature:

Lesson Four

Networks of Life



BRAIN BREAKS!

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2. Apple, Watermelon, Banana (rock, paper, scissors) Students play rock, paper, scissors replacing rock with apple, paper with watermelon and scissors with banana. Play as many rounds as possible in given time frame.

3. Garden Taboo Teacher plays music. When music stops students pair up. Teacher calls out a garden topic such as fruit. Partner A has to describe any fruit they want to their partner without saying the name. Partner B has to try and guess what their partner is describing.

4. Syllable Snacks Teacher will call out a number (1-4). Students work with a partner to come up with garden vocabulary words that contain that number of syllables. Partner A will begin by naming a vocabulary word with the given number of syllables; partner B will go next. They will alternate until one partner can no longer name a vocabulary word with the given number of syllables.

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OVERVIEW

Students will look at the ecological principle that all living things in an ecosystem are interconnected through networks of relationships.

OBJECTIVES

- Students will learn to observe and analyze elements in a system.
- Students will learn techniques to analyze how a system performs a function.
- Students will learn how the relationships of elements contribute to the overall survival of the system.

STANDARDS

Nevada State Standards

N.2.A.1, N.5.A.2 Describe objects and phenomena through written and spoken language, numbers and labeled drawings.

N.5.A.6 Explain that models are tools to learn about the things the model is intended to represent.

N.5.A.7 Identify patterns used in organizing a set of objects or ideas.

L.2.C.2 Describe the characteristics of a habitat (food, water, shelter, and space).

L.5.C.2 Explain how a given organism interacts with other organisms and the non-living parts of its ecosystem.

L.5.C.1 Create a diagram illustrating the transfer of matter and energy in a food web.

Next Generation Standards:

4-PS3-1, 4-PS3-2, 4-PS3-4 Energy can be transferred in various ways and between objects.

4-LS1-1, 4-LS1-2 A system can be described in terms of its components and their interactions.

ESS2.E Living things affect the physical characteristics of their regions.

LS1.A Structure and Function: Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

TEACHER INFORMATION

Biomimicry is a perfect example of the interconnectedness of life webs; it is a physical representation of patterns found in nature. It can also be interpreted as a metaphorical representation that all life forms are connected and interdependent. Biomimics allows humans to understand the relationships and connections in nature.

For more information: http://biomimicry-static.s3.amazonaws.com/digital_toolkit/index.html#p=2

TIME

Two Parts: 45-60 minutes

QUESTION

Quote: "No Man is an Island"

What does this quote mean to you?

- What do you need in order for you to survive?
- What type of networks, systems, cycles, and developments help nature to
- sustain life? (This question could be changed to make it personal, instead of asking about networks, systems, etc. for nature, how about what it takes for each person to survive?)

MATERIALS

Poem by John Donne (1572-1631) See below

- Yarn
- Scissors
- Index Cards
- Markers
- Tape
- Science Journals

PROCEDURES

Day 1

1. Have students write the quote in their science journals and brainstorm what they think the quote means.

2. Class discussion about possible answers to the question. Teacher asks the students about the WEB OF LIFE. Define and illustrate the concept of 'networks' (web of life). To illustrate this concept, the teacher will have the students sit in a large circle. Each student will be assigned a certain element in the garden. For example: soil, pollinator, sun, water, air, plant, insects, etc.

▶ Day 2

1. Teacher will give the ball of yarn to one of the students. Teacher will then ask the students, “Who needs you and who do you need?” The student with the yarn then passes/tosses the yarn to someone in the circle they feel represents answers the question. As each child is tossed the ball of yarn, they will then hold onto the their end as they toss it to someone else in the circle – thus creating a giant ‘web’ of interconnections/networks.

2. This will continue until everyone in the circle is connected.

3. Students can pull on the web to see just how strong it is.

4. Students discuss what they have just encountered as well as conclusions drawn from the experience.

5. To show just how important the connections are, the teacher will then systematically take away certain elements from the circle by asking a question for example: “What would happen if the garden was not watered for a week?” The students would answer the question. If a connection is broken/lost, the teacher then cuts the yarn representing that connection. For example: If the garden were not watered for a week, some of the plants would die. (The yarn would be cut connecting the water to the particular plants.)

6. After a few ‘cuts’ to the web, have the students discuss what is happening to the web. How strong is the web? Class discussion.

7. Students would then reflect on the experience and write in their science journals.

▶ Day 3

1. Take a tour out into the garden for the students (working in pairs/small groups) to observe networks. Students will enter their observations in their science journals as they tour the garden.

2. Return back to the class. Teachers will then ask for any final thoughts on the lesson. The students can discuss reflections with partners, in small group or in whole group discussion.

▶ POEM BY JOHN DONNE

For Whom the Bell Tolls (No Man is an Island)
By John Donne

No man is an island,
Entire of itself.
Each is a piece of the continent,
A part of the main.
If a clod be washed away by the sea,
Europe is the less.

As well as if a promontory were.
As well as if a manor of thine own
Or of thine friend's were.
Each man's death diminishes me,
For I am involved in mankind.
Therefore, send not to know
For whom the bell tolls,
It tolls for thee.

Source: http://www.famousliteraryworks.com/donne_for_whom_the_bell_tolls.htm

ASSESSMENT

- Class participation
- Science journal entries

ADAPTATIONS

- Students create other webs showing the connections. For example, their families, neighborhoods, community, etc.
- Research the history of the poem, *For Whom the Bell Tolls*.
- Compare/contrast the relevance to today's world.
- Find other literary works from the past that would apply to today.

DIGGING DEEPER

- Have Students create other webs showing the connections. For example, their families, neighborhoods, community, etc.
- Research the history of the poem, "Form Whom the Bell Tolls."
- Find other literary works from the past that would apply to today.

DID YOU KNOW?

- Certain plants like to live in communities/patterns called nebka.
- Water filters are designed like animal cell membranes that let certain things pass through while others are kept out.

NUTRITION FACTS

- The MyPyramid food plate suggests serving sizes, sample foods, and ingredients for breakfast, lunch, and dinner at different food pattern levels.

  See an example here: http://www.cnpp.usda.gov/sites/default/files/usda_food_patterns/SampleMealPatterns.pdf

STANDARDS FOR LESSON 4 LESSON MAP

NG: ESS2.E: Living things affect the physical characteristics of their regions.

LS1.A: Structure and Function: Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. Patterns can be used as evidence to support an explanation.

ELA Reading RL.4.10 By the end of the year, read and comprehend literature, including stories, dramas, and poetry, in the grade 4–5 text complexity band proficiently, with scaffolding as needed at the high end of the range.

RL.4.9 Compare and contrast the treatment of similar themes and topics (e.g., opposition of good and evil) and patterns of events (e.g., the quest) in stories, myths, and traditional literature from different cultures.

Math 4.OA.A.3 Solve multistep word problems posed with whole numbers and having whole number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

LESSON 4 LESSON MAP

Lesson 4: Networks of Life

Day 1

- What does this mean to you?
- What do you need to survive?
- What networks or systems are you a part of to sustain life?
- Procedure 1-2

Day 2

- Yarn web activity
- Procedure 3-9 (4.OA.A.3)

Day 4

- Garden system mapping
- See map attached
- Procedure 10-11

Day(s) 2

Math Students develop their own word problems based on a story of interconnecting systems, *The Ladybug and the Spider*

Day(s) _____

Literacy Literacy: compare and contrast For Whom the Bell Tolls to quote(see below)

Day(s) _____

Science/Social Studies Extension Community connection web

H3.4.2 Recognize that communities include people who have diverse ethnic origins, customs, and traditions, and who make contributions to Nevada.

H3.4.2A Recognize that communities include people who have diverse ethnic origins, customs, and traditions, and how they make contributions to Nevada.

Name:_____

Date: _____

Poem	Quote	Response	Comparison or Contrast
For Whom the Bell Tolls (No Man is an Island) By John Donne *No man is an island, Entire of itself.* *Each is a piece of the continent,* *A part of the main.* *If a clod be washed away by the sea,* *Europe is the less.* *As well as if a promontory were.* *As well as if a manor of thine own* *Or of thine friend's were.* *Each man's death diminishes me,* *For I am involved in mankind.* *Therefore, send not to know* *For whom the bell tolls,* *It tolls for thee.*	"This planet is an exquisitely arranged and interconnected system. What's controlled in one place is going to have consequences in another place. Our job as gardeners is to try and figure this out no matter how small our allotted space might be. Discipline has to be the watchword for our controlling hands. It means not gardening without thinking of the garden as a habitat: for mice, for squirrels, for bees and wasps. For other living creatures beyond ourselves." - Marjorie Harris, In the Garden		

Name:_____

Date: _____

Poem	Quote	Response	Comparison or Contrast
For Whom the Bell Tolls (No Man is an Island) By John Donne *No man is an island, Entire of itself.* *Each is a piece of the continent,* *A part of the main.* *If a clod be washed away by the sea,* *Europe is the less.* *As well as if a promontory were.* *As well as if a manor of thine own* *Or of thine friend's were.* *Each man's death diminishes me,* *For I am involved in mankind.* *Therefore, send not to know* *For whom the bell tolls,* *It tolls for thee.*	"One could not pluck a flower without troubling a star." - Francis Thompson		

Computing Multi-Step Word Problems
From: Coevolution Institute

Name:_____

Coevolution Institute
Buggy Word Problems-Bug Story

Read or listen to the story. Draw a picture of the story as you read it. Listen for important information.

The Lady Bug and the Spider

In the garden there was a little red lady bug. She was very pretty. She had 6 black spots on her wings. And Lady Bug was an insect, so she had 6 legs.

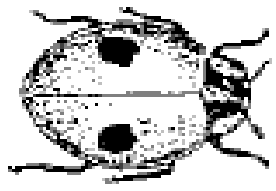
Lady Bug was also very helpful in the garden. She liked to eat tiny green bugs called aphids. Aphids were bad pests in the garden. Her 2 little wings helped her fly around the garden, chasing aphids.

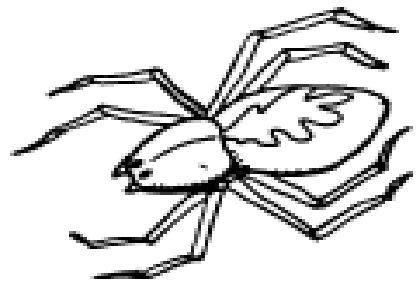
One day, Lady Bug flew by a yellow garden flower. She sat down to rest in the shade of the flower. "I'm so very tired from chasing aphids all morning," she said.

All of a sudden, a yellow garden spider sat down beside her! Spider was hiding in the flower and spinning his web to catch aphids. "Hello, Lady Bug!" he said, waving his 8 legs. "You are under MY flower. The aphids here are MINE! Go find your own flower!"

"Oh, Spider," said Lady Bug, "I don't want your aphids. I can find my own. I just want to rest. I will help the garden later."

Spider said, "OK, you can rest in the shade of my flower. But I am going to go eat MY aphids. And I am helping the garden too! Good bye."





Based on the story, write a word problem with two or more steps that requires two or more operations.

_____

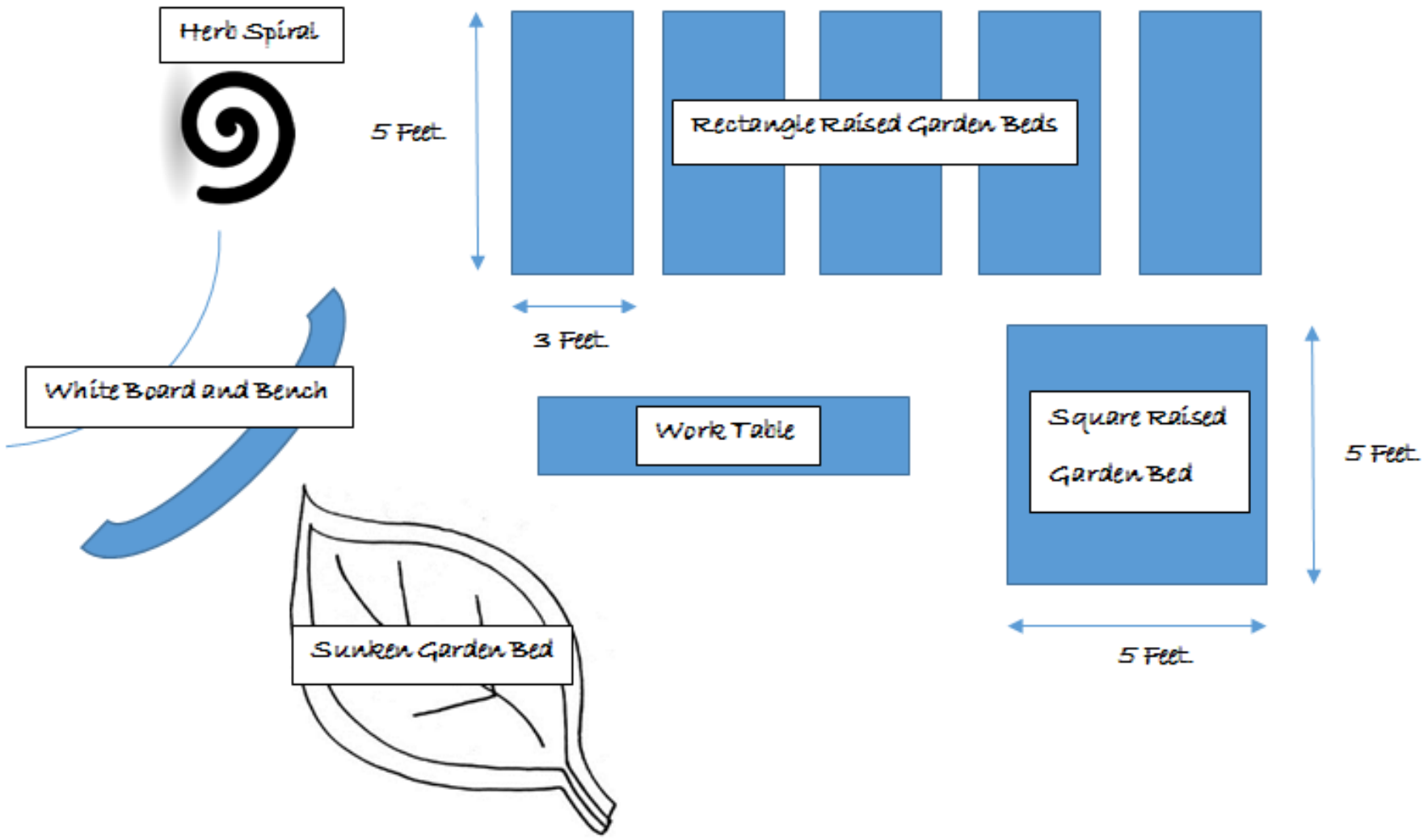
_____

_____

Garden System Mapping

Our Outdoor Classroom

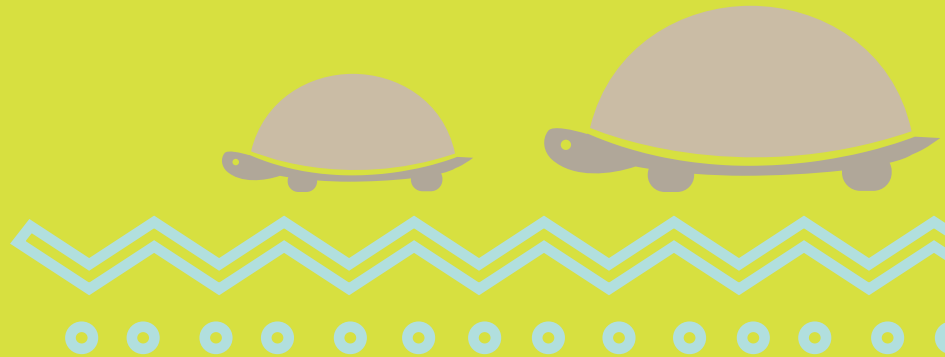
There are many systems occurring at once in our outdoor classroom. Show the larger systems and smaller systems within the larger systems. You can illustrate them and provide written captions to explain your thinking.

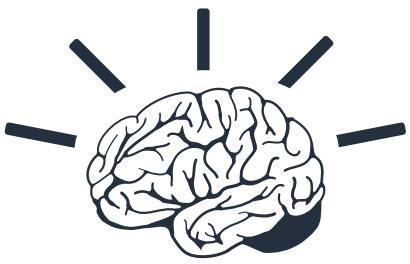


*This is an example of the garden mapping extension for Day 4. This is a sample of one outdoor classroom. For this extension to make sense, you will need to provide a map of your outdoor classroom or have the students draw one.

Lesson Five

Interconnections of Elements





BRAIN BREAKS!

1. Plant Partners Teacher will give class a plant part (seed, root, stem, leaves, flower). Students turn to a partner and go back and forth naming vegetables harvested from that part of the plant. Repeat until partners can no longer name vegetables from that plant part.

2. Apple, Watermelon, Banana (rock, paper, scissors) Students play rock, paper, scissors replacing rock with apple, paper with watermelon and scissors with banana. Play as many rounds as possible in given time frame.

3. Garden Taboo Teacher plays music. When music stops students pair up. Teacher calls out a garden topic such as fruit. Partner A has to describe any fruit they want to their partner without saying the name. Partner B has to try and guess what their partner is describing.

4. Syllable Snacks Teacher will call out a number (1-4). Students work with a partner to come up with garden vocabulary words that contain that number of syllables. Partner A will begin by naming a vocabulary word with the given number of syllables; partner B will go next. They will alternate until one partner can no longer name a vocabulary word with the given number of syllables.

5. Fruit/Veggie Knock Students will work with a partner and touch knuckle to knuckle (veggie) and palm to palm (fruit) in a given sequence. Teacher will name the sequence to the class (Ex: veggie, veggie, fruit) and students will have to use the given hand gestures to complete the sequence. Teacher will increases the number of movements with each round (Ex: Round 1-veggie, veggie, fruit. Round 2-fruit, veggie, veggie, fruit).

6. Fruit/Veggie Match Students will stand. Teacher will name a fruit or vegetable and students will have to touch that part of the body corresponding to the part of the plant that the fruit or vegetable grows from (roots-feet, stem-legs, leaves-body, flowers-head). Teacher will call out and play the game “Simon says” going a little faster with each round.

7. Plant Part Finger Hop Students touch thumb to thumb, pointer to pointer, middle to middle, ring to ring, pinkie to pinkie as they say the plant part finger hop chant (seeds, roots, stems, leaves, flowers). Teacher will randomly call out a plant part, students will have to touch the corresponding fingers. Teacher will repeat, increasing the pace with each round.

8. The Harvester Students will stand and squat (harvest) with a shovel in hand. They will shovel the dirt over alternating shoulders like a farmer. Students will work at their own pace “harvesting” for the given time frame.

9. Apple Squat Students will stand and begin by squatting. They will then stand up on one foot, hop twice saying “apple, apple” then return to a squat. Repeat with increasing speed each round and alternating feet.

10. Fruit Freeze Teacher will randomly call out different fruits and vegetables. If the teacher calls out a veggie, students have to jog (or march) in place, if teacher calls out a fruit, students have to freeze.

11. Garden Guess Students will work with a partner. Partner A will silently think of a fruit or vegetable. Partner B can ask three questions about what their partner is thinking. After three questions, partner B has to guess the fruit or vegetable. They will then switch roles, and partner B will silently think of a fruit or vegetable and partner A gets to ask questions and guess. Repeat as many times as possible in the given time frame.

OVERVIEW

Students will explore interconnections of elements in a system through analysis.

OBJECTIVES

- Students will determine how internal and external structures support the survival, growth, behavior and reproduction of plants and animals.
- Students will learn how everything is connected.

STANDARDS

Nevada State Standards

N.5.A.1 Students know conducting careful investigations, recording data, and communicating the results in an accurate method make scientific progress.

N.5.A.3 Students know how to draw conclusions from scientific evidence.

N.2.A.1, N.5.A.2 Students describe objects and phenomena through written and spoken language, numbers and labeled drawings.

N.5.A.7 Students know observable patterns can be used to organize items and ideas. Students record patterns in nature.

Next Generation Standards:

4-PS4-1 Similarities and differences in patterns can be used to sort and classify natural phenomena.

4-PS4-2 Cause and effect relationships are routinely identified.

4-PS4-3 Generate and compare multiple solutions that use patterns to transfer information.

TIME

3 to 4 sessions, approximately 60 minute session per part

QUESTION:

- How do you decide if you are ready for a pet?
- What factors do you need to consider to evaluate if you have the right environment for your pet?

MATERIALS

- Chart paper or white board
- Markers
- Pictures of cat, dog, tortoise
- Handout (template below)
- Science Journals

PART 1

PROCEDURE

- Day 1

1. Students will answer the question in their science journals and share within a small group.

2. Teacher will have on the board/chart paper a picture of a dog/cat. Under each picture will be two columns: one “inputs” and the other column “outputs”. Teacher will then have children explain what they think the terms inputs and outputs mean in relation to the pets. (“inputs” = "needs," “outputs” = "products"/ what do they provide).

3. Class will then share in whole group their answers to the question. As each answer is given, the students decide if it is an input or an output.

- Day 2

1. Discuss conclusions from the chart. Teacher then asks students to draw/design the space for their pet, making sure they allow for inputs and outputs.

2. Share designs in small groups or in whole group.

3. Teacher will take one as an example and recreate it on the board. Teacher and class will discuss the energy flows of the design. For example: "How far do you have to go to get water/food for the pet?” “Is there a more efficient way to set up the design?” “How?” Mark energy flows in different colors on design space to show flow of energy. Examples of energy flows could be walking to and from the pets’ living space, sunshine, water, wind, other animals, waste products, etc.

4. Students will then go back to their own design and modify it by showing the flow patterns and making it a more efficient design.

5. They will then write their conclusions in their science journals.

ASSESSMENT

Class participation, science journal entries

ADAPTATION

Modifications: Have students change the overall focus: from school to garden, or from garden to neighborhood, etc.

Outgoing questions: What makes a system productive and successful? Answers may vary.

PART 2

PROCEDURE

- Day 3

Question: "How might you design a desert tortoise habitat for our school?"

Refer to the following websites for more information about the desert tortoise and their needs:

http://www.defenders.org/desert-tortoise/basic-facts
https://www.tortoisegroup.org/adoption.php https://www.tortoisegroup.org/forms/?form=adoption&submit=Start

1. Review ideas/conclusions from the previous lesson.

2. Students will then write their answers to the question in their science journals. The teacher will evaluate science journals in terms of student generated inputs and outputs.

3. Students will then create the input/output chart in their science journals and fill them in using the tortoise and the main element. Students will work individually or in small groups to design a desert tortoise habitat. Teacher will remind students they will need to label their drawings. Also, students will indicate different flow patterns in their designs with different colors.
   - If the school has a tortoise habitat, go out to the habitat to compare/contrast their charts. Have students work individually or in small groups to redesign for improvements. Draw the design in their science journals.
   - If the school does not have a tortoise, have students work individually or in small groups to design a tortoise habitat to include the needs for the tortoise. Draw the design in their science journals.
4. Compare and contrast the designs in a whole group discussion.

- Day 4

5. Go out into the garden to observe the actual tortoise habitat OR to find a place where a habitat could be created, if the school does not have a habitat.

6. Conclusion, students will write their reflections in their science journals. Students will also explain why their tortoise habitat is productive and whether or not their habitat will be successful.

ASSESSMENT

Class participation, group work, science journals.

ADAPTATION

- Have students select the design that is most efficient and draw a final map of the design to scale.
- Invite the Tortoise Group organization to come and speak to the class.
- Students research where to acquire a desert tortoise. Compose a letter to the organization asking to receive a desert tortoise emphasizing the design of the habitat and why it would be an ideal place for the tortoise. Fill out a mock application for a desert tortoise adoption: https://www.tortoisegroup.org/forms/?form=adoption&submit=Start
- Modifications: Have students change the overall focus: examples are from school to garden, or from garden to neighborhood, etc.

Outgoing questions: "What makes a system productive and successful?" Answers may vary.

DIGGING DEEPER

- Modifications: Have students change the overall focus: example from school to garden, or from garden to neighborhood, etc.
- Outgoing questions: What makes a system productive and successful? Answers may vary.

NUTRITION FACTS

- Different vegetables and fruits have different mineral and nutrient profiles; the body gets different amounts of these by eating a variety of colors and types of fruits and vegetables (and items in each subgroup) to give our bodies adequate nutrition.
- See the chart with nutrients contents for fruits, vegetables, and subgroups here: http://www.cnpp.usda.gov/sites/default/files/usda_food_patterns/NutrientProfilesforAllFoodGroupsandSubgroups.pdf

INPUTS AND OUTPUTS

What element are you designing for? Now think about what this element needs and write them under the column labeled Inputs. Think about what this element creates or gives to you and write them under the column labeled Outputs.

Inputs	Outputs

STANDARDS FOR LESSON 5 LESSON MAP

NG: 4-PS4-3 Generate and compare multiple solutions that use patterns to transfer information.

4-PS4-1 Similarities and differences in patterns can be used to sort and classify natural phenomena.

ELA Reading CCSS.ELA-Literacy.RI.4.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.

ELA Writing CCSS.ELA-Literacy.W.4.1Write opinion pieces on topics or texts, supporting a point of view with reasons and information.

Math Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

LESSON 5 LESSON MAP

Lesson 5: Interconnections of Elements

Day 1

- "How do you decide if you are ready for a pet?"
- "What do you need to consider if you have the right environment for your pet?"
- Input output chart for dogs and cats
- Procedure Part 1 1-3

Day 2

- Draw design space/habitat
- Share designs in small group
- Share out one whole class discuss energy flow and any modifications
- Modify individual designs
- Procedure Part 1 3-8

Day 3

- Repeat input output for tortoise
- Procedure Part 2 1-4

Day 4

- Where could you fit your idea on campus or in the garden
- Procedure Part 2 5-6

Day(s) 2

Math Finding angles, line segments, perpendicular/parallel lines, and graphing in plants.

*Complete student evidence sheet

Day(s) _____

Literacy View Article Below, make connections between the main ideas and students desert tortoise habitat designs.

Day(s) _____

Science/Social Studies Extension
Where do you find larger populations, or more cities? Why?

Name:_____ Date: _____

THE DESERT TORTOISE

The desert tortoise is a medium-sized species of tortoise that is found in the south-western desert regions of Northern America, and parts of northern Mexico. The desert tortoise is most commonly known for its high, patterned shell and the fact that is lives in burrows underground.

The desert tortoise is found inhabiting the vast sandy plains and rocky foothills that are in and surround both the Mojave and Sonoran deserts. When temperatures get too high for the desert tortoise it simply digs itself a burrow into the sand where it can remain cool until the heat dies down.

The desert tortoise has a number of biological adaptations that enable the desert tortoise to survive more successfully in such arid conditions. The front legs of the desert tortoise are heavy and flattened in shape. This complete with a set of claw-like scale means that the desert tortoise is an effective digger.

As with other tortoise species, the desert tortoise is a herbivorous animal surviving only on organic plant matter. Grasses make up the majority of the desert tortoise's diet, along with herbs, wild flowers and the rare fruits and berries that can be found.

Due to its small size, the desert tortoise has a surprising number of natural predators even despite its hard outer shell. Coyotes, feral cats, reptiles and birdsof prey are the main predators of the desert tortoise along with the gila monster.

The average desert tortoise breeds twice a year, in the spring and again in the autumn. The female desert tortoise lays around 6 or 7 eggs although clutch sizes can be bigger or smaller. The ping-pong ball sized eggs of the desert tortoise usually hatch within a couple of months.

From: http://a-z-animals.com/animals/desert-tortoise/

Name:_____ Date: _____

ANGLES ARE EVERYWHERE!

Angle _____

Acute angles _____

Right angles _____

Obtuse angles _____

Find each kind of angle in the Outdoor Classroom. Draw a picture of the item and highlight the angle. Then, approximate the degree of the angle.

Acute angles	Right Angles	Obtuse Angles

Name:_____ Date: _____

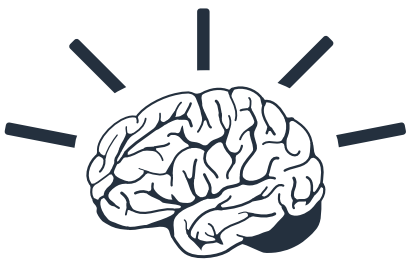
STUDENT EVIDENCE SHEET WITH GEOMETRY

Directions Find all the plants that have lines, line segments, right angles, obtuse angles, and acute angles, perpendicular lines.

Plant	Type of geometry the plant has:

Lesson Six

Photosynthesis



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PART 1

OVERVIEW

Introduce the system of photosynthesis.

OBJECTIVES

- Students will explore the early experiments used to explain the photosynthesis system.
- Students will design and conduct an experiment to show the concept of photosynthesis.
- Students will be able to name the elements in the photosynthesis system.

STANDARDS

Nevada State Standards

(4)1.1 Generate investigative questions based on observations and interactions with objects, organisms and phenomena.

(4)1.2 Use science notebook entries to develop, communicate, and justify descriptions, explanations, and predictions.

(4) 1.3 Create and use labeled illustrations, graphs, and charts to convey ideas, record observations and make predictions.

(4)1.7 Identify observable patterns to organize items and ideas and make predictions.

Next Generation Standards

4-PS3-1 Use evidence to construct an explanation relating energy being transferred in various ways and between objects.

4-PS3-2 Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

TEACHER INFORMATION

Photosynthesis is the process by which plants make their own food. In order for plants to make their own food, they need carbon dioxide, water and sunlight. Photosynthesis begins when light (either the sun or artificial light) hits the plant leaves.

Each leaf is made up of small cells called chloroplasts. The chloroplasts contain chlorophyll, the chemical in the plant that gives it the green color. The chlorophyll interacts with the light to split the water in the plant into its basic components.

The leaf takes up carbon dioxide from the air through small holes called stomata. The combination of energy from the sun, carbon dioxide from the air and water from the plant produces glucose (food for the plant). The glucose is then sent through the tubes in the leaves to the stems, roots and fruits of the plant. Not all of the energy is used right away; some is stored as starch in the plant; and some is used for plant growth into a more complex structure (example: cellulose: the main element of the cell walls of plants and wood).

Plants many times produce more food than they need, lucky for us. This stored energy in the stems, roots, seeds or fruit can be obtained by eating the plant. Every creature on the planet depends to some degree on photosynthesis for survival.

Oxygen is released as a byproduct of photosynthesis. In essence, plants are the 'lungs of our planet'.

TIME

3 parts containing 60-minute sessions

QUESTION

- How do plants eat?
- How would you explain the process of photosynthesis to others?

MATERIALS

- Science journals
- Story of Jan van Helmont (see below)

PROCEDURE

1. Have students answer the question, "How do plants eat?" Students will then share their answers in small groups.

2. Teacher and students will go out into the garden to observe plants. Students will write their observations in their journals.

3. Teacher will ask students what are the necessary elements for plants to 'eat'. Record the answers.

4. Teacher will introduce the word, photosynthesis: "photo" means light and "synthesis" means putting together.

    - Photosynthesis is the process by which plants make their own food.

5. As a group, class would list the elements of photosynthesis: sunlight – air – water.

6. Teacher will then ask the question, "How would you explain the process of photosynthesis to others?" Students will work in small groups to answer the question.

7. Groups will then share their answers in the whole group. Teacher will record answers.

8. Teacher will read the story about Jan van Helmont. (See story below).

9. Discuss the following questions:

   - How did van Helmont set up his experiment?
   - What were the results of Helmont's experiment?

10. Teacher will ask groups to design an experiment to explain the photosynthesis process. Remind students of the Scientific Method: For reference see: http://www.sciencebuddies.org/science-fair-projects/project_scientific_method.shtml#overviewofthescientificmethod

    - Ask a question: "How can I explain the process of photosynthesis?"
    - Do background research.
    - Construct a hypothesis.
    - Test your hypothesis.
    - Analyze your data and draw a conclusion.
    - Communicate your results.

11. Teacher can have the students refer to their observations from the garden experience earlier in the class, or take the class back out to the garden for further observations, focusing on variables/details to add to their experiment.

12. Students will then go back to their small groups to modify their explanation of photosynthesis and design an experiment to test their hypothesis.

13. Give groups time to create the experiment and carry out the experiment. Time allowed will be up to the teacher; however, this experiment will take several days/weeks to collect data and conclude.

ASSESSMENT

- Class participation
- Experiment design
- Science journal entries and diagram

ADAPTATION

- Have students draw and label ‘Inputs and Outputs’ of the photo synthesis system.
- Remind the students to think of all the:
  - Inputs (elements needed) for photosynthesis to occur.
  - Outputs (elements created/produced) from photosynthesis.
- Have students draw and label the plant with the different parts: chloroplasts, chlorophyll, stomata, leaves, stem, etc. (See example below).
- Have students study Nicolas de Saussure’s experiment showing how gases aid in plant growth.

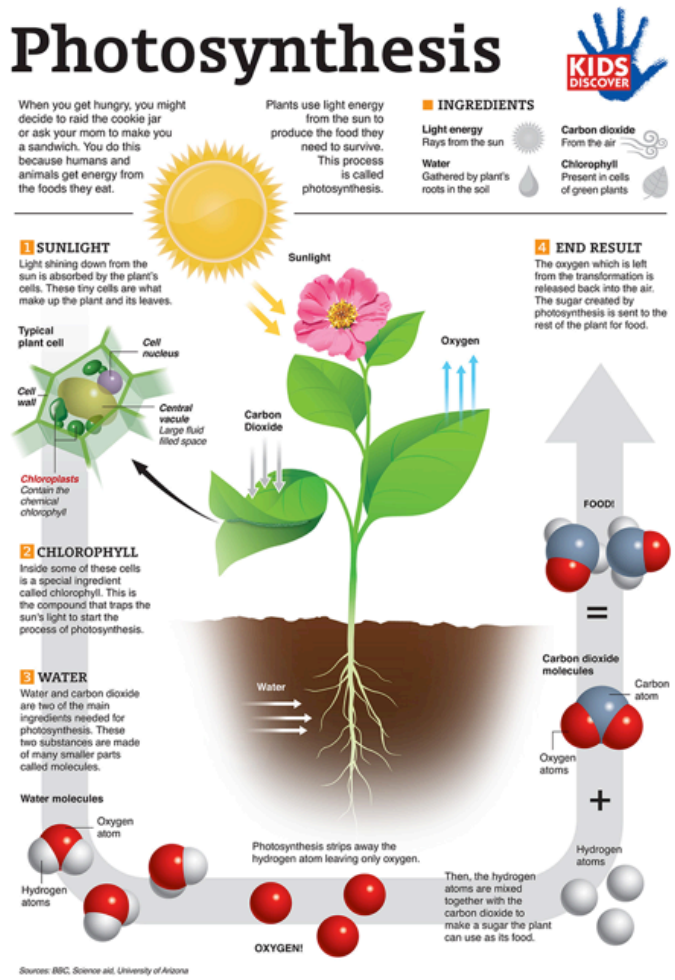
JAN BABTIST VAN HELMONT'S STORY

Jan Babtist van Helmont (1579-1644) was a Flemish physician and chemist. He conducted many experiments, including the study of gases (comparing/contrasting gases from ordinary air). He is best known for his work in experimenting with plant growth. Many people, at the time thought that plants grew by consuming soil and water. He set up his experiment to learn if this was true.

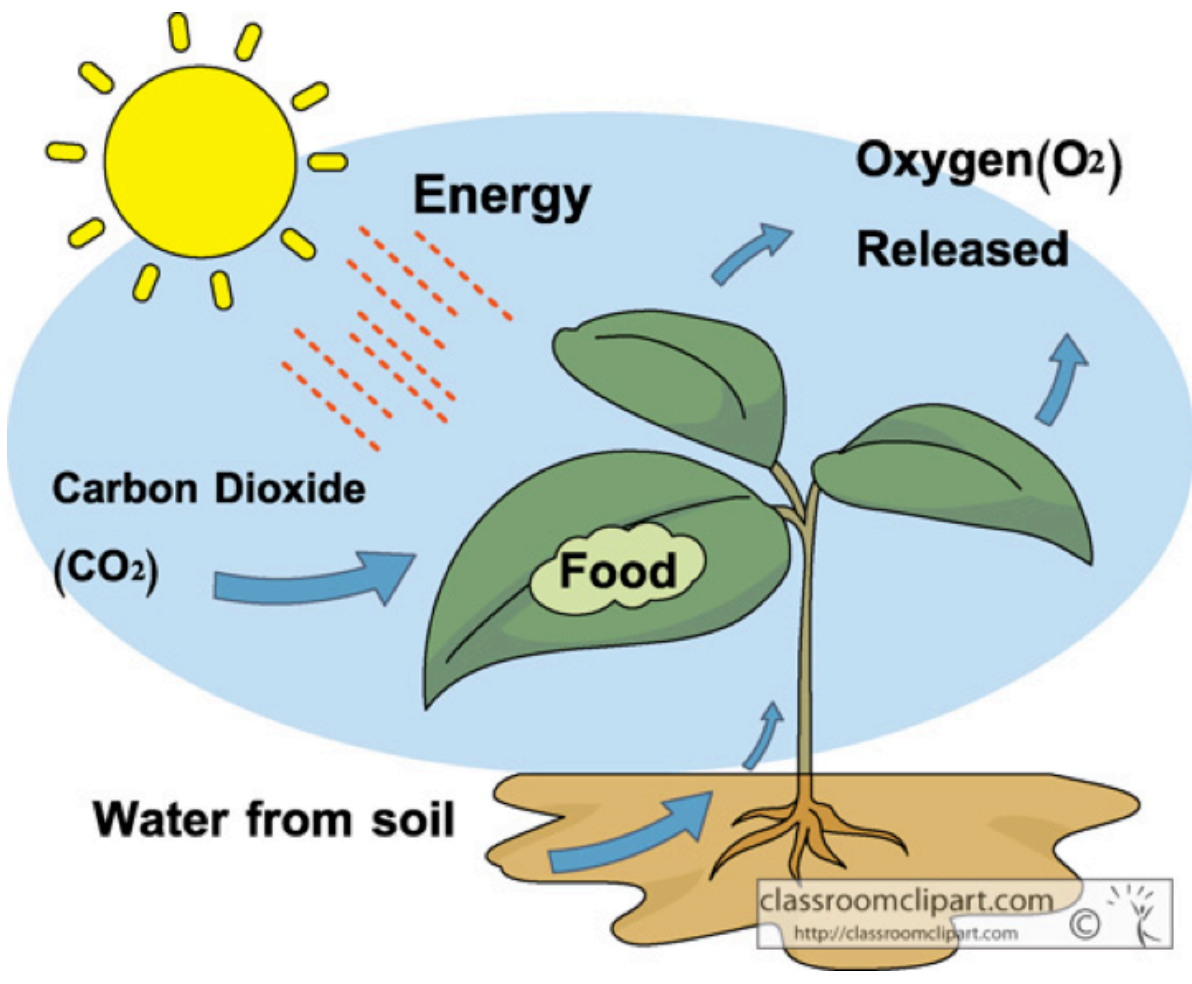
He took a young willow plant, weighed it carefully, and then planted the plant in a container of soil after carefully weighing the dry soil. He cared for and tended the willow for the next five years, being sure to water as needed. After five years,
he reweighed the willow and the soil. The willow had grown from 5 pounds
(2.2 kilograms) to 169 pounds (77 kilograms), while the dry soil had only lost 2 ounces (57 grams)! Jan Van Helmont had demonstrated, through this experiment, that plants do not simply take up soil as they grow. He concluded that the plant had taken up the water during this time, which contributed to the weight gain. He did not take into account the gases from the air might have contributed to the plant growth. That was demonstrated by Nicolas de Saussure more than 100 years later.

Source: http://www.encyclopedia.com/topic/Jan_van_Helmont.aspx

Directions Draw a plant that you observed in the Outdoor Classroom. Label the following in your model: engery (sun, water, and oxygen), chloroplasts, chlorophyll, stomata, leaves, and stem. Be sure to add arrows to show the flow of energy.



From: http://cdn4.kidsdiscover.com/wp-content/uploads/2013/08/Photosynthesis-Infographic-Kids-Discover.png



From: http://classroomclipart.com/images/gallery/Clipart/Science/photosynthesis_diagram_illustration.jpg

More Resources:
http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/P/Photosynthesis_history.html Different experiments on photosynthesis
http://scienceunraveled.com/Photosynthesis for kids
http://scienceunraveled.com/category/science-for-kids/natural-sciences/
http://www.juliantrubin.com/bigten/photosynthesisexperiments.html
https://sites.google.com/site/experimentsinphotosynthesis8b/jan-van-helmont
https://answers.yahoo.com/question/index?qid=20091007104715AAdL2yZ
http://www.newtonsapple.tv/TeacherGuide.php?id=915
http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/newton/phytosy.html

PART 2

OVERVIEW

Students will explore how sunlight affects the photosynthesis process.

OBJECTIVES

- Students will be able to describe how sunlight affects the process of photosynthesis.

STANDARDS

Nevada State Standards

(4)1.1 Generate investigative questions based on observations and interactions with objects, organisms and phenomena.

(4)1.2 Use science notebook entries to develop, communicate, and justify descriptions, explanations, and predictions.

(4) 1.3 Create and use labeled illustrations, graphs, and charts to convey ideas, record observations and make predictions.

(4)1.7 Identify observable patterns to organize items and ideas and make predictions.

Next Generation Standards

4-PS3-1 Use evidence to construct an explanation relating energy being transferred in various ways and between objects.

4-PS3-2 Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

TEACHER INFORMATION

During photosynthesis, energy from the sunlight is used to convert water and carbon dioxide into glucose (food for plants). Oxygen is also produced and released from the leaves into the atmosphere. Some of the glucose is used to provide energy for the growth as well as the plant's development. The glucose that is not used is stored in the roots/fruits for later use.

- Photosynthesis occurs in two stages, known as:
- Light Dependent Reactions
- Light Independent Reactions

Light Dependent Reactions As the name suggests, this occurs in the chloroplasts only when light is present. During this stage, the light energy is converted into chemical energy.

Light Independent Reactions This occurs without the light.

From: http://photosynthesiseducation.com/photosynthesis-for-kids/

TIME

60 minutes, for initial lesson. (This experiment will continue for a week)

QUESTION:

- How does sunlight affect photosynthesis?
- How are plants in wet climates different than plants in desert climates?

MATERIALS

- Science Journals
- Plants from the garden
- Cardboard, construction paper (dark color), aluminum foil, transparent material (example: clear plastic)
- Scissors
- Paper clips and/or tape

PROCEDURES

1. Cut squares out of the construction paper, aluminum foil and clear plastic. Make sure the shapes are the same size and will cover at least half of the selected leaves.

2. Select the leaves to use in your garden.

3. Add one of the squares cut to each leaf. This can be done with tape or a paper clip. Note: be careful not to damage the leaf.

4. There are two options to do over the course of a week:

    - Remove the papers from the leaves. Record your observations.
        - Place the shapes back on the leaves, making sure to place them as close to the original site of the paper as possible.
    - Keep the papers on the leaves for the entire week. Remove the papers at the end of the week. Record your observations.

5. Compare and contrast the leaves that were covered and those that were not covered. Record your observations and conclusions.

6. Compare and contrast the leaves that were covered with the opaque paper and the transparent paper. Record your observations and conclusions.

7. Discuss the conclusions within small groups or whole group.

ASSESSMENT

Entries in the science journals and Class/group participation

ADAPTATION

- Compare and contrast garden plants with indoor plants.
- Using the information from this lesson, have students design a solar collector.
- Cover the entire leaf of a plant; are the results different?
- What is the 'critical mass' of the plant? In other words, how many leaves does a plant need in order to survive?

PART 3

OVERVIEW

Students will explore how sunlight affects the photosynthesis process in desert plants.

OBJECTIVES

Students will learn plant adaptations to survive in a desert environment.

STANDARDS

Nevada State Standards

(4)1.1 Generate investigative questions based on observations and interactions with objects, organisms and phenomena.

(4)1.2 Use science notebook entries to develop, communicate, and justify descriptions, explanations, and predictions.

(4) 1.3 Create and use labeled illustrations, graphs, and charts to convey ideas, record observations and make predictions.

(4)1.7 Identify observable patterns to organize items and ideas and make predictions.

Next Generation Standards

4-PS3-1 Use evidence to construct an explanation relating energy being transferred in various ways and between objects.

4-PS3-2 Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

4-ESS2-1 Cause and effect relationships are routinely identified, tested, and used to explain change.

TEACHER INFORMATION

The desert is very dry and often hot. Annual rainfall averages less than 10 inches per year, and that rain often comes all at the same time. The rest of the year is very dry. There is a lot of direct sunlight shining on the plants. The soil is often sandy or rocky and unable to hold much water. Winds are often strong and dry out plants. Plants are exposed to extreme temperatures and drought conditions. Plants must cope with extensive water loss. Below are some of the adaptations plants have made to survive in the desert:

- Some plants, called succulents, store water in their stems or leaves.
- Some plants have no leaves or small seasonal leaves that only grow after it rains. The lack of leaves helps reduce water loss during photosynthesis. Leafless plants conduct photosynthesis in their green stems.
- Long root systems spread out wide or go deep into the ground to absorb water.
- Some plants have a short life cycle, germinating in response to rain, growing, flowering, and dying within one year. These plants can survive drought.
- Leaves with hair help shade the plant, reducing water loss. Other plants have leaves that turn throughout the day to expose a minimum surface area to the heat.
- Spines discourage animals from eating plants.
- Waxy coatings on stems and leaves help reduce water loss.
- Flowers that open at night lure pollinators that are more likely to be active during the cooler night.
- Slower growing requires less energy. The plants don't have to make as much food and therefore do not lose as much water.
- Plants adapted to desert climates are called xerophytes. Xerophytes use the following strategies:
  - Drought Escapers:
    - The annual plants that will germinate only when enough water is available to wash away germination-inhibiting chemicals from their seed coats
    - Once germinated, they mature rapidly producing flowers, fruit, and seeds
    - Offspring lay in wait below the soil for the next rainy season
  - Drought Avoiders:
    - These plants have vegetative parts that stay alive during the dry season, but they are inactive
    - They keep their metabolic processes and above-ground leaf surfaces to a minimum to avoid water loss
    - Drought-deciduous – losing their leaves in summer to minimize evaporative surfaces
    - Perennials with some vegetative parts (as a bulb) surviving underground
  - Drought Endurers:
    - Remain alive and metabolically active during drought
    - Some adaptive features:
      - Hairy leaf surfaces
        - Traps humidity and forms moisture barrier layer to minimize evaporation)
      - Waxy or gummy coating
        - Traps moisture in the leaf
    - Small leaves or large leaves divided into smaller leaflets.
    - Minimizes leaf surface
    - Plants with green stems don’t need leaves for photosynthesis
    - Tough fibrous tissues
      - Prevents wilting when water is scarce

TIME

60 minutes

QUESTION:

- How are plants in wet climates different than plants in desert climates?
- Why is there a difference?

MATERIALS

- Science Journals
- Plants from the garden
- Plants native to the desert: (actual examples or photos of desert native plants)
  - Mesquite Tree
  - Globe Mallow
  - Acacia Tree
  - Yucca
  - Cacti and Succulents

PROCEDURES

1. Have students answer the questions, “How are plants in wet climates different than in desert climates?” and “Why is there a difference?” Students will then share their answers in small groups.

2. Teacher and students will go out into the garden to observe garden plants and native/desert plants. (If there are no native plants in the garden, perhaps there are native/desert plants in other areas of the school grounds). Students will write their observations in their journals.
   - Have the students use the observations to make a conclusion as to why the plants are different.

3. Once the students have completed their observations and conclusions, share within small groups or in the whole group.

4. Students (individually or in small groups) choose a desert-adapted plant to research and report to the class. Some of the items to include in the report are:
   - Name of the plant (common name and botanical name)
   - A brief description of the plant, including size.
   - Habitat
   - Adaptations to survive in the desert climate.
   - Any other unusual facts about the researched plant.
   - Photos/pictures/3-D items to show the selected plant

ASSESSMENT

- Class participation
- Science journal
- Research project

ADAPTATION

Have students plan and design a landscape using native plants.

More Resources

http://eebweb.arizona.edu/links/desert/plantadaptations.htm

www.desertmuseum.org

McKay, Pam, Mojave Desert Wildflowers. Guilford, Connecticut. Falcon Press, 2003.

NUTRITION FACTS

- Our bodies need water too! How much? Its long been though that we should drink 8 glasses of water each day, but truth is everyBODY is different, Experts say you should try to drink between ½ and 1 ounce of water for every pound you weight (high end of the spectrum if you live in hot environments and/or exercise often).

STANDARDS FOR LESSON 6 LESSON MAP

NG: 4-PS3-1.Use evidence to construct an explanation relating the speed of an object to the energy of that object.

4-PS3-2.Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

4-PS3-4.Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

ELA Reading CCSS.ELA-Literacy.RI.4.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.

ELA Writing W4.2a-e Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

W.4.2a Introduce a topic clearly and group related information in paragraphs and sections; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension.

W.4.2b Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic.

W.4.2c Link ideas within categories of information using words and phrases (e.g., another, for example, also, because).

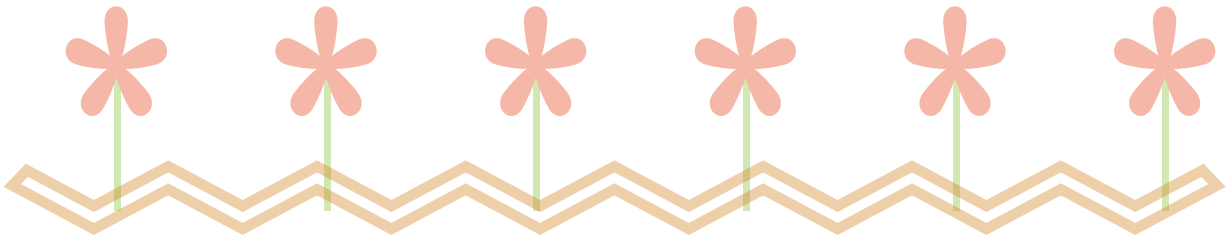
W.4.2d Use precise language and domain-specific vocabulary to inform about or explain the topic.

W.4.2e Provide a concluding statement or section related to the information or explanation presented.

W4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic.

Speaking and Listening SI4.4 Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

Math 4.OA.A.3 Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted.



LESSON 6 LESSON MAP

Lesson 6: Photosynthesis

Part 1

Day 1

► Procedure 1-7 (garden observation)

Day 2

► Procedure 8-12 (garden observation)

Day 3

► Procedure 5: 13

Part 2

Day 1

Procedure 1-3 (garden observation)

Day 2

Procedure 4-6 (garden observation)

Day 3

Procedure 7

Part 3

Day 1

Procedure 1-3 (garden observation)

Day 2-5

Procedure 4 (research in lab)

Day(s) 2

Math Multi step word problems

Day(s) ____

Literacy Greek and Latin affixes

Other words with the prefix "photo" then introduce other roots and meanings

Compare and contrast writing

Speaking knowledgeably about a topic

Research writing

Day(s) ____

Science/Social Studies Extension Native plant uses by native peoples of the Mojave

Name:_____ Date: _____

MULTISTEP WORD PROBLEMS

Plant	Seeds Per Packet
Sunflower	25
Cucumber	30
Squash	20
Pea	100
Melon	25
Beet	200
Corn	100
Brussel Sprouts	150

1. Susie planted 3 packets of Sunflowers. 15 of the seeds didn't sprout. How many seeds did sprout?

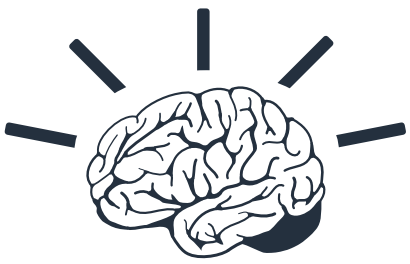
2. Danny bought 2 packets of melon seeds, 3 packets of beets and 4 packets of peas. He planted each packet. How many seeds did he plant in all?

3. Alex bought a packet of corn seeds, cucumber seeds, and a packet of Brussel Sprout seeds. How many seeds did she buy in all?

4. Miguel decided to replant his garden. In the garden he had 3 large planter boxes. The first can hold 2,600 seeds. The second can hold 55 seeds, 3 squash packets and 14 beet packets. In the first he decides to plant beets. In the second he decides to plant the squash. How many seeds were left over after planting the two boxes?

Lesson Seven

The Element of Water in the Desert



BRAIN BREAKS!

1. Plant Partners Teacher will give class a plant part (seed, root, stem, leaves, flower). Students turn to a partner and go back and forth naming vegetables harvested from that part of the plant. Repeat until partners can no longer name vegetables from that plant part.

2. Apple, Watermelon, Banana (rock, paper, scissors) Students play rock, paper, scissors replacing rock with apple, paper with watermelon and scissors with banana. Play as many rounds as possible in given time frame.

3. Garden Taboo Teacher plays music. When music stops students pair up. Teacher calls out a garden topic such as fruit. Partner A has to describe any fruit they want to their partner without saying the name. Partner B has to try and guess what their partner is describing.

4. Syllable Snacks Teacher will call out a number (1-4). Students work with a partner to come up with garden vocabulary words that contain that number of syllables. Partner A will begin by naming a vocabulary word with the given number of syllables; partner B will go next. They will alternate until one partner can no longer name a vocabulary word with the given number of syllables.

5. Fruit/Veggie Knock Students will work with a partner and touch knuckle to knuckle (veggie) and palm to palm (fruit) in a given sequence. Teacher will name the sequence to the class (Ex: veggie, veggie, fruit) and students will have to use the given hand gestures to complete the sequence. Teacher will increases the number of movements with each round (Ex: Round 1-veggie, veggie, fruit. Round 2-fruit, veggie, veggie, fruit).

6. Fruit/Veggie Match Students will stand. Teacher will name a fruit or vegetable and students will have to touch that part of the body corresponding to the part of the plant that the fruit or vegetable grows from (roots-feet, stem-legs, leaves-body, flowers-head). Teacher will call out and play the game “Simon says” going a little faster with each round.

7. Plant Part Finger Hop Students touch thumb to thumb, pointer to pointer, middle to middle, ring to ring, pinkie to pinkie as they say the plant part finger hop chant (seeds, roots, stems, leaves, flowers). Teacher will randomly call out a plant part, students will have to touch the corresponding fingers. Teacher will repeat, increasing the pace with each round.

8. The Harvester Students will stand and squat (harvest) with a shovel in hand. They will shovel the dirt over alternating shoulders like a farmer. Students will work at their own pace “harvesting” for the given time frame.

9. Apple Squat Students will stand and begin by squatting. They will then stand up on one foot, hop twice saying “apple, apple” then return to a squat. Repeat with increasing speed each round and alternating feet.

10. Fruit Freeze Teacher will randomly call out different fruits and vegetables. If the teacher calls out a veggie, students have to jog (or march) in place, if teacher calls out a fruit, students have to freeze.

11. Garden Guess Students will work with a partner. Partner A will silently think of a fruit or vegetable. Partner B can ask three questions about what their partner is thinking. After three questions, partner B has to guess the fruit or vegetable. They will then switch roles, and partner B will silently think of a fruit or vegetable and partner A gets to ask questions and guess. Repeat as many times as possible in the given time frame.

OVERVIEW

Students will explore the aspects of drought.

OBJECTIVES

- Students will be able to describe a drought.
- Students will learn some of the contributing factors of a drought.
- Students will learn methods to avoid some of the effects of a drought.

STANDARDS

Nevada State Standards

(4)1.1 Generate investigative questions based on observations and interactions with objects, organisms and phenomena.

(4)1.2 Use science notebook entries to develop, communicate, and justify descriptions, explanations, and predictions.

(4) 1.3 Create and use labeled illustrations, graphs, and charts to convey ideas, record observations and make predictions.

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4-PS3-1 Use evidence to construct an explanation relating energy being transferred in various ways and between objects.

4-PS3-2 Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

4-ESS2-1 Cause and effect relationships are routinely identified, tested, and used to explain change.

TEACHER INFORMATION

Believe it or not, the Las Vegas Valley was a watering spot for travelers many years ago. In fact, some of the artifacts found in this area date back to at least 3, 000 years ago. John C. Fremont arrived in this area in the mid-1800's and was followed by Mormon settlers a decade later. During the mid-1800's the Las Vegas Valley was known for its cattle ranches. In 1902, when the railroad came to the area, there was only 19 settlers living in Las Vegas. This was the beginning of what we would know as the city of Las Vegas today. The Hoover Dam was built along the Colorado River in the 1930's. Las Vegas would welcome Nellis Air Force Base and later the entertainment and tourism businesses helped to bump the population of Clark County of over 1.5 million people!

All the water that was used in the Valley was provided by pumped wells within the valley. To keep up with the growing population and demand, the Las Vegas Valley Water District created what is known as the Southern Nevada Water System. This 4-mile pipeline and pumping plant supplied approximately 85% of the water used in Las Vegas.

Nevada is one of the driest states in the entire country. The average rainfall per year is about 4 inches. The Spring Mountains, located to the west of Las Vegas add to our annual rainfall; however, it isn't enough. Due to the high summer temperatures, winds and low humidity, the evaporation rate for what little precipitation we receive is very high. It has been estimated that the annual evaporation rate from open water is more than 90 inches. Therefore, we are relying on imported water and pumped wells.

A small portion of the water used in the valley is pumped from aquifers (geological formations containing or conducting ground water). The watershed (area or region drained by a river, stream, etc.) for the valley ranges from its highest, Mount Charleston, (11,918 feet) to the lowest level of 1,450 feet in the Las Vegas Valley Wash which eventually drains into Lake Mead. Many of the tributaries that contribute to the groundwater have dropped significantly due to demand, especially for residential lawns and commercial landscaping. There are some simple steps to take to help relieve this water shortage. From: http://www.h2ouniversity.org

When water touches the soil, it does one of two things: it will infiltrate the soil or it will run off the surface of the soil (erosion). The roots of the plants can use the water that infiltrates the soil. Therefore, it is imperative to conserve water in the desert. The best and most natural place to store water is in the soil. There are a number of ways to increase the amount of water that can be stored in the soil. They include:

- Improve the Soil Structure by adding compost (organic matter)
- Add Mulch to the surface of the soil. Mulch: an organic or inorganic layer placed on top of the soil to:
  - Cool the soil in the summer
  - Warm the soil in the winter
  - Helps the soil retain water by slowing the evaporation rate
- Plant a Living Mulch: a low-growing plant that spreads over the soil (example white clover)
- Dense Plantings: provides shade for the soil, smothers the weeds (they will feed on the water in the soil if allowed to grow)
- Soil Contouring: (sculpting the land to hold water)
  - This method catches water and directs it to where it is needed.
  - Helps plants/soil life survive in both the wet/dry times
  - Builds up the humus (the dark organic material in soils, produced by the decomposition of vegetable or animal matter and is essential to the fertility of the soil)

From: *Gaia's Garden* by Toby Hemenway. See reference paper (Water Wisdom) at the end for more details.

TIME

The initial class introduction is approximately 60 minutes. The projects that will be researched and completed may take several months, depending how in-depth you want to go.

QUESTION:

- What is a drought?
- What are some of the contributing factors to a drought?
- How can you help to alleviate the effects of a drought?

MATERIALS

- Science Journals
- Reading: “Dark Days” from: http://utah.agclassroom.org/files/uploads/estore/unit_dirt.pdf
- Research materials: books, websites, etc. (See some suggestions at the end)

PROCEDURES

1. Students will answer the first two questions in their journals.

2. Students will share their answers either with a partner, small group or whole group. This is up to the teacher how they conduct the sharing of answers.
   - If this is done with partners or small groups, have each group come up with a representative answer to share with the whole group.
3. Students will read the story “Dark Days” and write in their journals reflecting on the story.

4. Teacher will ask the students to answer the third question in their journals.

5. Group will then go out to the garden to see if there are methods they recognize as ways to alleviate the loss of water in their garden. They will write/draw observations in their journals.

6. While out in the garden, the teacher can talk about some of the ideas presented in the “Water Wisdom” notes. Students will observe if any of these techniques are being used at the present time in the garden.

7. Using the “Water Wisdom” notes listed below, have students (working in small groups) select one of the methods to research.

8. Students are to use the Scientific Method (examples listed below) to choose one of the methods in “Water Wisdom” to see how much water can be saved.
    - If students so desire, they may come up with their own solution to alleviate the effects of the drought going through the Scientific Method, as well.
9. If possible, the projects would use different areas of the garden to test, observe and collect data on their project.

ASSESSMENT

Science journal entries and Research project

ADAPTATION

Have students study the history of the Dust Bowl days.

“WATER WISDOM”

In conventional garden design, water appears only by rainfall or gardener’s intervention like hoses and sprinklers. Ample moisture isn’t the natural state of a typical garden. In an ecologically designed garden, water is not a externally caused event. Water is:

- Designed into the garden
- Naturally present
- Naturally abundant
- Ample water, not drought, is default condition
- Doesn’t need to babied, nudged and prodded into health. Relies on natural systems/cycles.

“How can you create a garden that survives the idiosyncrasies of weather without constant care?” Be sensitive to limits of our water supply and energy required to tap it. The results:

- Less watering
- Resilient, healthy ecosystem
- Better drainage
- Water storage for future use
- Puts water where needed most

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- Resilient, healthy ecosystem
- Better drainage
- Water storage for future use
- Puts water where needed most

This method isn't just for the dry land dwellers but can be used (with some modifications) anywhere, even in wet climates. To learn how to design a garden that is naturally water-wise, we look, as always to nature. How does nature store water?

- Lakes/ponds
- Plants
- In air
- In soil
- Water: recycled in wetlands
- Breathed into air by trees
- Collected and channeled by landforms

The Five Water Conserving Methods and Their Benefits:

Using these methods protects against failure since it relies on more than one way to fight drought (retain water). Soil that is rich in organic matter drains better than nearly any soil except very sandy soil. Mulches, dense plantings, and contoured ground will help prevent pounding rains from causing soil erosion.

1. Holding Water in the Soil with High Organic Matter Content

- Cheapest place to store water: soil
- Humus and other organic matter act as sponge (swelling to hold several times their weight in water). The key to soil's capacity to hold water is organic matter.
- Soil is typically stingy with water.
- Rainstorm must first saturate soil with water before a single drop trickles away as runoff.
- Research shows that as little as 2% organic matter can reduce the irrigation needed by 75% when compared to poor soils with less than 1% organic matter.
    - Before homeowners can achieve the lake-in-ground effect, they must build up that organic matter.
    - By building up our garden's soil, we can store whole rivers/lakes in our yard.

Benefits of High Organic Matter Content

- Holds moisture
- Adds fertility
- Stores nutrients
- Boosts soil life/plant life
- Fluffs soil

2. Mulching for Moisture

- 2-4 inch mulch layer (or more) will stop moisture loss by slowing evaporation from soil and by keeping plant roots cool, reducing transpiration (movement of water into roots and out through leaves).
- Organic mulch also soaks up rain instead of letting it run off.
- Organic matter also breaks down, adding humus to soil, thus enriching soil.
- Mulched soil usually won't warm up in spring as quickly as bare soil: strip mulch off soil for heat-loving plants and replace mulch once temperatures start to rise.
- A wide variety of mulch material:
    - Straw
    - Bark
    - Leaves
    - Seaweed
    - Pine needles
    - What about rocks as mulch?
        - In dry country,1-4 inch diameter of rocks will pick up morning dew and condense it into the soil. During the day, hot air goes through spaces between rocks and moisture condenses out of warm air onto cooler rocks trickling moisture down into ground.
        - Think about what it's like when you lift up rocks: What do you find?
    - Rock works best in cooler climates.

Benefits of Mulching for Moisture

- Slows evaporation
- Cools soil
- Adds fertility
- Boosts soil life
- Smothers weeds
- Enhance soil's water holding capacity
- Reduces soil erosion
- Protects soil structure

3. Drought Tolerant Plants

- Water Conserving Plants need less water and can survive drought. There is a difference between "native desert" plants and "Mediterranean".
  - Keeps root temperatures down.
    - Desert plants can't survive a long time with 'wet roots'.
    - Mediterranean plants are those that can adapt to the swings of moisture. They tend to do better in non-desert climates. Mediterranean plants are good for outlasting the unpredictable dry spells that do occur.
- Know every property has its own microclimate. Observe, assess and then station your thirstiest plants in naturally wet places.
- Use plants that are suited to available water in your area. You needn't use only drought-tolerant plants.
- Use mix of natives that are adapted to local climate, drought-tolerant varieties, and plants whose water use changes seasonally.
- Plants that need more water can be located where they can get water with minimal human effort.
- Plants should be in right relationship with overall climate, microclimate, landforms, soil and surroundings.

4. Dense Plantings

- Most plants do well with some sort of dappled shade/sun.
- Stack your plants into layers to hold moisture beneath the canopy (creating microclimates).
  - Spring:
    - First: plants to arrive, tiny herbs and ground covers
    - Next: come the shrubs
    - Then: the low trees
    - Lastly: the forest giants
  - Summer: canopy is nearly closed from large trees. Once closed, air and soil beneath it stays far more moist than in the open.
  - This 'time delay' approach can also work in your garden.

Benefits of Dense Plantings

- Shade soil
- Smother weeds
- Densely packed plants create shade, thus, creating cooler ground.
- Reduces evaporation up to 60%
- Keeps root temperatures down
- Slows moist exhalations of transpiring leaves that would otherwise pump water into the sky
- Plants shading each other reducing water loss

5. Soil Contouring

- Contour soil to catch water
- Let nature and gravity do you watering for you.
- If you have a 'boggy' place where water collects – build a swale slightly off contour to carry water to an appropriate catchment.

Benefits of Soil Contouring

- Catches water
- Directs water where needed
- Helps plants/soil life survive wet/dry times
- Builds humus
- Adds visual interest

"DARK DAYS"

The "Dust Bowl" is a term sometimes used to describe both a time and a place. The dust bowl region of the United States is the southern portion of the Great Plains, including parts of Texas, Oklahoma, New Mexico, Colorado, and Kansas. But Dust Bowl—with a capital D and B—refers to the time during the 1930's when drought, prairie winds, and poor land use practices combined to make life in this region miserable and farming nearly impossible.

On Sunday afternoon, April 14, 1935, clouds of dust moved through the dust bowl area and turned the sky black. People had to cover their noses and mouths so they could breathe. The day was to go down in history as Black Sunday. Robert E. Geiger was a writer for the Associated Press who visited the area during that time. In a series of firsthand articles for the Washington Evening Star, Geiger described "pelting winds full of topsoil" and was the first to call the area "The Dust Bowl."

Dust storms were common on the Great Plains, but the west has had its own areas of dust storms and soil erosion. In Grantsville, Utah, (in the heart of the Tooele Valley) also during the 1930's, dust storms occurred that caused the same economic and ecological problems as the ones occurring in the Great Plains. The Grantsville dust bowl was caused from over grazing and drought. The Great Plains dust bowl was caused by similar conditions; however, farmers in the region had also been using a newly invented steel plow that dug up acres of prairie grasses. During the early 1900's gas-powered tractors and combines enabled farmers to cultivate millions of acres and to enjoy bountiful harvests. But few farmers knew what they were doing exposed soil to wind and rain, setting the stage for mass erosion.

In Grantsville most residents recall the mid 1930's as dark and dirty. The Tooele Valley was first settled about 1847. Grass covered the valley floor. The grass was abundant. The Tooele Valley became one of the most popular winter grazing areas in the west. More and more livestock were allowed to graze in this grassy valley. Large outside trail herds making their way to Idaho and Nevada traveled across the valley lingering as long as possible to pick up any available feed. Slowly the grass disappeared and sage took its place. Over- grazing stunted and scattered the sage until what was once a range of plenty became almost barren.

From time to time, hot destructive brush fires swept through the valley, destroying what little perennial vegetation was left. Residents of the valley needed to increase their income. They plowed up many acres, which without irrigation couldn't yield crops on the yearly rainfall of 12 inches or less. The wind whipped up small dust clouds sending them into the city. Then, there came a drought. This was a recipe for an ecological disaster. Suffering from the catastrophe was not confined to the 1,200 citizens of Grantsville. The other 6,000 residents of the valley also breathed the dust. Soil from the Tooele Valley settled as far away as Salt Lake City, Ogden, and Logan. Idaho even got some of Utah's dust.

In the case of both dust bowls the situation was reversed largely due to government actions. And by the time rains returned, the situation had already improved dramatically. A special branch of the United State Department of Agriculture (USDA), the Soil Conservation Service (SCS) was created and went to work. The SCS used carefully planned conservation methods and wiser farming

techniques to restore grasses. With the help of state Cooperative Extension Services, SCS taught farmers how to conserve topsoils. Local Soil Conservation Districts were established and still, today help promote conservation on public and private lands. Today the SCS is called the Natural Resource Conservation Service (NRCS).

Once the land was restored with vegetation farmers and ranchers moved back onto the land. Using improved farming and grazing management practices agriculture has returned to the Tooele Valley and the Great Plains.

Even today, the Dust Bowl is remembered as one of the most severe tragedies to affect both nature and people in this country's history. In the mid 1990's, parts of Texas experienced a few years of drought. Farmers, ranchers and conservationists moved quickly to remove livestock to keep as many plants as possible on the range. Livestock can graze on rangelands if they are managed properly. Ranchers and public land managers must be able to move livestock when weather and range conditions will not allow the germination of new plants. We can learn from our mistakes!

From: www.agclassroom.org

NUTRITION FACTS

- Most rainwater is safe to drink! In fact, rainwater serves as the main water supply for most of the world's population.

LESSON 7 STANDARDS & LESSON MAP

NG: 4-PS3-Use evidence to construct an explanation relating the speed of an object to the energy of that object.

4-PS3-2. Observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another

ELA Reading RI.4.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

ELA Writing W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic.

W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.

Speaking and Listening SL.4.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.

SL.4.4 Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace

Lesson 7: The Element of Water in the Desert

Day 1

- Procedure 1-4

Day 2

- Procedure 5-6 (Garden observation)

Day 3-5 or more

- Procedure 7-9

Day(s) ____

Math

Day(s) ____

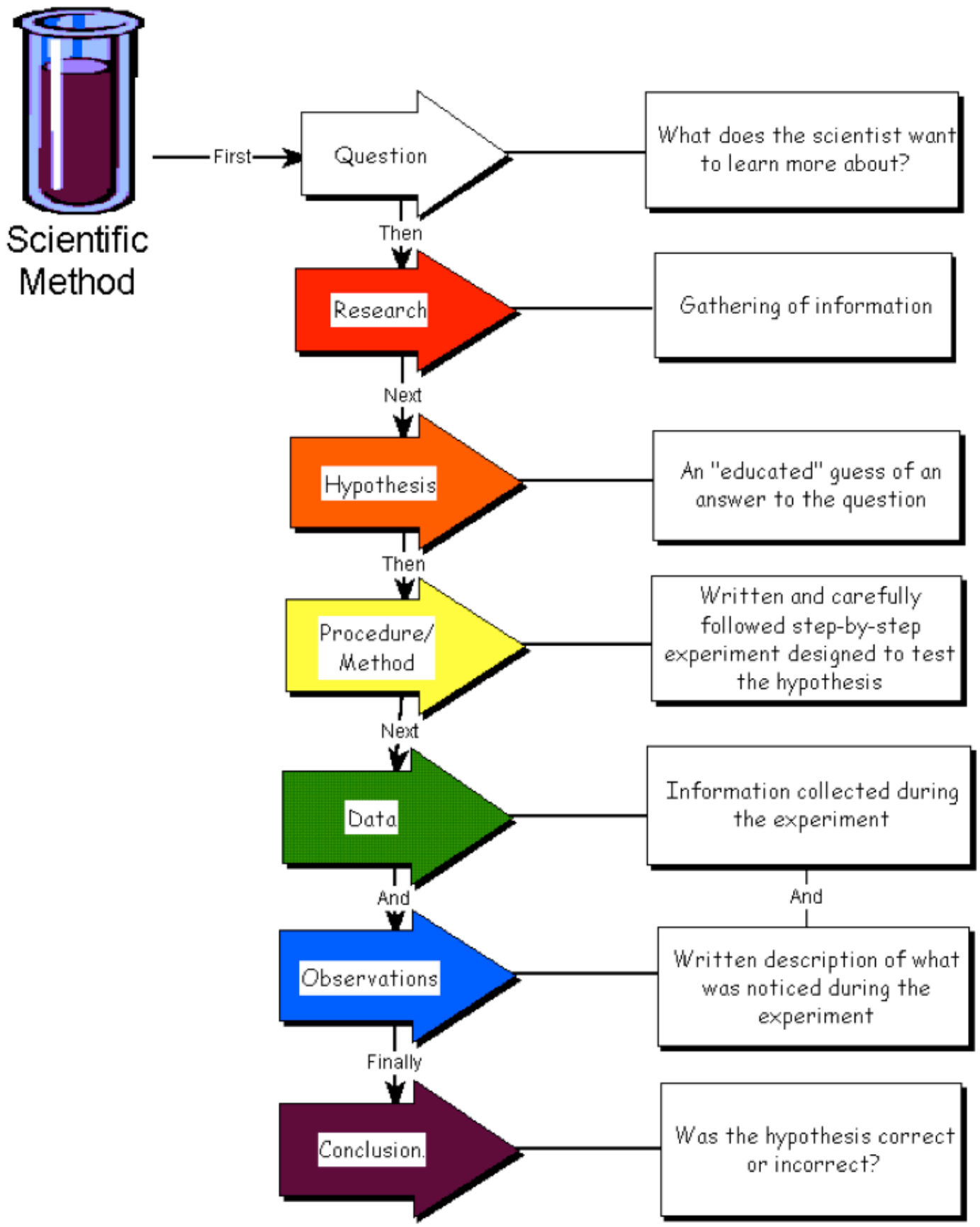
Literacy Research writing

Group presentations on research and experiments

Day(s) ____

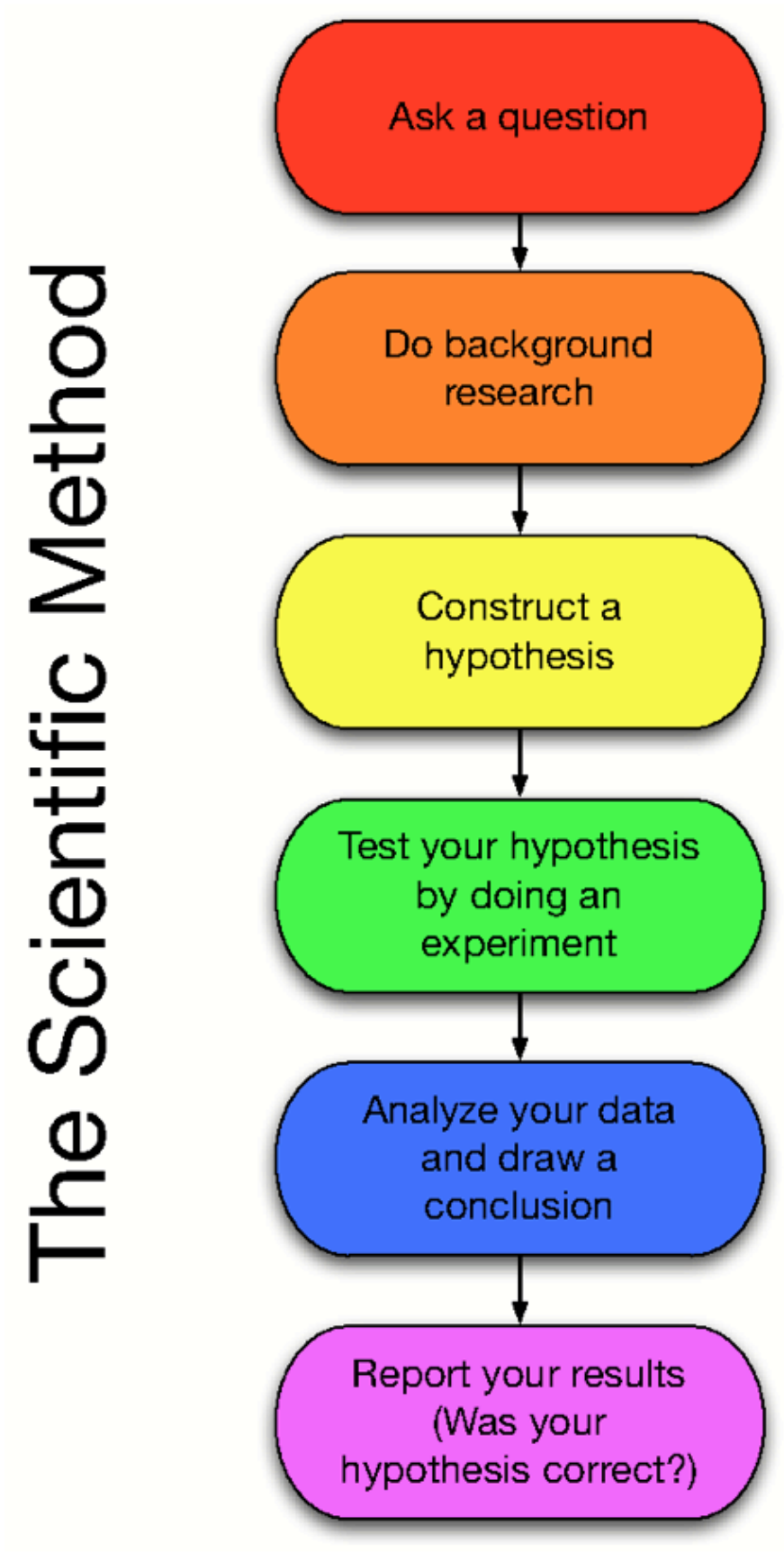
Science/Social Studies Extension Scientific method and experiments

SCIENTIFIC METHOD



http://www.sciencemadesimple.com/scientific_method.html
http://www.sciencebuddies.org/science-fair-projects/project_scientific_method.shtml

THE SCIENTIFIC METHOD

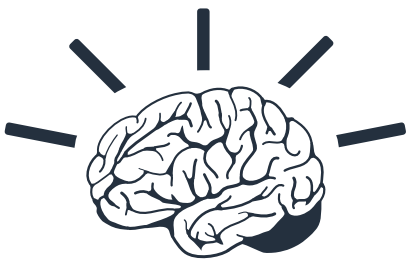


From: http://luisaglobalblog.blogspot.com/2009/09/scientific-revolution-scientific-method.html

Suggested readings for research:
http://utah.agclassroom.org/files/uploads/estore/unit_dirt.pdf
http://www.h2ouniversity.org
http://www.h2ouniversity.org/html/library_hydrologic_cycle.html
http://www.projectwet.org/sites/default/files/content/documents/drought-lesson-plan.pdf
http://www.discoverwater.org/water-cycle/
http://drought.unl.edu/DroughtforKids.aspx
http://www.theguardian.com/education/2012/mar/26/teaching-resources-drought-uk-hosepipe
http://www.freebookezz.com/pdf/187606757608/
http://education.nationalgeographic.com/archive/xpeditions/lessons/01/g35/drought.html?ar_a=1
http://pmm.nasa.gov/education/lesson-plans/earthlabs-drought
http://pmm.nasa.gov/education/lesson-plans/water-earths-geosphere
http://www.42explore2.com/drought.htm
http://pmm.nasa.gov/education/primary-topic/water-cycle
http://www.scpr.org/blogs/education/2014/02/03/15747/5-ways-to-teach-kids-about-the-california-drought/
http://www.ehow.com/list_7781514_dustbowl-classroom-activities.html
http://www.weatherwizkids.com/weather-rain.htm

Lesson Eight

The Power of a Raindrop



BRAIN BREAKS!

1. Plant Partners Teacher will give class a plant part (seed, root, stem, leaves, flower). Students turn to a partner and go back and forth naming vegetables harvested from that part of the plant. Repeat until partners can no longer name vegetables from that plant part.

2. Apple, Watermelon, Banana (rock, paper, scissors) Students play rock, paper, scissors replacing rock with apple, paper with watermelon and scissors with banana. Play as many rounds as possible in given time frame.

3. Garden Taboo Teacher plays music. When music stops students pair up. Teacher calls out a garden topic such as fruit. Partner A has to describe any fruit they want to their partner without saying the name. Partner B has to try and guess what their partner is describing.

4. Syllable Snacks Teacher will call out a number (1-4). Students work with a partner to come up with garden vocabulary words that contain that number of syllables. Partner A will begin by naming a vocabulary word with the given number of syllables; partner B will go next. They will alternate until one partner can no longer name a vocabulary word with the given number of syllables.

5. Fruit/Veggie Knock Students will work with a partner and touch knuckle to knuckle (veggie) and palm to palm (fruit) in a given sequence. Teacher will name the sequence to the class (Ex: veggie, veggie, fruit) and students will have to use the given hand gestures to complete the sequence. Teacher will increases the number of movements with each round (Ex: Round 1-veggie, veggie, fruit. Round 2-fruit, veggie, veggie, fruit).

6. Fruit/Veggie Match Students will stand. Teacher will name a fruit or vegetable and students will have to touch that part of the body corresponding to the part of the plant that the fruit or vegetable grows from (roots-feet, stem-legs, leaves-body, flowers-head). Teacher will call out and play the game “Simon says” going a little faster with each round.

7. Plant Part Finger Hop Students touch thumb to thumb, pointer to pointer, middle to middle, ring to ring, pinkie to pinkie as they say the plant part finger hop chant (seeds, roots, stems, leaves, flowers). Teacher will randomly call out a plant part, students will have to touch the corresponding fingers. Teacher will repeat, increasing the pace with each round.

8. The Harvester Students will stand and squat (harvest) with a shovel in hand. They will shovel the dirt over alternating shoulders like a farmer. Students will work at their own pace “harvesting” for the given time frame.

9. Apple Squat Students will stand and begin by squatting. They will then stand up on one foot, hop twice saying “apple, apple” then return to a squat. Repeat with increasing speed each round and alternating feet.

10. Fruit Freeze Teacher will randomly call out different fruits and vegetables. If the teacher calls out a veggie, students have to jog (or march) in place, if teacher calls out a fruit, students have to freeze.

11. Garden Guess Students will work with a partner. Partner A will silently think of a fruit or vegetable. Partner B can ask three questions about what their partner is thinking. After three questions, partner B has to guess the fruit or vegetable. They will then switch roles, and partner B will silently think of a fruit or vegetable and partner A gets to ask questions and guess. Repeat as many times as possible in the given time frame.

OVERVIEW

Students will explore how erosion occurs.

OBJECTIVES

- Students will learn what erosion is.
- Students will learn the effects erosion has on land.
- Students will learn ways to prevent erosion.

STANDARDS

Nevada State Standards

E.5.A.2 Evaluate the interactions between processes in the water cycle.

Next Generation Standards:

4-PS3-3 Ask questions and predict outcomes about the changes in energy that occur when objects collide.

4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

4-ESS2-2 Analyze and interpret data from maps to describe patterns of Earth's features.

TEACHER INFORMATION

- Rain is the largest cause of erosion.
- Water is about 800 times heavier than air, one half to one third the weight of rock.
- Water's most damaging moment is when it hits the ground.
- Up until recent times, it was thought that the sheeting of rain (when drops gather and flow over the ground) was the most damaging to the soil.
- It has now been discovered that as the raindrops grow in size, both their speed and mass increase; thus, increasing the destructive results as the raindrop size increases.
- Since the late 1980's, rains have become heavier everywhere in the world, creating more destruction and erosion from their impact.
- To fight erosion, the soil needs to be covered by foliage or by mulch.

From: http://www.seafriends.org.nz/enviro/soil/erosion2.htm

"Erosion is a naturally occurring process. Erosion has given us some of our most beautiful landscapes. There are beautiful erosion formations such as the Grand Canyon, Kolob Canyon (Zion National Park) the San Rafael Swell (Emery County, Utah), and Bryce Canyon, Utah, to name a few. Erosion is the loosening, transportation, and relocation of soil particles from one place to another. Erosion occurs primarily due to the action of wind and water. The rate and extent of erosion are determined by soil type and condition, slope of the land, plant cover, land use, and climate.

Erosion does not occur only on wilderness landscapes, and the effects are not always positive, especially when you are talking about productive topsoil.

Water erosion includes raindrop splash, sheet erosion, rill erosion, gully erosion, and slumping or mass erosion. Raindrop splash is the most obvious on bare ground during a torrential rainstorm. The raindrops strike the ground and upon impact break soil particles apart, splashing these particles into the air. Plant cover can lessen the impact of raindrops. Plants break the fall of the raindrops and allow for water infiltration or percolation.

Sheet erosion is the washing away of a thin surface layer of soil over a large area of land. Because sheet erosion occurs evenly, it is generally not obvious until most of the topsoil is removed.

Rill erosion may be noticeable on sloping bare ground after a rainstorm. Water forms small, well-defined channels that carry soil away from the sides and bottom of these channels. The rills of channels erode more soil as they move downslope and increase in size. When rills become large, the process is called gully erosion. This severe form of soil erosion removes tons of soil from the sidewalls and bottom of the gully.

Streambank erosion (and similarly, coastal erosion) is the cutting away of the banks by water. It is generally a slow process, which represents the normal situation occurring along most streams. It is most active during floods when the amount and velocity of water are the greatest and when the bank soils are submerged under water and saturated.

To control erosion, plant cover is usually the best solution. But to grow our food, farmers make furrows in the land for row crops. A farmer can use a variety of methods to “keep soil in its place.” A farmer may plant his/her crops around the curve of a hill rather than up and down the hill. This is called contour planting. Plowing will also be done on the contour. Farmers may also build terraces. Terraces are wide ridges that go around a hill to prevent water from rushing down the hill too fast. On steep hillsides, rather than clear the area for cropland, farmers will maintain the area in forest and grass. Water always runs downhill, so farmers do not plow in low areas where water collects; instead they maintain low ditch areas as grassed waterways.

Soils susceptible to wind erosion should be kept covered with some kind of vegetation. If this cannot be done year-round, a windbreak of trees and shrubs may be planted. Windbreaks are rows of trees planted to slow down the wind and prevent soils from blowing away in the wind.”

From: www.utah.agclassroom.org

TIME

4 sessions, 30 minutes

QUESTIONS

How powerful is a raindrop?

MATERIALS

- Pencil
- Rulers
- Eyedroppers (1 per small group)
- Soil
- Small container of water
- Splash Zone Target (see below)
- Graph (see below)
- Science Journals

PROCEDURES

- Day 1

1. Discuss their answer to the question with a partner or in small groups.

2. Divide the class into small groups.

- Day 2

1. Each group will have the following:

   - Splash Zone Target
   - Eyedropper
   - Small container of water

2. Each group will place approximately ½ teaspoon dry soil in the center of their target.

3. Fill the eyedropper with water and hold the dropper about 18 inches from the surface of the soil.

4. Drop 5 drops of water onto the soil. If there is a miss, continue until 5 drops have landed on the soil.

5. Record the number of 'water splashes' (drops containing soil) in each zone in your journal. Teacher will encourage students to draw the zone target in their journals too.

- Day 3

1. The groups will use the data from the target to complete the graph.

- Day 4

1. Teacher will ask the following questions for discussion:

   - What did you observe?
   - How did the soil move from the center of the target?
   - Which zone had the most water drops with soil particles? Why?
   - Which zone had the least water drops with soil particles? Why?
   - What do you think if the water drops were bigger?
   - What would happen if you had the eyedropper higher?
   - How could the erosion be prevented?

2. Have the students write conclusions to the lesson in their science journals.

ASSESSMENTS

- Class participation
- Group participation
- Science journal entries
- Graph accuracy

ADAPTATIONS

Repeat the experiment but have the distance from the paper to the eyedropper higher than 18 inches. Record your results.

Repeat the experiment but use a ‘turkey baster’ instead of the eyedropper. Compare and contrast the results with the eyedropper.

Create an experiment to show the effects of raindrops on soil that has vegetation or mulch covering the soil.

More Resources

https://utah.agclassroom.org/teachercenter/index.cfm?controller=main&action=lpsearch&lpID=497&searchGrade.gradeID=5&-searchSub.subjectID=2

http://www.seafriends.org.nz/enviro/soil/erosion2.htm

DIGGING DEEPER

- Repeat the experiment but have the distance from the paper to the eyedropper higher than 18 inches. Record your results.
- Repeat the experiment but use a 'turkey baster' instead of the eyedropper. Compare and contrast the results with the eyedropper.
- Create an experiment to show the effects of raindrops on soil that has vegetation or mulch covering the soil.

DID YOU KNOW?

- Rain is the largest cause of erosion.
- It has now been discovered that as the raindrops grow in size, both their speed and mass increase; thus, increasing the destructive results as the raindrop size increases.
- Since the late 1980's, rains have become heavier everywhere in the world, creating more destruction and erosion from the impact.

NUTRITION FACTS

- You could collect rainwater yourself and make drinking water. To make rainwater safer for drinking, you can do two things: boil it (to kill pathogens) or filter it (to remove chemical and contaminants).

LESSON 8 STANDARDS & LESSON MAP

NG: 4-PS3 Use evidence to construct an explanation relating the speed of an object to the energy of that object.

4-PS3-2. Observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.

ELA Writing W.4.3e Provide a conclusion that follows from the narrated experiences or events.

Speaking and Listening SL.4.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.

Math 4.MD.A.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.

Lesson 8: Power of a Raindrop

Day 1

- Procedure 1-2. Model 4-7 for students as they will be preforming experiment day 2

Day 2

- Procedure 3-7. Give students roles to keep it organized and quick

Day 3

- Procedure 8

Day 4

- Procedure 9-10

Day(s) ____

Math Graphing

Measurement using ruler

Day(s) ____

Literacy Drawing conclusions

Concluding statements from observation and class discussions

Day(s) ____

Science/Social Studies Extension Experiments to prevent erosion and water loss

Scientific Process Variables that affect outcomes of experiments

Dirt's Worth

Overview: Students discuss the value of soil, explore their connection to soil and demonstrate how erosion impacts our soil resources.

Grade Level: 3-8

Materials: The materials for these activities are found in the soil kit

* Cutting board
* Large apple (bring your own)
* Knife to cut the apple (bring your own)
* Glue
* Paper for flow charts
* Paper strips for chain
* Scissors (stored in a separate container)
* Soil (5 tsp. per group)
* Water (bring your own)
* eyedroppers
* rulers
*"Earth's Soil Resource" worksheet (make copies)
* Flow chart poster
*Splash zone target (on transparency sheets)
* Graph worksheet and Cost vs. Value worksheet (make copies back to back)
* "Soils on the Move and Erosion Control Practices worksheets (make copies back to back)
* "Soil is Important to Me" handout (make copies)
* Clip boards

Activity: This lesson contains three separate activities that can be done as a whole lesson or as three shorter, separate lessons. They can be done wherever students can gather for discussion. Activity 3, "Keeping Soil in its Place" requires a flat surface to work on. The soil pit area along the trail to the south of the shelter/fire pit serves as a nice backdrop for these lessons.

Activity 1 – "How Much is Dirt Worth" – Follow the directions on the activity sheet and have the students complete their graphs. This activity has a simple math extension.

Activity 2 – "The Soil Chain" – Follow the directions on the activity sheet. Use the flow chart poster to demonstrate how to make a flow chart, then have them make their own on separate sheets of paper

Activity 3 – "Keeping Soil in its Place" – Follow the directions on the activity sheet using the splash zone targets. Use the soil erosion handouts to discuss the different types of soil erosion and how soil erosion can be controlled.

Assessment/Extension:

* After any of these activities, have the students complete the "Soil is Important to Me" worksheet and discuss their reasons.
* Take a hike and look for examples of soil erosion.
* Back in the classroom, set up the soil erosion demonstration.

How Much Is Dirt Worth?

Hitting Pay Dirt

Objective

Students will appreciate topsoil and be able to communicate soils economic value.

Materials

- large apple
- knife
- cutting board
- Earth's Soil Resource pie chart activity sheet

Time

Activity 1: 15 minutes
Activity 2: 20 minutes

Adapted from materials provided by Oklahoma Agriculture in the Classroom.

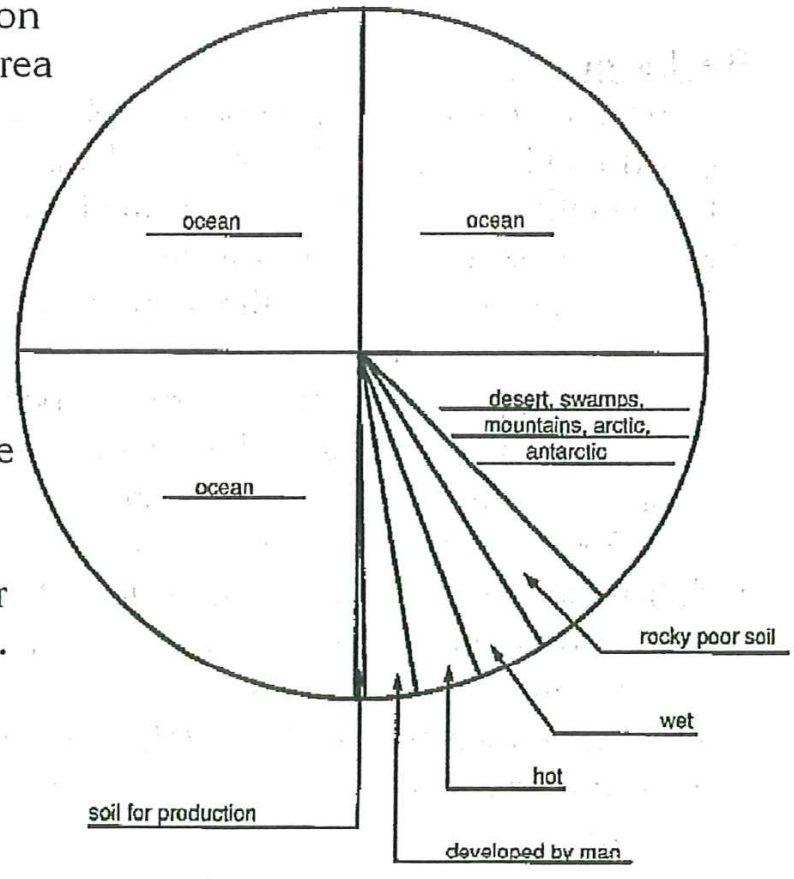
Teacher Preparation

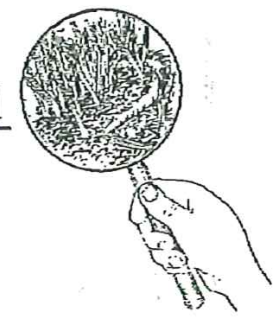
Gather materials, and make the necessary copies.

Procedures

Activity 1 - Slicing-up Earth's land resources.

1. Demonstrate the following: Imagine that the apple is planet earth.
2. Students should fill in their pie chart as you begin to tell them what each slice means.
3. Cut the apple in quarters. Oceans occupy 3/4 of our earth. One quarter of our earth is our land area. Take this quarter and cut it in half, now you have two 1/8th sections of land. One-eighth of our land is not suitable for producing food, this is the deserts, swamps, mountains and the Arctic and Antarctic regions. The other eighth represents land where people can live. Slice this 1/8th section lengthwise into four equal parts. Now you have four 1/32nd of an apple. The first section represents the areas of the world which have rocky soil that is too poor for any type of food production. The next two sections represents land that is too wet or too hot for food production. The fourth section represents the area of the world developed by man. Carefully peel the last 1/32nd section. This small bit of peeling represents all the soil of our earth which humans depend upon for food production.





Activity 2 - Cost versus Value

1. After reading the background material. Demonstrate the following problem and scenario on the board:

   Let's say you have 1 acre of land and 7 inches of topsoil. If every inch is worth $10.00 (working with round numbers make the math a bit easier) your topsoil would be worth $70.00.

2. Because of erosion you lose 1/2 an inch of topsoil each year. How much in dollars would you be losing each year? ($5.00 of topsoil from an acre).
3. What is your topsoil now worth? ($65.00)
4. Discuss what other losses would occur. (Because of lost topsoil, crops will not be as productive and your income would go down. You've lost topsoil and money!)
5. At your current rate of topsoil loss, how many years will go by before all 7 inches of topsoil are gone? (14 years)

Discussion

1. Since soils provide our food, how is it we can place a value on them?
2 What is an acre of pristine farmland worth?
3. How do we decide what to pay for an acre of land?
4. What can you do to minimize the loss of topsoil?

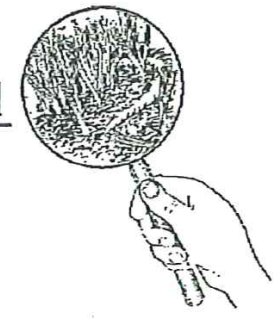
Background

Agriculture is the nations largest employer. Roughly 20 out of 100 people rely on farms and farming for their livelihood. The United States exports more farm products than any other country in the world. It costs the farmer more to produce good crops on poor soil and this cost is passed on to the consumer "you" in higher prices at the grocery store.

Look at the economics or the money earned by our productive soils. Soils produce our food, keeping us alive. How do we place a value on human life? Food production or agriculture employs 20 out of every 100 people in the United States. Agricultural exports are translated into billions of dollars for United States trade. The soils on this planet are essential to our survival! Good soils are a limited resource and because it takes an average of 100 to 500 years to make 1 inch of topsoil, soil is considered a nonrenewable resource. It is difficult to place a value on our soils. The best thing to do is conserve what we have. Soil loss or erosion effects our country's economics and our lives.

Famine and economic depression is the end result of lost topsoil. So good farmers use conservation measures such as ***strip cropping***, crop rotation, grassed waterways, wind breaks, ***cover crops***, contour planting, terracing, and other methods to control wind and water erosion.

Dirt: Secrets in the Soil



In Utah 5 tons of topsoil is lost each year. What does this mean? Some of our most productive soils are being lost each year. We have slowed erosion over the past 30 years, but we are still losing some of our topsoil. Fertile topsoil is what gives us higher yields or more food per acre. What will we do when our topsoil is gone? Farm the subsoil and get lower yields? That's a possibility, but that is why agricultural scientists are working hard to find out how we can sustainably grow and produce food. This area of agricultural research is called sustainable agriculture. ***Sustainable agriculture*** involves studying methods and practices to keep topsoil in its place, increase soil fertility, and use lower energy inputs to produce our food. Soil is important economically and for our very survival!

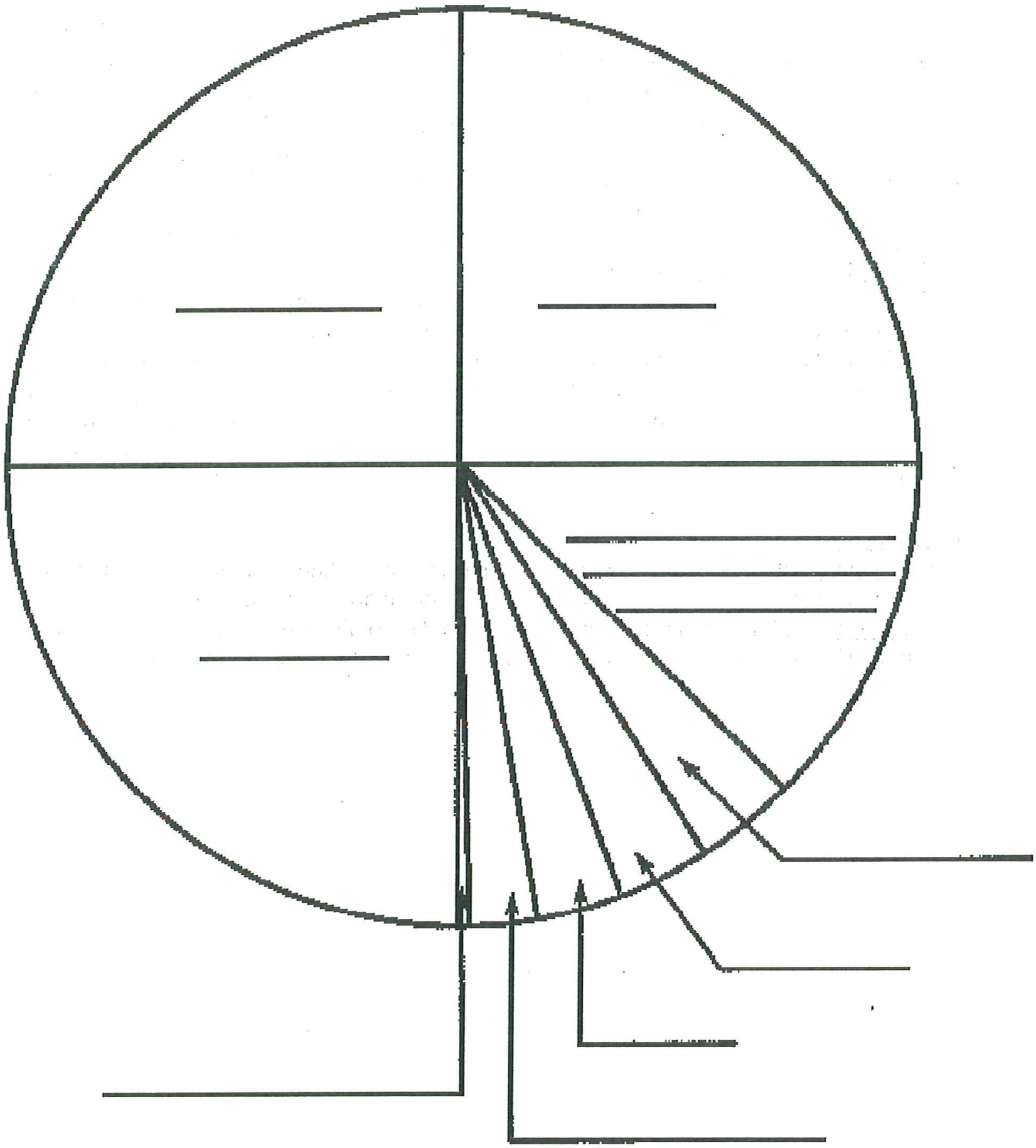
Some good news, half a ton of topsoil is made each year. Topsoil loss is greater than our gain, but farmers buy time with conservation methods. We still lose topsoil, just at a slower rate. The goal of farmers and researchers is to find methods whereby we lose no more topsoil than what is made. Sustainable practices such as adding compost, managing cover crops, and no-till (tillage) farming are methods currently being used and studied to save our topsoil. But really, how can we put a value on soil or land, it's kind of like placing a value on human life.

Vocabulary

Strip cropping: planting crops in strips, several rows, alternating with other crops that have a different root type. Fibrous roots hold the soil better than crops with tap roots.

Cover crops: land that is planted with a fibrous root crop (like clover, various grasses, vetch, etc.) that will hold soil and is usually a legume that will add nitrogen to the soil.

Earth's Soil Resources



The Soil Chain

It's Your Food Dude!

Objectives

Students will be able to identify their relationship to the soil.

Students will be able to draw a flow chart from common objects to soil.

Materials

- paper
- pencils
- stapler or glue
- scissors
- paper for chain
- flow chart transparency

Time

Activity 1: 60 minutes
Activity 2: 30 minutes

Getting Started

Gather materials.

Procedures

Activity 1- My Soil Family

1. Show the students the list of 30 objects on page 3. For a variation, you may ask students to help you make a list of 30 objects, things they use everyday.
2. Ask them to pick five of the objects (or more) and using a flow chart, like the one on the bottom of the transparency, "link" the objects back to the soil. (A flow chart uses lines and arrows to show the relationships or direction of flow between an object or group of objects.)
3. Many of the objects will be linked back to the soil. Some may not. That's okay. The transparency depicts two of the more difficult objects students may choose to link the soil.
4. After the students have completed their flow charts, have them select one object (or pick a new one) to create a soil chain. Instruct students to cut out strips of paper that will become links in a chain. Each link should be labeled as one of the "connections" showing the objects relationship to the soil. You might challenge students to create the longest chain and the shortest chain. Note: It is easier to label the links before the ends are stapled or glued together to make the chain.

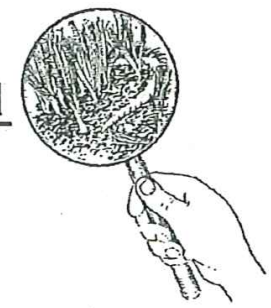
Activity 2- Ranking the Importance of Soil

1. Show the students statements on the transparency master on page 4. Ask them to rank the statements in order of importance.
2. Form groups of five or six students and ask the groups to rank the statements. Ask them to be prepared to explain why they ranked them in that order.

Discussion

1. What can you conclude about the role of soil in your life?
2. What would life be like without soil?

Dirt: Secrets in the Soil



Background

Soil is one of our most useful natural resources. From the soil we get food, clothes and materials for the houses we live in. From gardens and truck farms we get vegetables. Fruit grown on trees and vines come from orchards, groves, and vineyards. Trees also give us valuable lumber and the wood can also be used to make paper, paints and numerous other products. Planted field crops of wheat and corn are used for making flour to make our bread, crackers, pasta, and so many other foods. Nuts and berries come from our farms and forests.

Our animal food also comes from the soil. Cows eat grass, hay, silage, and grain to produce milk, meat, and leather products. All animals eat plants; plants grow in the soil. In addition to the products listed above, animals supply us with by-products that are used in paints, camera film, pet food, rubber, crayons, lotions, soaps, leather, medicines, and, the list is long.

The fuel that warms our houses comes indirectly from the soil. Coal is made from plants that grew ages ago. Oil and gas also originate from organic materials, possibly including the remains of animals. Some of these things grew in the soil at one time or lived on things that grew in the soil.

Fish from the sea, rivers and lakes live on plants (some on other fish). And these plants require dissolved minerals that are washed into the sea, rivers, and lakes from the soil.

There are a few exceptions to linking things back to the soil. Here are a few examples: a volcano, the ocean (even though plants are part of the water cycle), and the sky (although plants give off oxygen for the air in the atmosphere).

Vocabulary

soil: Particles of minerals, organic matter (plant and animal), water, and air; that is found on most surfaces of the land.

dirt: misplaced soil, i.e., soil on your clothes, your kitchen floor, and under your fingernails is called dirt.

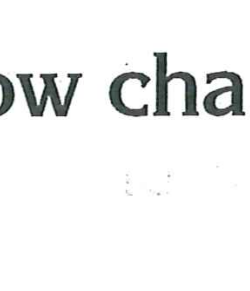
Draw a flow chart back to the soil for...

butter
wool blanket
ice cream
leather shoes
electricity
vegetable oil
farmer's bank account
well water
chocolate cake
glass plate

plastic cup
book
brick house
skateboard
toothbrush
turkey sandwich
egg
blue jeans
candy bar
bicycle

table
bubble gum
baseball
pickle
cereal
rope
road
apple
soda pop
pencil

plastic jug ⇨

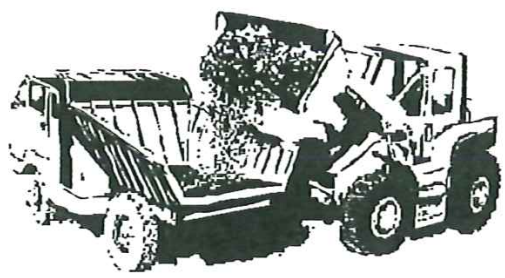


oil extraction ⇨

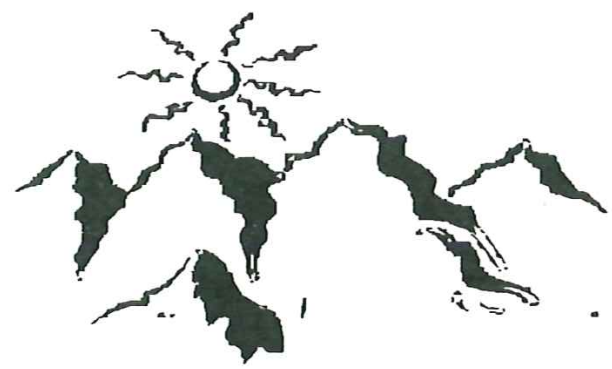
old decay of plants & animals ⇨

oil under layers of rock & old soil

bicycle, metal ⇨



extracted from rocks ⇨



weathered rocks become soil

Rank the following statements in order of their importance. Be prepared to explain why you ranked them in that order.

Soil is important to me (or us)...

___ a) to grow plants (for food, oxygen, paper, lots of things).
___ b) to filter out pollutants that may contaminate drinking water.
___ c) to provide income for farmers, food companies, clothing companies and grocers, to name a few.
___ d) as a surface for building roads, sidewalks, and the places where we live.
___ e) to provide food for livestock.
___ f) to walk on.
___ g) to provide wildlife and insect habitat.
___ h) . . . make up your own

Keeping Soil in Its Place

Slip Slidin Away

Objectives

Students will be able to demonstrate rain drop splash or splash erosion, and determine its impact on bare soil.

Students will be able to visually identify types of erosion.

Materials

- Splash Zone Target (these could be made on a transparency, this way they could be washed and used year after year)
- Graph handout
- Soils on the Move handout
- 5 teaspoon of dry soil
- eyedroppers
- water
- rulers
- Erosion Control Practices transparency
- Soil on the Move transparency

Time

Activity 1: 40 minutes
Activity 2: 20 minutes
Activity 3: 20 minutes

Getting Started

Gather materials, and make the necessary copies.

Procedures

Activity 1 - Splash Zone

1. Divide the class into five groups.
2. Give each group a Splash Zone Target, eyedropper, and a small container of water.
3. Instruct student to put enough soil (about a teaspoon of dry soil) in the center of their target to just cover the center circle.
4. Fill the eyedropper with water
5. Hold the eyedropper about 12 inches (30 cm) above the soil sample.
6. Drop 5 drops of water directly onto the soil sample. If a drop misses the soil, continue until 5 drops hit the soil.
7. Record the number of water "splashes" drops containing soil in each zone.
8. Complete the graph to show your results.
9. Discuss questions in Discussion section before moving on to Activity 2.

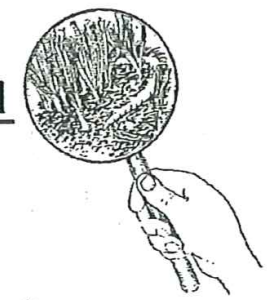
* *You may want to repeat this activity with drops from 1 meter high. Also try the activity with wet soil.*

Activity 2 - Soils on the Move

1. Introduce students to the types of erosion using the erosion section in the "*Dirt:* Secrets in the Soil" video and the background information.
2. Provide each student with a copy of the "Soils on the Move" handout or make a transparency.
3. Label the handout or transparency. Discuss how each type of erosion differs.

Activity 3 - Methods for Controlling Soil Erosion

1. Introduce students to the methods for controlling erosion using the erosion section in the "*Dirt:* Secrets in the Soil" video and the background information. You could also duplicate the demonstration using the erosion trays "turkey pans" in the video.



2. Student should complete the Erosion Control Practices activity sheet, or use it as a transparency for discussion.
3. Discuss the various methods and why they are used.
4. Answers: 1) streambank erosion, 2) gully erosion, 3) wind erosion, 4) rill erosion, 5) sheet erosion.

Discussion

1. What did you observe? How did the soil particles move from the center of the target? (they were picked up and moved with the water)
2. Which zone contained the most number of water drops with soil particles? Why?
3. Which zone contained the least number? Why?
4. What would happen if the drops were larger? (splashes would travel further)
5. How might you prevent splash erosion? (plant vegetation, cover the soil with mulch)
6. How do farmers decide which erosion control methods to use? (it depends on the slope, soil types, and what he or she wants to plant)

Background

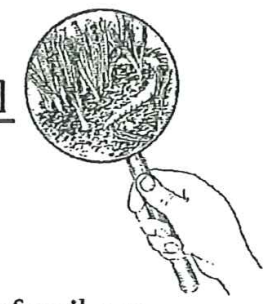
Erosion is a naturally occurring process. Erosion has given us some of our most beautiful landscapes. There are beautiful erosion formations such as the Grand Canyon, Kolob Canyon (Zion National Park) the San Rafael Swell (Emery County) or Bryce Canyon, to name a few. Erosion is the loosening, transportation and relocation of soil particles from one place to another. Erosion occurs primarily due to the action of wind and water. The rate and extent of erosion are determined by soil type and condition, slope of the land, plant cover, land use and climate.

Erosion does not occur only on wilderness landscapes, and the effects are not always positive, especially when you are talking about productive topsoil. Landslides, can bury towns and claim thousands of lives. Streams or rivers loaded with eroded soil can turn sources of clean drinking water into major health hazards.

Water erosion includes raindrop splash, sheet erosion, rill erosion, gully erosion, and slumping or mass erosion. ***Raindrop splash*** is the most obvious on bare ground during a torrential rainstorm. The raindrops strike the ground and upon impact break soil particles apart, splashing these particles into the air. The impact of raindrops can be lessened by plant cover. Plants break the fall of the raindrops and allow for water infiltration or percolation.

Sheet erosion is the washing away of a thin surface layer of soil over a large area of land. Because sheet erosion occurs evenly, it is generally not obvious until most of the topsoil is removed.

Rill erosion may be noticeable on sloping bare ground after a rainstorm. Water forms small, well defined channels that carry soil away from the sides and bottom of these channels. The rills of channels erode more soil as they move downslope and increase in size.



When rills become large, the process is called gully erosion. This severe form of soil erosion removes tones of soil from the sidewalls and bottom of the gully.

Streambank (and coastal erosion) erosion is the cutting away of the banks by water. It is generally a slow process which represents the normal situation occurring along most streams. It is most active during floods when the amount and velocity of water are the greatest and when the bank soils are submerged under water and saturated.

To control erosion plant cover is usually the best solution. But to grow our food farmers make ***furrows*** in the land for ***row crops***. A farmer can use a variety of methods to "keep soil in its place." A farmer may plant his of her crops around the curve of a hill rather than up and down the hill, this is call ***contour planting***. Plowing will also be done on the contour. Farmers may also build ***terraces***. Terraces are wide ridges that go around a hill to prevent water from rushing down the hill too fast. On steep hillsides, rather than clear the area for cropland, farmers will maintain the area in ***forest and grass***. Water always runs down hill, farmers do not plow in these low areas where water collects, instead they maintain these low ditch areas as ***grassed waterways***.

Soils susceptible to wind erosion should be kept covered with some kind of vegetation. If this cannot be done year-round, a ***windbreak*** of trees and shrubs may be planted. Windbreaks are rows of trees planted to slow down the wind and prevent soils from blowing in the wind.

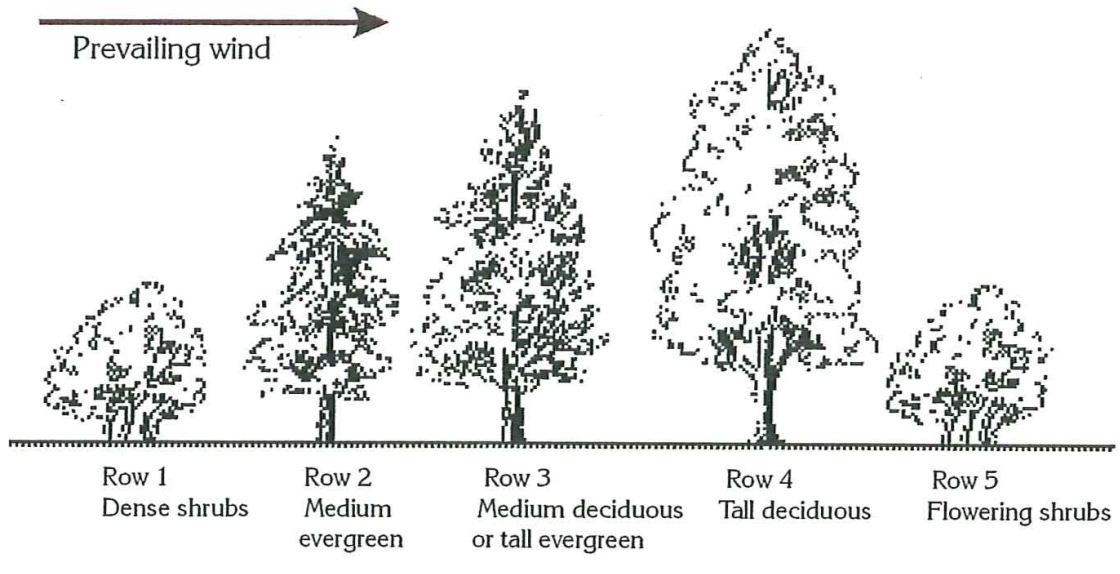
Vocabulary

mulch: a covering placed on bare soil to keep it from eroding, loose leaves, straw, bark chips etc.

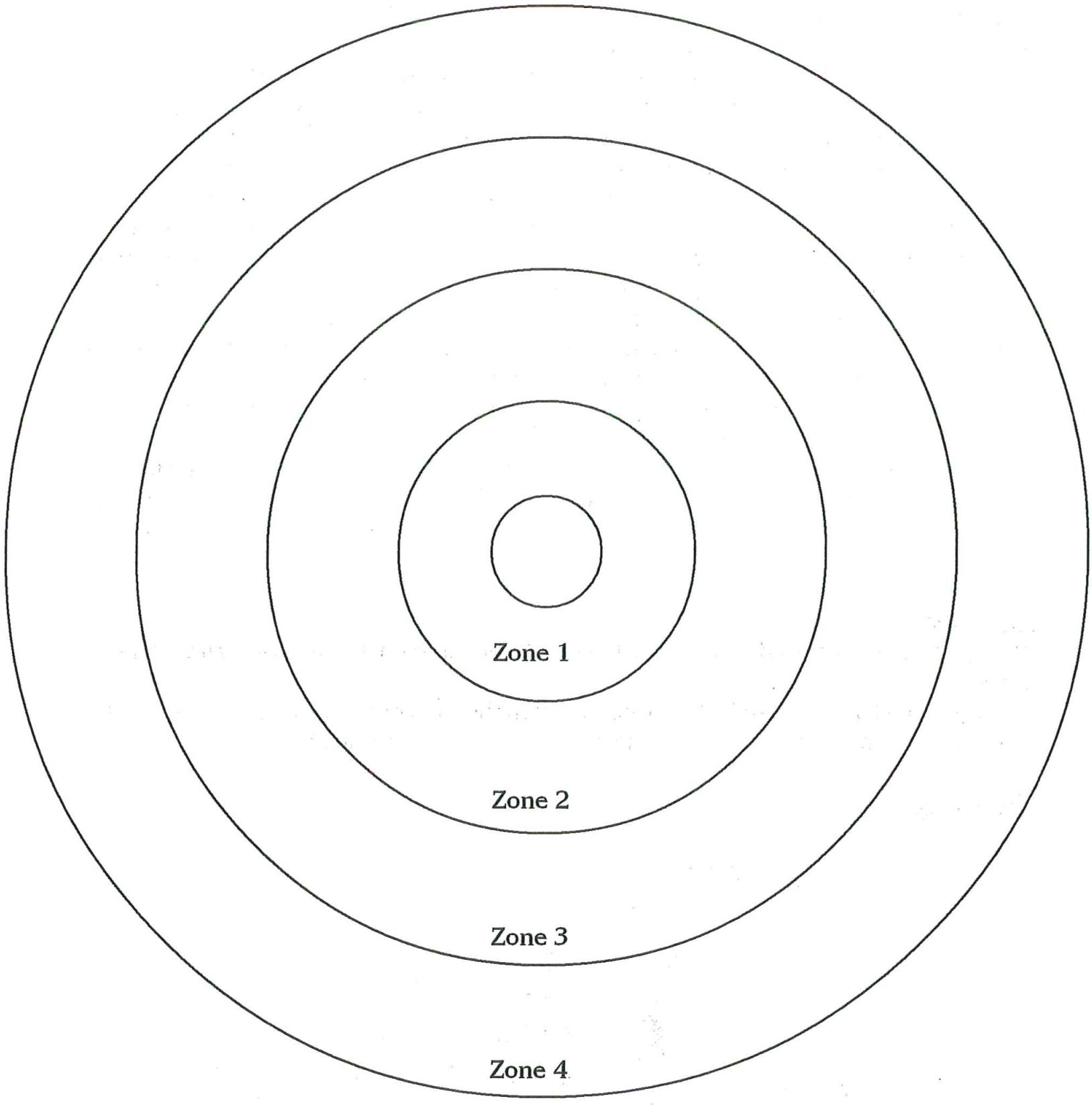
furrows: small ditches (2-6 inches deep) between the rows of plants used to convey water.

row crops: plants planted in a row to facilitate harvesting and watering.

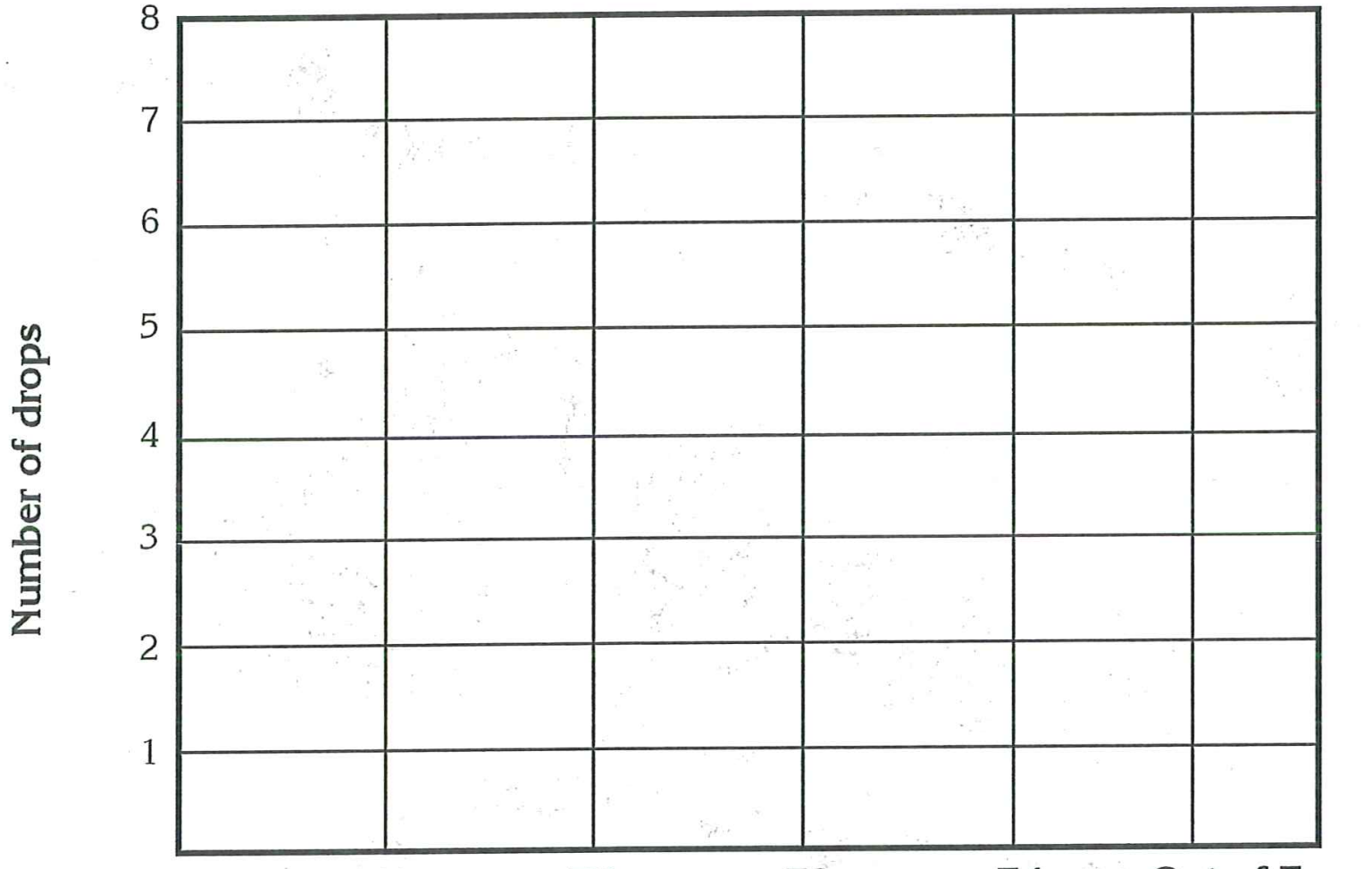
Windbreak



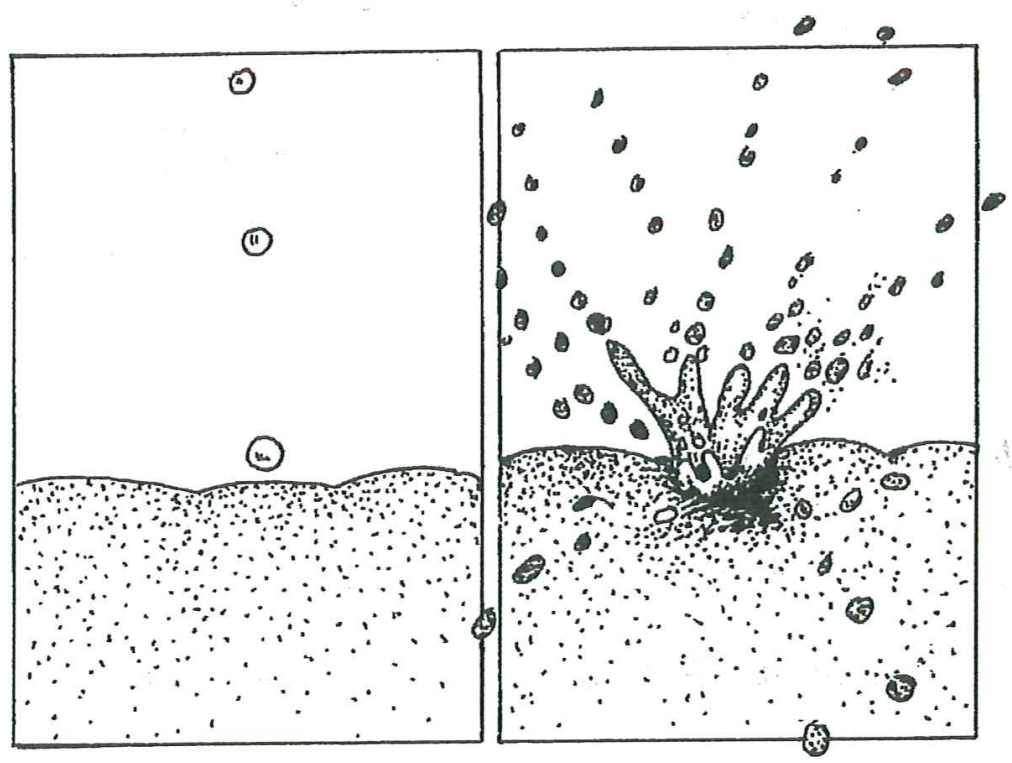
Splash Zone Target



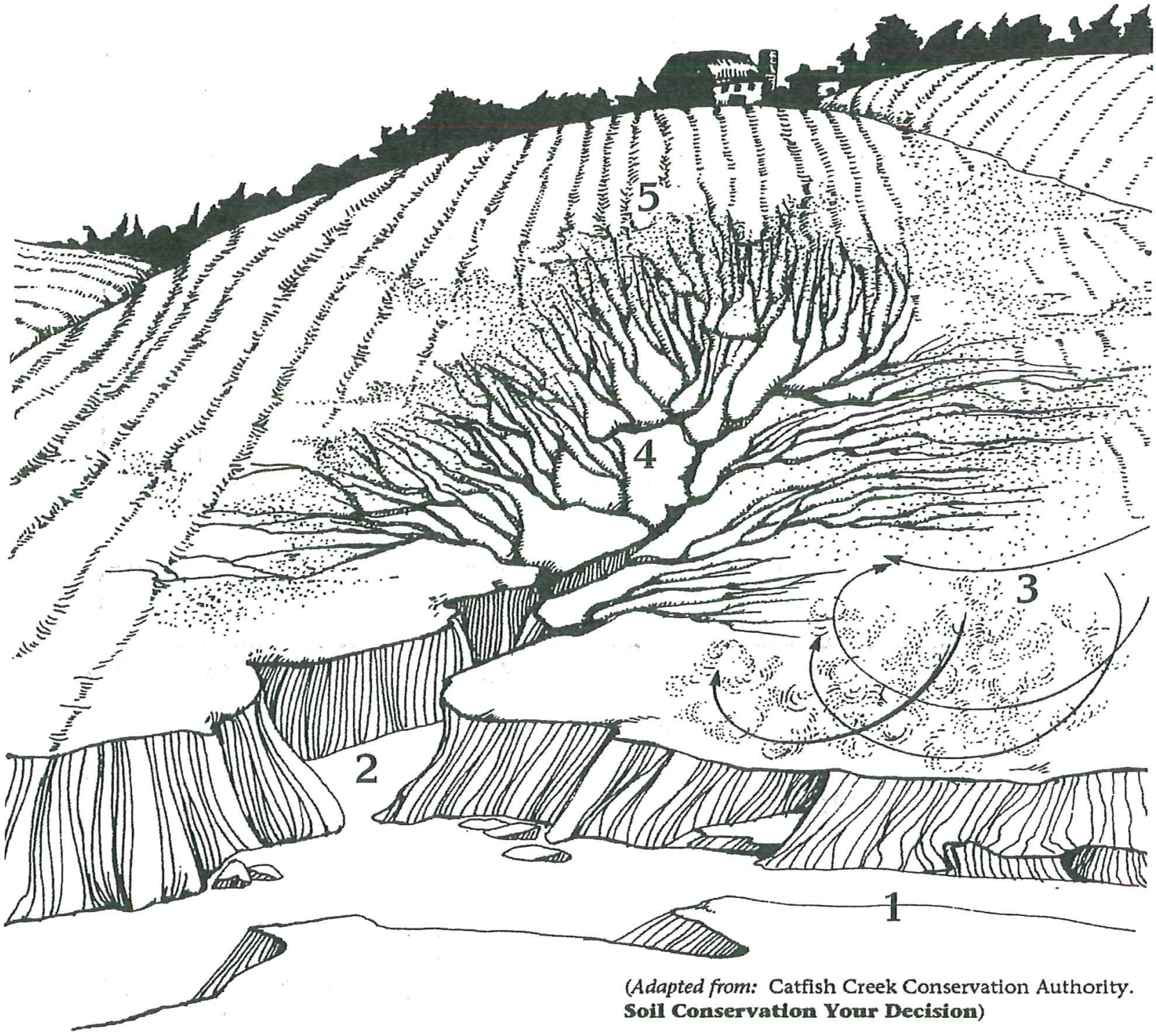
Splash Zone Graph



Raindrop splash



Soils on the Move



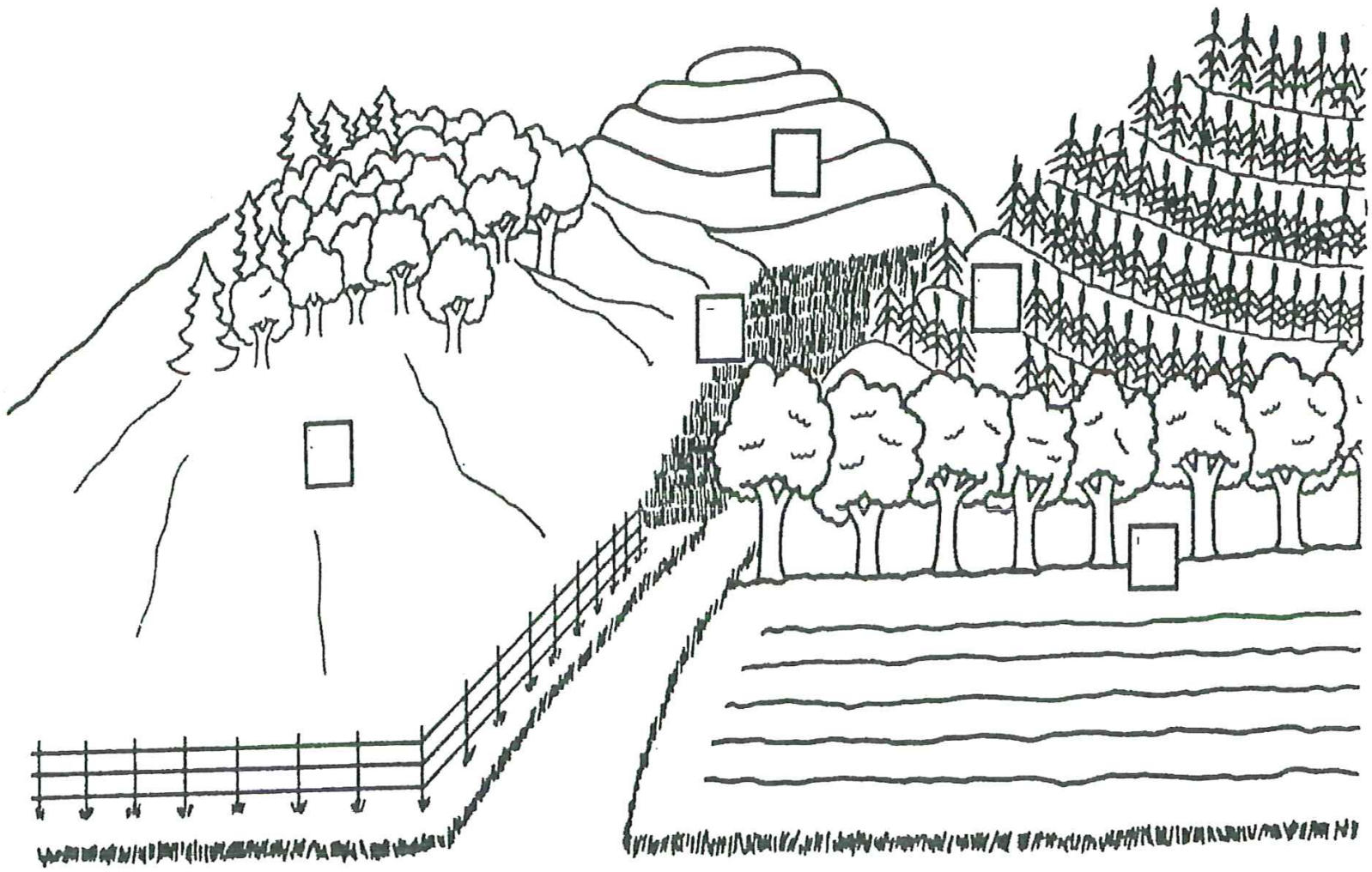
(*Adapted from:* Catfish Creek Conservation Authority. **Soil Conservation Your Decision**)

Identify which area is:

____ wind erosion ____ gully erosion ____ rill erosion

____ streambank erosion ____ sheet erosion

Erosion Control Practices

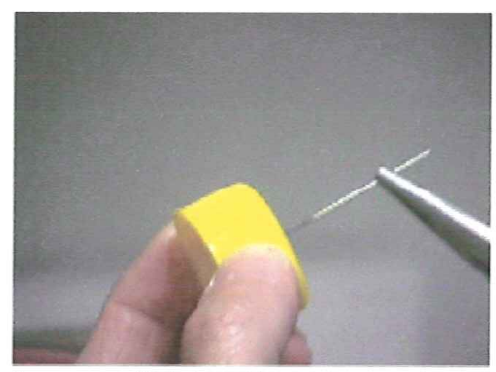


Farmers use several methods to conserve soil. Match the number of practices below in the correct box in the picture.

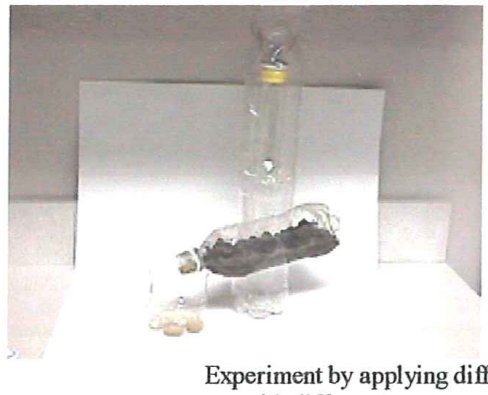
1. **Contour Planting:** plant crops around the curve of a hill rather than up and down the hill.
2. **Terraces:** wide ridges that go around a hill to prevent water from rushing down the hill too fast.
3. **Forest and Grass Areas:** keep steep hillsides in trees or grass rather than clear for cropland.
4. **Grassed Waterways:** plant grass and don't plow low areas in a field where water usually runs.
5. **Windbreak:** rows of trees planted to slow down the wind and prevent soils from blowing.

Soil Erosion Demonstration


Fill plastic bottles with "hot" water and peel the labels off.

Cut bottles to make the erosion model and pierce cap with hot needle.

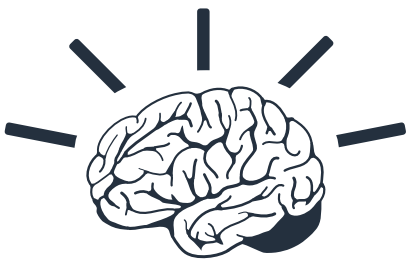



Experiment by applying different mulches to the surface or by using soils with different percent organic matter. (Garden vs. Forested Soils)


Soils high in organic matter and soils covered with mulch will yield

Lesson Nine

Soil Erosion



BRAIN BREAKS!

1. Plant Partners Teacher will give class a plant part (seed, root, stem, leaves, flower). Students turn to a partner and go back and forth naming vegetables harvested from that part of the plant. Repeat until partners can no longer name vegetables from that plant part.

2. Apple, Watermelon, Banana (rock, paper, scissors) Students play rock, paper, scissors replacing rock with apple, paper with watermelon and scissors with banana. Play as many rounds as possible in given time frame.

3. Garden Taboo Teacher plays music. When music stops students pair up. Teacher calls out a garden topic such as fruit. Partner A has to describe any fruit they want to their partner without saying the name. Partner B has to try and guess what their partner is describing.

4. Syllable Snacks Teacher will call out a number (1-4). Students work with a partner to come up with garden vocabulary words that contain that number of syllables. Partner A will begin by naming a vocabulary word with the given number of syllables; partner B will go next. They will alternate until one partner can no longer name a vocabulary word with the given number of syllables.

5. Fruit/Veggie Knock Students will work with a partner and touch knuckle to knuckle (veggie) and palm to palm (fruit) in a given sequence. Teacher will name the sequence to the class (Ex: veggie, veggie, fruit) and students will have to use the given hand gestures to complete the sequence. Teacher will increases the number of movements with each round (Ex: Round 1-veggie, veggie, fruit. Round 2-fruit, veggie, veggie, fruit).

6. Fruit/Veggie Match Students will stand. Teacher will name a fruit or vegetable and students will have to touch that part of the body corresponding to the part of the plant that the fruit or vegetable grows from (roots-feet, stem-legs, leaves-body, flowers-head). Teacher will call out and play the game “Simon says” going a little faster with each round.

7. Plant Part Finger Hop Students touch thumb to thumb, pointer to pointer, middle to middle, ring to ring, pinkie to pinkie as they say the plant part finger hop chant (seeds, roots, stems, leaves, flowers). Teacher will randomly call out a plant part, students will have to touch the corresponding fingers. Teacher will repeat, increasing the pace with each round.

8. The Harvester Students will stand and squat (harvest) with a shovel in hand. They will shovel the dirt over alternating shoulders like a farmer. Students will work at their own pace “harvesting” for the given time frame.

9. Apple Squat Students will stand and begin by squatting. They will then stand up on one foot, hop twice saying “apple, apple” then return to a squat. Repeat with increasing speed each round and alternating feet.

10. Fruit Freeze Teacher will randomly call out different fruits and vegetables. If the teacher calls out a veggie, students have to jog (or march) in place, if teacher calls out a fruit, students have to freeze.

11. Garden Guess Students will work with a partner. Partner A will silently think of a fruit or vegetable. Partner B can ask three questions about what their partner is thinking. After three questions, partner B has to guess the fruit or vegetable. They will then switch roles, and partner B will silently think of a fruit or vegetable and partner A gets to ask questions and guess. Repeat as many times as possible in the given time frame.

OVERVIEW

Students will explore the effects of water/rain on the surface of the Earth.

OBJECTIVES

- Students will learn how water affects the surface of the Earth.
- Students will be able to demonstrate how rain impacts soil.
- Students will be able to visualize erosion.

STANDARDS

Nevada State Standards

E.5.A.2 Evaluate the interactions between processes in the water cycle.

Next Generation Standards:

4-PS3-3 Ask questions and predict outcomes about the changes in energy that occur when objects collide.

4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

4-ESS2-2 Analyze and interpret data from maps to describe patterns of Earth's features.

TEACHER INFORMATION

Erosion is the moving of the surface of the Earth by natural forces (water or wind). Water is the most powerful force of erosion. 25% of the rainfall on land goes into rivers, streams, lakes or oceans. The water erosion carving the countryside as it moves carries nutrients, soils and rocks. Many times you can see examples of erosion near rivers. One of the best examples of water erosion is the Grand Canyon. Years of water erosion have created this spectacular site.

TIME

4–6 30 minute sessions.

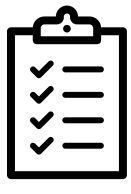
QUESTION:

- How does water change our landscape?
- Does the surface of the soil affect the amount of soil erosion?
- What type of surface helps to deter erosion?

MATERIALS

For each group (groups of 3-5 students)

- Aluminum casserole pan (for example: 14 x 9 x 3)
- Soil
- Paper cups (2 per group)
- Pencil
- Small plastic lid (for example: yogurt/cottage cheese/margarine top)
- Water
- Leaves/twigs/grass
- Science Journals



PROCEDURES

- Day 1

1. After the students answer one or all of the above questions in their science journals, have the students share their answers within a small group (3-5 students).

2. Have each small group decide which answer(s) they will share with the entire classroom.

- Day 2

1. Give each small group an aluminum pan, water, paper cup and plastic lid. Teacher will instruct the groups to create a landscape using the soil. (The students might need to add water to the soil to create hills/mountains/etc.)

2. Each group will draw their landscape in their science journal.

- Day 3

1. Once the landscapes are completed, have each small group show the rest of the group their landscape.

2. Teacher will instruct the groups to punch holes in the bottom of their paper cups using the tip of their pencil.

3. After the cups have been completed, the students will cover the bottom of their paper cups with the plastic lid. One group member will then fill the paper cup ½ full while another member of the group will hold the plastic lid under the cups preventing the water from running out.

4. Students will then hold the cup over their landscape, remove the plastic lid and watch what happens to the created landscape as the ‘rain’ falls over the land scape.

5. Students will observe and record the results.

- Day 4

1. Students can recreate the landscapes, but this time the groups can add leaves, twigs, and grass into the landscape.

2. Students will repeat the process of 'raining' on the landscape.

3. Students will observe and record data in their science journals.

4. Teacher will then lead a whole group discussion on observations and conclusions.

ASSESSMENTS

Participation in the small group and science journal entries

ADAPTATIONS

- Students can create a topographical map of the landscape they created.
- Students can observe the school playground for areas that show signs of erosion. Have them suggest a way to solve the erosion problem.
- Have the groups create the landscape as above and then each group will tilt the pan up by 2 inches, then 3 inches and higher. Punch a hole with the pencil in the pan on the side that is the lowest. Place a bowl under that side of the pan to catch the runoff. What are the results?
- Students can research the making of the Grand Canyon.
- Students research other landforms that have been the result of erosion.
- Students research other forms of erosion.
- Students research topographical maps of the area.

Complete the following experiment from the Mojave Desert Discovery

- Materials: Sand, hard plate or pan, 3 quarters, water

WATER:

1. Make a mound of sand (two inches deep in the center) on a flat plate.

2. Place three quarters on top, about one inch apart.

3. Place out in the rain or make your own with a sprinkler from above.

4. Note what happens to the sand.

WHAT HAPPENED AND WHY?

The quarters act like very hard rocks on less resistant stone. A cap rock protects the layers beneath from erosion so that *hoodoos*, pinnacles, and other strange shapes are made.

EXTENDING THE EXPERIENCE: Ask students to look for evidence of erosion in their neighborhoods. It can involve an entire mountain or just a square inch.

DIGGING DEEPER

- Students can create a topographical map of the landscape they created.
- Students can observe the school playground for areas that show signs of erosions. Have them suggest a way to solve the erosion problem.
- Have the groups create the landscape as above and then each group will tilt the pan up by 2 inches, then 3 inches and higher. Punch a hole with the pencil in the pan on the side that is the lowest. Place a bowl under that side of the pan to catch the runoff. What are the results?
- Students can research the making of the Grand Canyon.
- Students research other landforms that have been the result of erosion.
- Students research other forms of erosion.
- Research topographical maps of the area.

DID YOU KNOW?

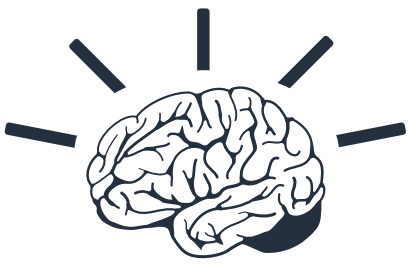
- Desert rock formations like arches and hoodoos are shaped over time by weather, wind, and water. A natural arch is formed when water or weather hollows out a cliff. A hoodoo takes shape when a soft rock layer is deposited under a hard one. The soft layer below erodes first, leaving a big top.
- Water is the most powerful force of erosion. 25% of the rainfall on land goes into rivers, streams, lakes or oceans.

NUTRITION FACTS

- Different regions of the US are well known for producing different crops. For example, California is well known for its milk and almonds, Washington for its apples, Florida for its oranges, and Iowa for its corn.

Lesson Ten

Mapping It Out



BRAIN BREAKS!

1. Plant Partners Teacher will give class a plant part (seed, root, stem, leaves, flower). Students turn to a partner and go back and forth naming vegetables harvested from that part of the plant. Repeat until partners can no longer name vegetables from that plant part.

2. Apple, Watermelon, Banana (rock, paper, scissors) Students play rock, paper, scissors replacing rock with apple, paper with watermelon and scissors with banana. Play as many rounds as possible in given time frame.

3. Garden Taboo Teacher plays music. When music stops students pair up. Teacher calls out a garden topic such as fruit. Partner A has to describe any fruit they want to their partner without saying the name. Partner B has to try and guess what their partner is describing.

4. Syllable Snacks Teacher will call out a number (1-4). Students work with a partner to come up with garden vocabulary words that contain that number of syllables. Partner A will begin by naming a vocabulary word with the given number of syllables; partner B will go next. They will alternate until one partner can no longer name a vocabulary word with the given number of syllables.

5. Fruit/Veggie Knock Students will work with a partner and touch knuckle to knuckle (veggie) and palm to palm (fruit) in a given sequence. Teacher will name the sequence to the class (Ex: veggie, veggie, fruit) and students will have to use the given hand gestures to complete the sequence. Teacher will increases the number of movements with each round (Ex: Round 1-veggie, veggie, fruit. Round 2-fruit, veggie, veggie, fruit).

6. Fruit/Veggie Match Students will stand. Teacher will name a fruit or vegetable and students will have to touch that part of the body corresponding to the part of the plant that the fruit or vegetable grows from (roots-feet, stem-legs, leaves-body, flowers-head). Teacher will call out and play the game “Simon says” going a little faster with each round.

7. Plant Part Finger Hop Students touch thumb to thumb, pointer to pointer, middle to middle, ring to ring, pinkie to pinkie as they say the plant part finger hop chant (seeds, roots, stems, leaves, flowers). Teacher will randomly call out a plant part, students will have to touch the corresponding fingers. Teacher will repeat, increasing the pace with each round.

8. The Harvester Students will stand and squat (harvest) with a shovel in hand. They will shovel the dirt over alternating shoulders like a farmer. Students will work at their own pace “harvesting” for the given time frame.

9. Apple Squat Students will stand and begin by squatting. They will then stand up on one foot, hop twice saying “apple, apple” then return to a squat. Repeat with increasing speed each round and alternating feet.

10. Fruit Freeze Teacher will randomly call out different fruits and vegetables. If the teacher calls out a veggie, students have to jog (or march) in place, if teacher calls out a fruit, students have to freeze.

11. Garden Guess Students will work with a partner. Partner A will silently think of a fruit or vegetable. Partner B can ask three questions about what their partner is thinking. After three questions, partner B has to guess the fruit or vegetable. They will then switch roles, and partner B will silently think of a fruit or vegetable and partner A gets to ask questions and guess. Repeat as many times as possible in the given time frame.

OVERVIEW

Students will draw a map showing how sun, water, and wind pass through the school garden.

After reading a spotlight on cartographer John C. Fremont, students will explore the differences between physical and topographical maps by looking at both contemporary and historical maps of Nevada.

OBJECTIVES

- Students will draw a map of the school garden.
- Students will read a non-fiction article to gather information about John C. Fremont and the historical places in southern Nevada.
- Students will locate places mentioned in the article on contemporary satellite maps of Nevada.

STANDARDS

Nevada State Standards

NV State Social Studies

H2.4.3 Identify explorers and settlers in pre-territorial Nevada.

G5.4.2 Identify spatial patterns on a map of NV, i.e. deserts, mountains, and population.

G5.4.4 Utilize different types of Nevada maps, i.e. population and physical maps, to understands spatial distribution.

G6.4.1 Describe the distinguishing features of historical regions in NV, i.e. Native American tribal territories, pioneer trails, and settlement areas.

G 8.4.1 Describe ways physical environments affect human activity in Nevada using historical and contemporary examples.

Next Generation Standards:

4-ESS1-1Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in landscapes over time.

4-ESS2-2 Analyze and interpret data from maps to describe patterns of Earth's features.

ELA Common Core

CCSS.ELA-LITERACY.RI.4.5 Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.

TEACHER INFORMATION

Summary of the five geographic concepts (adapted from the USGS website recommendations for Educators at http://usgs.gov)

The five geographic concepts developed by the Joint Committee on Geographic Education of the National Council for Geographic Education and the American Association of Geographers are articulated in Guidelines for Geographic Education, Elementary and Secondary schools.

The five concepts represent the types of questions geographers use as they strive to understand and define the Earth—for geography provides us with a system for asking questions about the Earth.

1. Location: position on the Earth's surface.

Look at a map. Where are places located? To determine location, geographers use a set of imaginary lines that crisscross the surface of the globe. Lines designating "latitude" tell us how far north or south of the equator a place is. Lines designating "longitude" measure distance east and west of the prime meridian—an imaginary line running between the North Pole and the South Pole through Greenwich, England. You can use latitude and longitude as you would a simple grid system on a State highway map. The point where the lines intersect is the "location"—or global address.

2. Place: physical and human characteristics

Every place has a personality. What makes a place special? What are the physical and cultural characteristics of your hometown? Is the soil sandy or rocky? Is the temperature warm or is it cold? If it has many characteristics, which are the most distinct?
How do these characteristics affect the people living there? People change the character of a place. They speak a particular language, have styles of government and architecture, and form patterns of business. How have people shaped the landscapes?
Help children understand their own neighborhood. Point out differences and similarities to other places. Help children understand various types of buildings and their uses. Are their features built to conform to the weather or topography? Do the shapes of some buildings indicate how they were used in the past or how they are used now?
Show children the historical, recreational, or natural points of interest in your town. What animals and plants live in your neighborhood? If you are near a national park, a lake, a river, or a stream, help children understand how it has affected the character of your town.

3. Relationships with places: humans and environments

How do people adjust to their environment? What are the relationships among people and places? How do they change it to better suit their needs? Geographers examine where people live, why they settled there, and how they use natural resources. For example, Hudson Bay, the site of the first European settlement in Canada, is an area rich in wildlife and has sustained a trading

industry for hundreds of years. Yet the climate there was described by early settlers as “nine months of ice followed by three months of mosquitoes.” People can and do adapt to their natural surroundings.

4. Movement: people interacting on Earth

People are scattered over the Earth. How do they get from one place to another? What are the patterns of movement of people, products, and information? Regardless of where we live, we rely upon each other for goods and information. Most people interact with other places almost every day. We depend on other places for food, clothes, and even items like pencils. We share information with each other using telephones, newspapers, radio, and television to bridge the distances.

5. Regions: how they form and change

How can places be described or compared? How can the Earth be divided into regions for study? Geographers categorize regions in two basic ways—physical and cultural. Physical regions are defined by landform (continents and mountain ranges), climate, soil, and natural vegetation. Cultural regions are distinguished by political, economic, religious, linguistic, agricultural, and industrial characteristics.

Help children understand physical regions by examining areas in the school—the classroom, the hallways, the cafeteria, and the coatroom. Have children describe their town. Are their neighborhoods around the hills, the waterfront? Ask children if there are "regions" in their homes. Are there "physical" regions in their town?

The U.S. Geological Survey

The U.S. Geological Survey (USGS) was established as a bureau of the Department of the Interior in 1879. For more than 100 years, the USGS carried on an extensive program of mapping to investigate the natural resources of the nation.

The USGS is the prime source of many kinds of topographic and special purpose maps of the United States and its territories. It is also a prime source of digital map data. All USGS maps are compiled to exacting standards of accuracy and content.

The USGS cooperates with agencies of other governments in distributing map information and map products internationally. USGS resources and expertise are made available to foreign governments through cooperative agreements and through the United Nations.

The USGS makes available to the public both basic map data and a family of general purpose maps. As these products are intended for a wide variety of uses—industrial, scientific, commercial, educational, and recreational—the maps are designed to satisfy a broad range of public needs. Maps depicting topography, geology and recreational use of national forests, parks, and refuges, among many other maps, are available from the USGS.

For more information, call 1-888-ASK-USGS or visit the USGS web site.

TIME

5 days – 50 minute periods each day

QUESTIONS

- What are sources of energy in the garden? What are sectors?
- Who was the first explorer to “put Las Vegas on the map?” Why was this so important?
- What does a physical map show? What does a topographical map show?
- What is the purpose of this map?

MATERIALS

- DAY 1
  - Butcher paper
  - Student journals
- DAY 2
  - 1 inch grid paper
  - Rulers
  - Compass (this would be a good opportunity to show use of appropriate technologies whether you are able to source the real thing or allow students to use the compass app on an iPad or iPhone)
  - Sidewalk chalk (4 different colors)
  - Bamboo pole or yard stick
  - Windsock
- DAY 3
  - Photo of John C. Fremont and Kit Carson
  - Copies of “John C. Fremont” article for each student
  - Green, yellow, and pink highlighters for each student
  - List of vocabulary words
  - Maps (3 copies of each, preferably in color. If color printing is unavailable, display using a projector)
    - Satellite View of Nevada from nationalatlas.gov
    - Populated Places of Nevada from nationalatlas.gov
    - Counties of Nevada from nationalatlas.gov
    - Precipitation of Nevada from nationalatlas.gov
    - Map of Oregon and Upper California from the Surveys of John C. Fremont and other Authorities
    - Old Downtown Las Vegas Map
  - Butcher paper (1 sheet of light colored paper per map, labeled with the map title)
  - Markers or post-its for gallery walk

- Vocabulary Graphic Organizer (1 copy for each word)
- Long sheet of butcher paper for timeline

PROCEDURES

DAY 1

1. Begin the lesson in the school garden. Review the concept of inputs and outputs for pets as explored in Lesson 5 (Interconnections of Elements). Inputs are the needs of a pet and outputs are the results of having a pet.

2. Ask students to list inputs and outputs in the garden, record examples on a piece of butcher paper and/or in student notebooks. Some examples of inputs may be sun, water, soil, wind, etc. Some examples of outputs may be vegetables, flowers, time spent in the sunshine, etc. Ask students what the inputs and outputs have in common (they are all sources of energy). See attached Input/ Output Graphic Organizer.

3. Ask students if the sun, a source of energy and input to the garden, is always in the same place at the same time. Students should reply no since the sun appears to move through the sky. This is an example of sectors, or how energy moves through a space (in the case, the space is the garden). See attached Sun Observation Graphic Organizer.

4. Assign students the other inputs they listed (at least have a water group, a sun group, a wind group). Explain that they will spend 2 quiet minutes of observation focusing on their input and how they see it moving (if it all) through the garden. This kind of observation can be included every time you visit the garden as it is important for students to notice that sources of energy like sun, water, and wind change but behave in a pattern.

5. Introduce the following helpful ways of observing (these are sourced from John Young, the author of *Coyote's Guide to Connecting to Nature*):

   - Owl Eyes – Students will learn to open their visual perception to a wider range side to side and top to bottom, like an owl.
     - Stand somewhere in the garden and focus on something in the distance. Stay focused on this item throughout the whole exercise! Stretch arms straight out to the side. Move your arms in until you can see the tips of your fingers in your peripheral vision. Now you have a wider range of view from side to side. Do the same for top to bottom vision. Stretch arms straight up above your head and down below. Move your arms in until you can see the tips of your fingers in your peripheral vision. Now you have a wider range of view from top to bottom. Spend at least 30 seconds taking in as much as you can with your new "owl eyes"!
   - Deer Ears – Students will learn to open their aural perception to a wider range, like a deer.
     - Place cupped hands behind ears to hear sounds in front of you with more clarity. Place cupped hands on top of ears (cupped toward the ground) to hear sounds below you. Place cupped hands in front of ears (cupped toward the back of you) to hear sounds behind you. Place cupped hands below ears to hear sounds above you.

- Fox Feet – Students will learn to walk quietly. This helps when you want students to observe birds, insects, or other forms of "wildlife" in your garden so they are not disturbing them. This can also help in the hallway or any other time you need them to walk quietly!
  - Step forward slowly and place foot down on the ground starting with the pinkie toe to the big toe. Then set down the arch and heel of the foot. This process may take a while to learn and it is recommended you start with a slow pace.

6. Once students have had a chance to practice the observation tools listed above have them spend 2 quiet minutes observing how their designated input (water, wind, sun, etc.) moves through the garden. Students should write in their observations in their science journals.

7. Students will then act out how that source of energy moves through the garden. For example, water may puddle in a low spot in the bed, wind may come from a certain direction, the sun may never hit a certain shady spot, etc. This is an important part of the process of design for students to understand that the garden is a living ecosystem with forces of energy that work on scales of strength and quantity.

8. Ask students to discuss with a partner how they could record that information to use as a reference for different seasons and to share with other school gardens. Have students record their ideas in their science journals.

DAY 2

1. Begin the lesson in the school garden with student notebooks open to Day 1's observations. Have students re-read their notes with a partner.

2. Prompt students to discuss some of the ideas they generated on how to record their observations to use as a reference for different seasons and to share with other school gardens. Students should suggest drawing a map.

3. Review with students that a map can show locations on Earth, physical characteristics of a place, movements of people and how they relate to the land, and physical and cultural regions.

4. Divide students into groups of four. Review the jobs below ahead of time and decide which job works best with the learning styles of each of your students. Either you can designate the jobs and groups or allow students to self-select.

5. Explain that within each group, students will be drawing a map of their school garden. Each person in the group will have a specific job:

** Scale Master and Compass Keeper should work as a team**

- Scale Master – This student will be responsible for measuring the physical characteristics of the garden (beds, trees, benches, etc.). Remind the students in this group that the grid paper is 1 inch by 1 inch, so a good scale to use would be 1 inch = 1 foot.
- Compass Keeper – This student will be responsible for finding the North point of the garden using the compass and orienting the physical characteristics of the garden on the map.

** The two Trackers should work as a team**

- Sun and Water Tracker – This student will be responsible for observing the path of the sun in the garden throughout the day by marking the shadow of a tall stick on the cement with sidewalk chalk every hour on the hour. He or she will also be responsible for observing where the water is sourced in the garden, how it moves through the garden, and where it collects.
- Wind and ____ Tracker – This student will be responsible for tracking the path of wind through the garden. A windsock may be hung from the bamboo pole or yardstick that the Sun Tracker is using, or from a nearby building or tree. Other ways of observing wind include identifying piles of trash or leaves in the garden. He or she will also be responsible for choosing one of the other “inputs” or sources of energy that come into the garden and tracking that. This could be children, heat, feral cats, birds, etc.

6. Allow time for students to explore the garden following directions for their specific job in the group. Roam the garden and assist students in staying focused and addressing any questions. You may want to gather all students in each job at separate times to review how to use the tools and record the information.

7. When students finish recording information on their map, gather them in a circle in the garden. Allow time for each group to succinctly present their maps. Ask the students to discuss differences and similarities in the group maps.

▶ DAY 3

1. Display the quote “From the ashes of his campfire have sprung cities” along with the photo of John C. Fremont and Kit Carson on the SmartBoard or white board. Direct students’ attention to the quote. Select a volunteer to read it out loud. See attached quote worksheet for 4.

2. Have students discuss with a partner whom they think the quote is about and who the men are in the picture. Teacher will record their thoughts on the white board.

3. Pass out copies of the adapted article “John C. Fremont” from the Las Vegas Review Journal. Have students read the article independently without highlighting anything.

4. Once students finish reading, have partners discuss the quote and picture. Discuss with the whole group and record new thoughts on the white board.

5. Ask students for any new words they need defined and write on the board. Vocabulary words should include (but are not limited to):

   - Ancestry
   - Archaeologist
   - Buckskins
   - Contradistinction (this word is a good example of how the English language changes over time)
   - Emigrants
   - Expeditions
   - Fertile
   - Llanos
   - Malevolent

6. Direct students to re-read the article with a partner. There will be three different groups, but students will work with a partner in the group. Each group will focus on highlighting specific information:

   - Vocabulary and context clues. Student should use student generated list and/or words listed above.
   - Names of people and places. Students should look for specific people and groups of people.
   - Dates of significant events. Students should look for both the date and the event.

7. Allow partners time to re-read the article and locate specific information. Roam the room to observe student conversations and interactions.

8. When partners are finished, have all partner groups sit in a circle with their designated teams (listed above) to review their highlights and notes. Students should not have to re-read the entire article, rather, skim through and make commentaries referring to place in the article (i.e. “In paragraph 5, sentence 4, the word “emigrant” is used”) Make time to stop in at each team and re-focus on their tasks (listed above).

9. As a whole group, discuss their original thoughts on the quote and photograph. Share with the students that the quote is the epitaph written on John C. Fremont’s headstone and the photograph is of Kit Carson (standing) and John C. Fremont.

10. Ask students to review with their partners what their tasks are in preparation for a project tomorrow.

▶ DAY 4

1. Display the maps on the Smartboard one at a time and allow students to explore the maps by zooming in and out. If no Smartboard is available, print out the maps and distribute throughout the room for students to observe and interact with.

2. List the titles of each map on the white board or on separate sheets of butcher paper. As students take a gallery walk to explore each map, have them record what key features they notice on the butcher paper with markers or post it notes. See attached Graphic Organizer, "Map Walk."

3. As a whole group, review student notes. Focus on the key features of a physical map (streams, rivers, mountains, valleys, etc.) and a political map (cities, county lines, population).

4. Review each map and have students label it is a physical and/or political map.

   - The Precipitation Map is an exception as its key feature is level of rainfall throughout the state. It is important to note that it is still a map because it represents the geographical concepts of location, place, and relationships.

5. Ask the students, “Why are there so many different kinds of maps?” The conclusion they should come to is that you can't display everything about a place on one piece of paper (this may be derived from the class discussion on day 2 about the student-generated garden maps). For a map to communicate clearly, it must show a limited number of things.

6. Have students gather in their teams assigned from Day 3. Review the tasks and give specific directions for today’s work. They will present their work on Day 5.

   - Vocabulary and context clues - Students will take information highlighted from Day 1 to fill in the Vocabulary Graphic Organizer (or something similar) for each word.
   - Names of people and places - Students will take information highlighted from Day 1 to locate place names on all maps. As an extension, have students research specific names and create a paragraph summary using the 5 Ws.
   - Dates of significant events - Students will take information from Day 1 to create a timeline with important dates and events.

▶ DAY 5

1. Have groups review work from Day 4 in preparation for their presentation.

2. Groups present final work to class. After every group presents, allow students to walk around and view each other’s work.

ASSESSMENT

Observation of student discussions, written responses to key questions, final group work and presentations.

ADAPTATIONS

Pull small groups for guided reading. Provide written copies of vocabulary words. Encourage ELL students to look up vocabulary words in a picture dictionary or online for images.

Schedule a field trip to the Springs Preserve to see part of the Old Spanish Trail and the original springs of Las Vegas. If a field trip is not possible, visit the website online, call the Education Center for an interview, or invite them to your school as a guest speaker.

Explore Bird Language and have students participate in a Bird Sit. To learn more about this, check out Jon Young's books *Coyote's Guide to Connecting to Nature* and *What the Robin Knows*.

DIGGING DEEPER

- Schedule a field trip to the Springs Preserve to see part of the Old Spanish Trail and the original springs of Las Vegas.
- If a field trip is not possible, visit the website online, call the Education Center for an interview, or invite them to your school as a guest speaker.
- Invite your students to make observations about their neighborhood around the school and to make maps showing different information. For example, edible fruit and nut trees, pathways that students take when walking or biking to school, street names, etc.

NUTRITION FACTS

- In Nevada, our most popular crop is hay (to feed livestock), and it's grown from a seed. Some of our other popular crops include alfalfa seed, barley, garlic, mint, onions, and wheat.

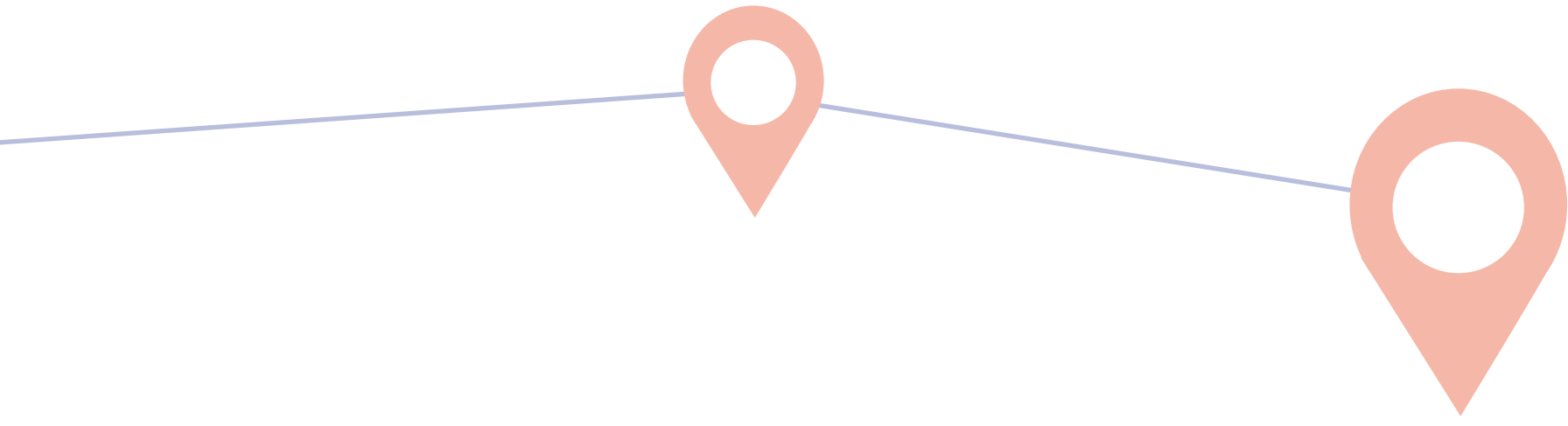
STANDARDS FOR LESSON 10 LESSON MAP

NG: 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features. [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]

4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of waterflow.] [Assessment Boundary: Assessment is limited to a single form of weathering or erosion.]

ELA Reading CCSS.ELA-Literacy.RI.4.5: Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text

Math 4.OA.C.5 Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself.



LESSON 10 LESSON MAP

Lesson 10: Mapping It Out

Day 1

- Review Inputs/Outputs (L. 5)
- Students make observations of Inputs/Outputs in OC, write in journals. *see attached

Day 2

- Sun Observation. *see attached

Day 3/4

- Make student groups based on inputs from day 1.
- Discuss Owl Ears, Deer Ears, and Fox Feet (See Procedure #5).
- Students will write down observations of the input (examples: sun, wind, water) they selected to observe. Focus on the movement of energy in the garden. Where does this energy go? Where does it not go?
- Procedure 6-8

Day 4

- Review Day 1 observations.
- Share information with partner.
- Discuss ideas on how to record oberservations of the movement of input energy.
- Students are likely to say "maps."
- Show examples of maps.

Day 5

- Draw a map of Outdoor Classroom Garden.
- Assign roles, give each role a different color to mark on their maps

Day 6

- Student groups present energy maps.
- Discussion: compare and contrast maps

Day(s) ____

Math Inputs and Outputs
Patterns (addition, subtraction, multiplication)

Day(s) ____

Literacy Procedures 1-10 from Day 3 in Lesson Plans.

Read John C. Fremont Article at the end of Lesson 10.

Complete quote worksheet.

Literacy Connection

Book (Stage) *Love, Stargirl: Jerry Spinelli*

Day(s) ____

Science/Social Studies

Day 4 Map Walk. Procedure from day 5, have students cut and paste their grphic organizer on a larger poster board and present

Movement Map*

Gardening Background

*Note to teacher: please read full article on Fremont at : http://www.review-journal.com/news/john-c-fremont

Name:_____ Date: _____

Outdoor Classroom Garden Observation Inputs	Outdoor Classroom Garden Observation Outputs
Seed	Sprout
Sun	Photosynthesis

1. What do all the inputs and outputs have in common?

2. Draw a diagram of the inputs and outputs on the back side of this page or on a separate sheet of paper. Indicate transfer of energy with arrows and label with inputs/outputs.

Name:_____ Date: _____

SUN OBSERVATION

Illustration the sun's position by drawing a student's shadow at hour intervals throughout the day. Use a different color to indicate different times. Label the times.

Place feet here facing same direction

1. Is the sun always in the same place at the same time?

2. How is this an example of how energy moves through a space like the garden? What evidence to you have to prove your answer?

3. Define the word sector.

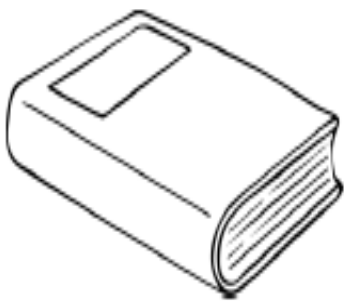
Name: _____

The First U.S. Cartographers to Map Nevada

“From ashes of his campfire have sprung cities.”
John C. Fremont
(Epitaph (quote) on his headstone)

Quote + My Own Thinking = Conclusion

Quote from the book:



My own Thoughts on What it Means:

My Conclusion:

Name:_____ Date: _____

MAP WALK

Title	Purpose of map	Key features	Type of Map: Political or Physical

Name:_____ Date: _____

MAP WALK- REFLECTION

1. What is the difference between political and physical map?

2. How would categorize the Percipitation Map?

3. Why are there so many different types of maps?

JOHN C. FREMONT

Discoveries are hardly ever the work of one person, and no case shows it more clearly than the debate over who “discovered” Las Vegas for settlers of European ancestry. Good arguments have been made for at least three different pathfinders, but it was John C. Fremont who literally put Las Vegas on the map. Greg Seymour, archaeologist at the Harry Reid Center for Environmental Studies, said it’s clear that people traveled to and from the valley in prehistoric times. The Anasazi, more usually associated with New Mexico and Arizona, the Patayan of the lower Colorado River and the Southern Paiutes all occupied the valley. “The Southern Paiute call the Old Spanish Trail the Paiute Trail, and believe it was in use even before them.” It is an accident of history that the Las Vegas route became famous as “The Old Spanish Trail.” The accident involves one of the most remarkable adventurers of Western history -- John C. Fremont.

In the spring of 1842, Fremont made his way to St. Louis and began assembling the first of the expeditions that would bear his name. He showed a talent for hiring the right men. On a chance meeting with Christopher “Kit” Carson, Fremont understood the remarkable man beneath the buckskins. Carson, at 33, had not yet learned to read nor write. Yet, he spoke French, Spanish, English, several Native languages, and sign language of the Native communities of the plains. Carson was one of the few mountain men, who would survive physical fights with Native people, starvation, thirst and malevolent mules, to die in bed.

In May 1843, Fremont’s second expedition was to map the area between the Rockies and the Pacific Ocean. On May 1, they encamped at a spring in the mountains -- probably today’s Mountain Spring. They made but 12 miles the next day, camping, probably, in the region of Blue Diamond or Oak Creek Canyon. And on May 3: "After a day's journey of 18 miles, in a northeasterly direction, we encamped in the midst of another very large basin, at a camping ground called Las Vegas -- a term which the Spaniards use to signify fertile or marshy plains, in contradistinction to llanos, which they apply to dry and sterile plains. Two narrow streams of clear water, four or five feet deep, gush suddenly with a quick current, from two singularly large springs; these, and other waters of the basin, pass out in a gap to the eastward. The taste of the water is good, but rather too warm to be agreeable; the temperature being 71 in the one and 73 in the other. They, however, afford a delightful bathing place."

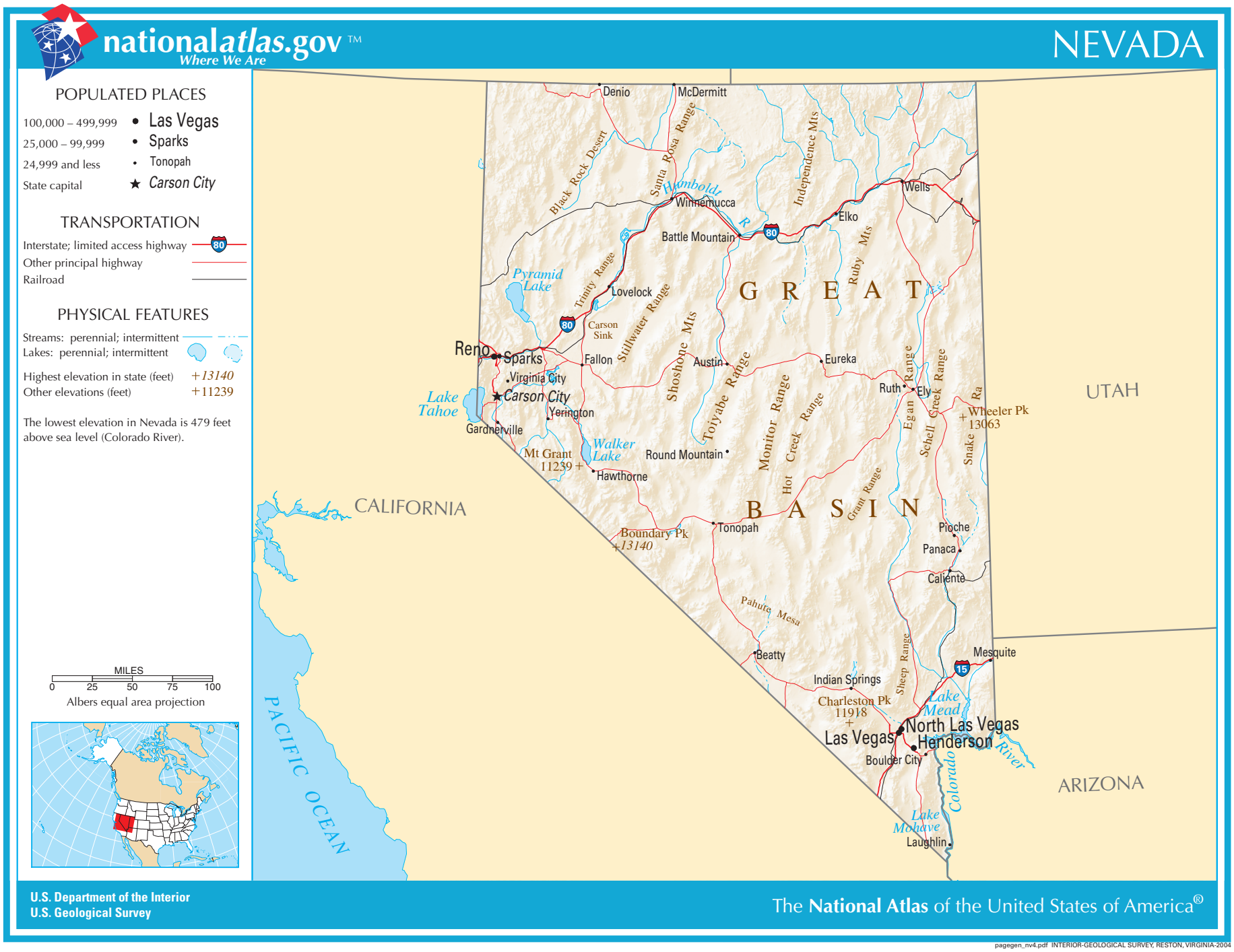
The route through Las Vegas became well traveled, simply because it became well known. Congress printed 20,000 copies of Fremont's 1845 report of this trip and its map. "This meant anybody who wanted one could have it," said Warren. "It became so important that if a group of emigrants did NOT have one, that fact would be mentioned in diaries."

Adapted from “John C. Fremont” article in Las Vegas Review Journal – February 7, 1999 by A.D. Hopkins

COUNTIES OF NEVADA MAP

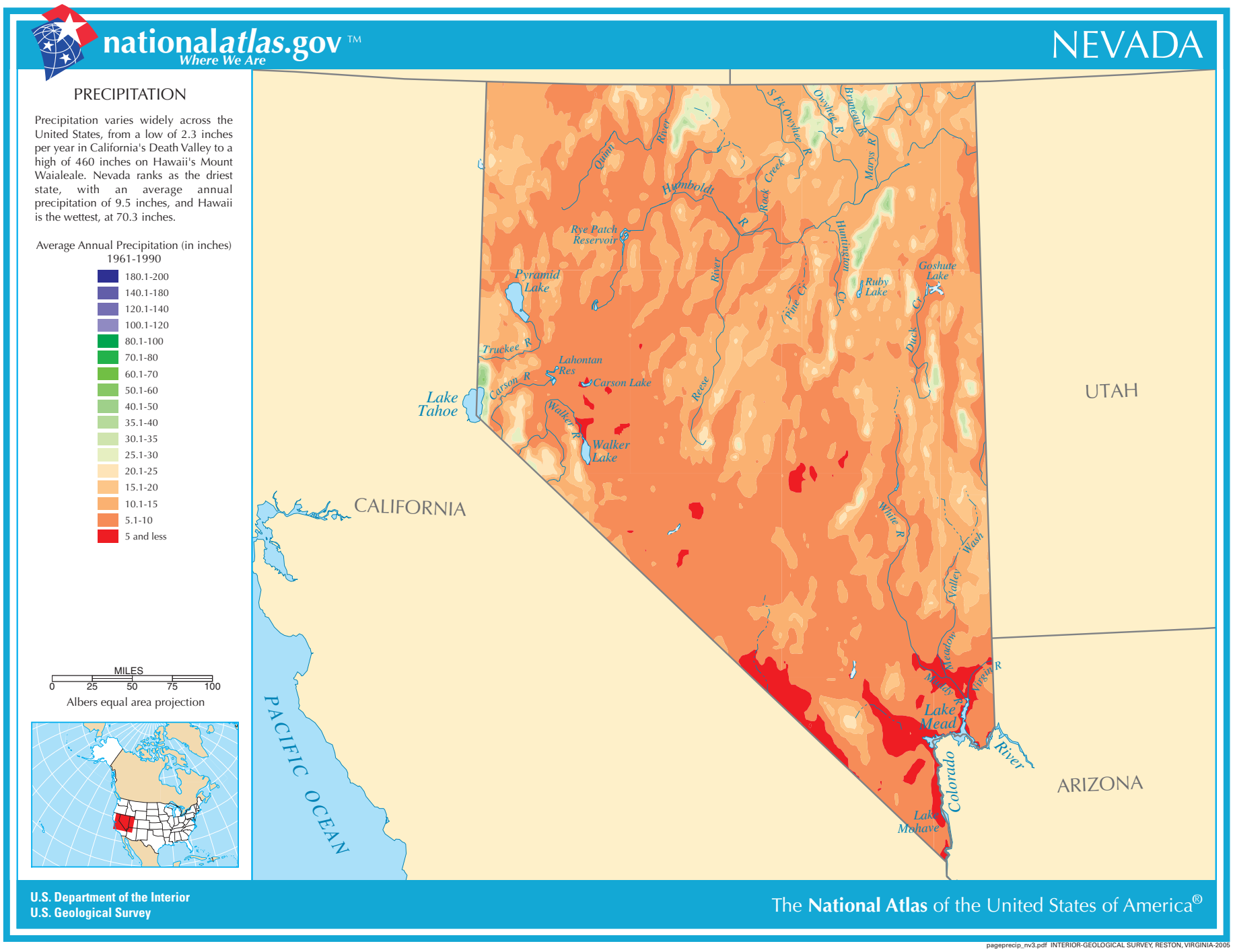
Counties of Nevada Map

POPULATED PLACES OF NEVADA MAP



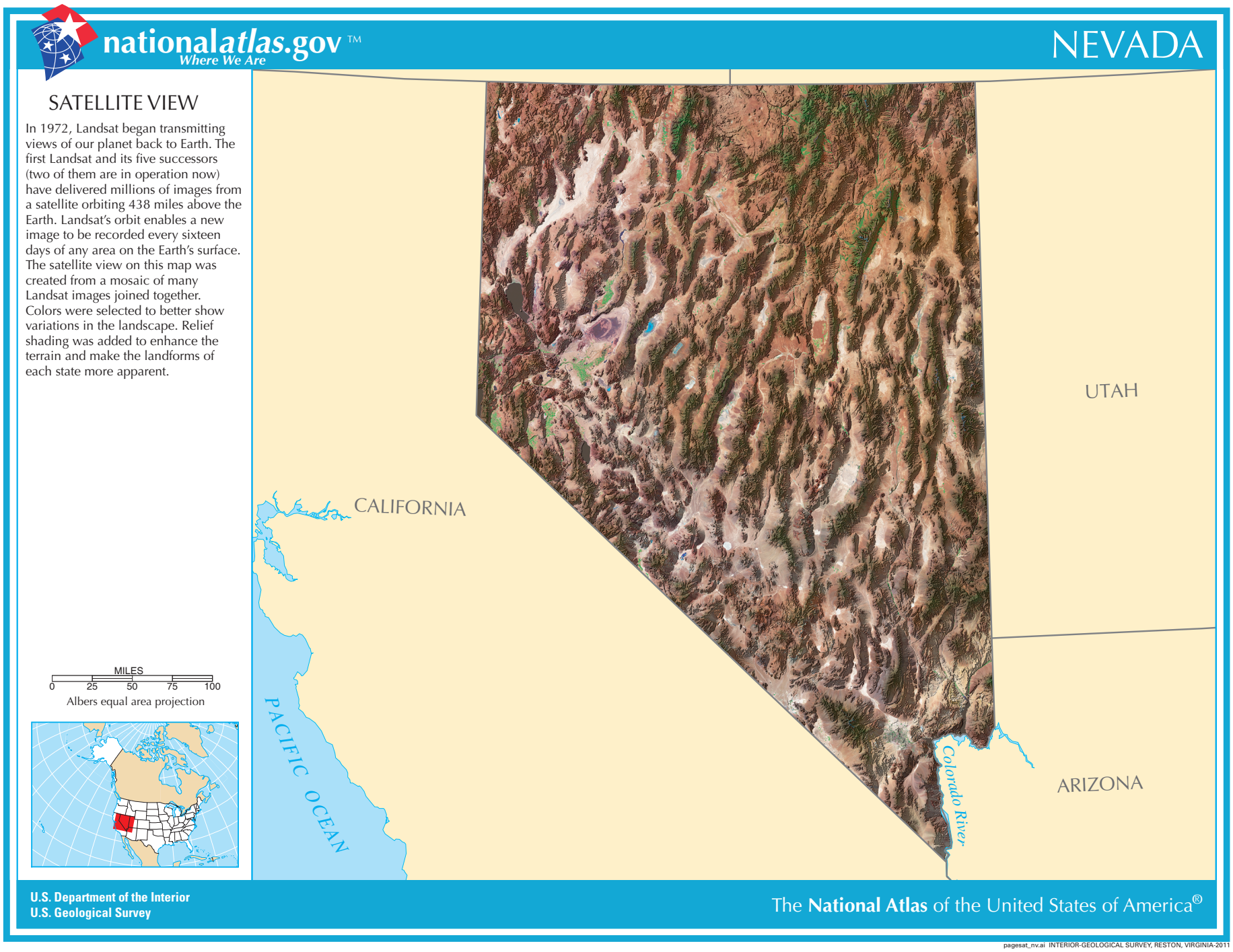
Populated Places of Nevada Map

PRECIPITATION OF NEVADA MAP



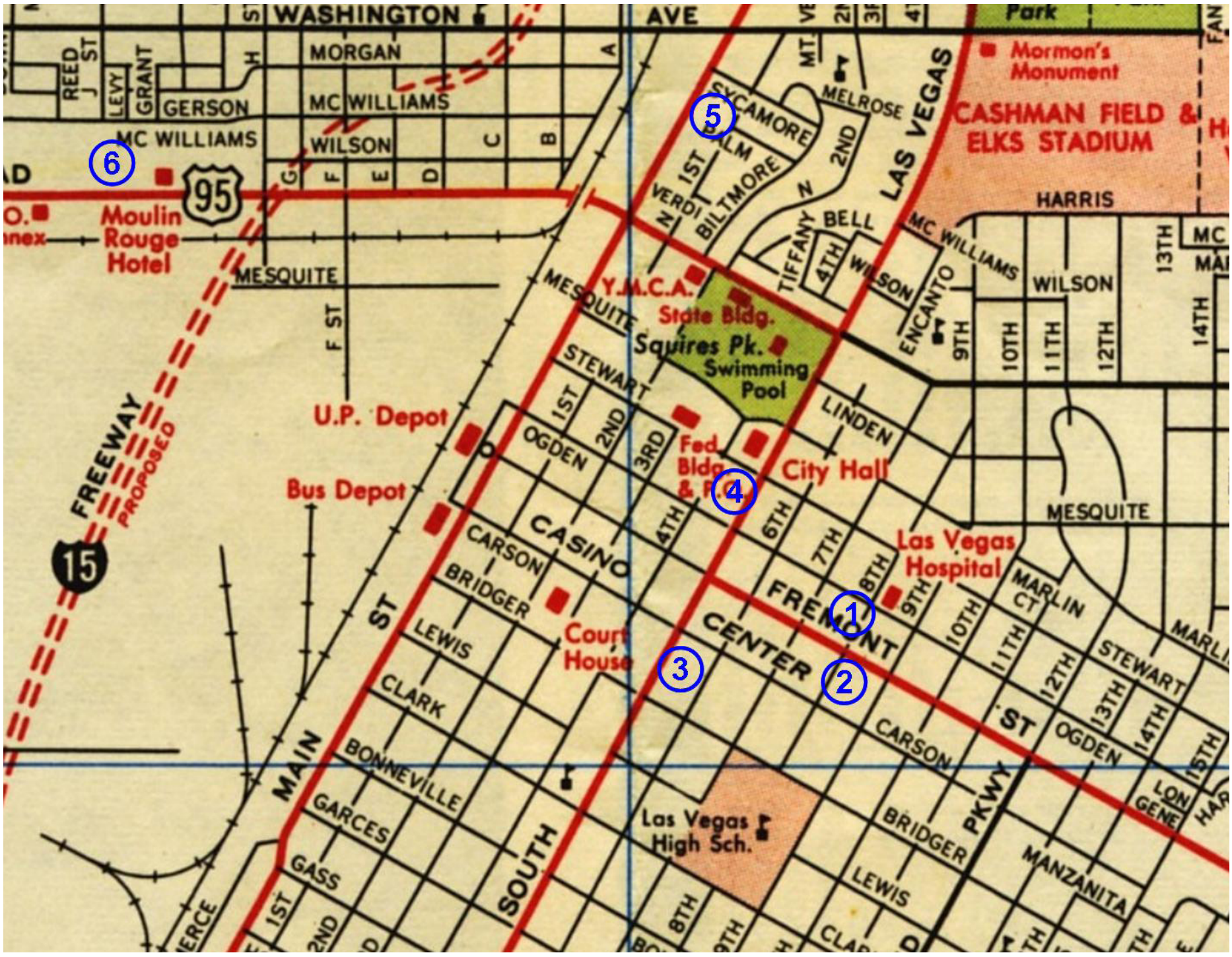
Precipitation of Nevada Map

SATELLITE VIEW OF NEVADA MAP



Satellite View of Nevada Map

OLD DOWNTOWN MAP

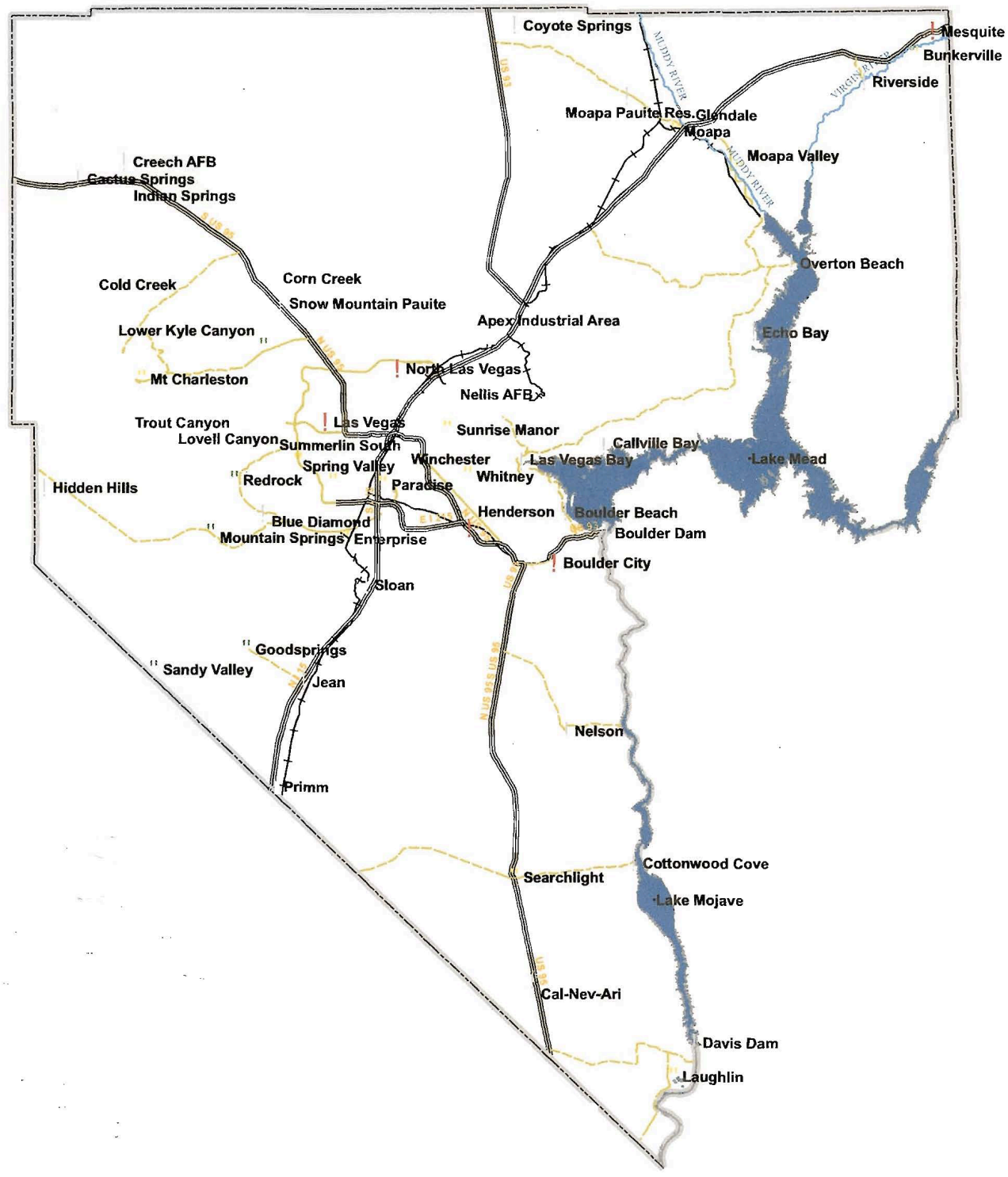


Old Downtown Map

OREGON AND UPPER CALIFORNIA MAP

Oregon and Upper California Map

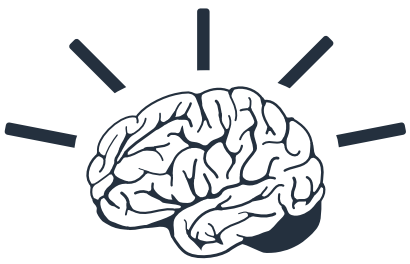
CLARK COUNTY MAP



Clark County Map

Lesson Eleven

Saving Seeds



BRAIN BREAKS!

1. Plant Partners Teacher will give class a plant part (seed, root, stem, leaves, flower). Students turn to a partner and go back and forth naming vegetables harvested from that part of the plant. Repeat until partners can no longer name vegetables from that plant part.

2. Apple, Watermelon, Banana (rock, paper, scissors) Students play rock, paper, scissors replacing rock with apple, paper with watermelon and scissors with banana. Play as many rounds as possible in given time frame.

3. Garden Taboo Teacher plays music. When music stops students pair up. Teacher calls out a garden topic such as fruit. Partner A has to describe any fruit they want to their partner without saying the name. Partner B has to try and guess what their partner is describing.

4. Syllable Snacks Teacher will call out a number (1-4). Students work with a partner to come up with garden vocabulary words that contain that number of syllables. Partner A will begin by naming a vocabulary word with the given number of syllables; partner B will go next. They will alternate until one partner can no longer name a vocabulary word with the given number of syllables.

5. Fruit/Veggie Knock Students will work with a partner and touch knuckle to knuckle (veggie) and palm to palm (fruit) in a given sequence. Teacher will name the sequence to the class (Ex: veggie, veggie, fruit) and students will have to use the given hand gestures to complete the sequence. Teacher will increases the number of movements with each round (Ex: Round 1-veggie, veggie, fruit. Round 2-fruit, veggie, veggie, fruit).

6. Fruit/Veggie Match Students will stand. Teacher will name a fruit or vegetable and students will have to touch that part of the body corresponding to the part of the plant that the fruit or vegetable grows from (roots-feet, stem-legs, leaves-body, flowers-head). Teacher will call out and play the game “Simon says” going a little faster with each round.

7. Plant Part Finger Hop Students touch thumb to thumb, pointer to pointer, middle to middle, ring to ring, pinkie to pinkie as they say the plant part finger hop chant (seeds, roots, stems, leaves, flowers). Teacher will randomly call out a plant part, students will have to touch the corresponding fingers. Teacher will repeat, increasing the pace with each round.

8. The Harvester Students will stand and squat (harvest) with a shovel in hand. They will shovel the dirt over alternating shoulders like a farmer. Students will work at their own pace “harvesting” for the given time frame.

9. Apple Squat Students will stand and begin by squatting. They will then stand up on one foot, hop twice saying “apple, apple” then return to a squat. Repeat with increasing speed each round and alternating feet.

10. Fruit Freeze Teacher will randomly call out different fruits and vegetables. If the teacher calls out a veggie, students have to jog (or march) in place, if teacher calls out a fruit, students have to freeze.

11. Garden Guess Students will work with a partner. Partner A will silently think of a fruit or vegetable. Partner B can ask three questions about what their partner is thinking. After three questions, partner B has to guess the fruit or vegetable. They will then switch roles, and partner B will silently think of a fruit or vegetable and partner A gets to ask questions and guess. Repeat as many times as possible in the given time frame.

OVERVIEW

Students will save seeds from the garden for the next season. This is a crucial yet often missing element in the education of the life cycle of a plant. Seed saving allows your students to select varieties of plants that thrive well in your garden and will help reduce overall costs, about $160 per year!

OBJECTIVES

- Students will identify the seed as an important part in the life cycle of a plant.
- Students will learn how to harvest and store different seed varieties.

STANDARDS

Nevada State Standards

(4)1.2 Use science notebook entries to develop, communicate, and justify descriptions, explanations, and predictions.

(4)1.5 Identify, gather, and safely use tools (magnet, thermometer, and lens) and materials needed in investigations.

Next Generation Standards:

4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

TEACHER INFORMATION

This lesson is designed to be paired with Grade 1, Lesson 7 – Seed Collecting. Coordinate with your first grade team after a harvest in the school garden. Ideally, the produce and flowers that are used for Grade 1, Lesson 7 and this lesson are the plants selected intentionally to go to seed (see part 1 of this lesson).

Partnering fourth graders with first graders in an investigation of seeds will build a strong connection to the Life Cycle of Plants unit for both grade levels. This provides an opportunity for the fourth grade students to lead by example and the first grade students to work in a hands-on cooperative environment with older children.

Saving seed isn't as difficult as it sounds! To begin with, read the *Seed Saving* Guide included as a resource for this lesson. It will give you a basic idea of when and how to harvest seed from the majority of the plants that grow in your garden.

For an in depth look at seed-saving, read *Seed to Seed* by Suzanne Ashworth. For more lessons and student activities, look into *From Generation to Generation*, a seed education program with grade-by-grade activities to bring young gardeners through the full cycle from seed to seed at http://www.fedcoseeds.com/forms/seedschool.pdf. Seed Savers Exchange is a wealth of knowledge including an online database with direct information on how to save specific varieties: http://www.seedsavers.org/learn

TIME

5-9 sessions.

QUESTIONS

- Why is it important to save seeds?

MATERIALS

- Copies of *"How to Save a Library: Make It a Seed Bank"* for each student
- Student notebooks
- Plants selected to go to seed in the school garden. If you have a farmer, ask them for assistance. They love to save seeds! Choose as many as you'd like, but ideally one from each of the following categories:
  - Flowers (i.e. sunflowers, etc.)
  - Root vegetables (i.e. carrots, beets, etc.)
  - Vegetables (i.e. broccoli, Swiss chard, etc.)
- 5 gallon buckets
- Tarps
- Strainers with different size holes
- Large bowls
- Ziploc bags or glass jars
- Funnels
- Markers
- Labels
- Copies of Seed-Saving guide for each student
- White paper
- Glue sticks
- Seed saver template (optional)
- Packets of seeds (at least one variety of the following categories: flowers, root vegetables, vegetables)
- Scissors
- Glue
- Pencil

- Coloring materials
- Seeds
- Chart paper

PROCEDURES

- PART 1
- Day 1

1. Hand out adapted article “How To Save a Library: Make It a Seed Bank” and have students read independently.

2. With a partner, have students discuss the main idea of the article by answering the following questions orally or on a piece of paper:

    - Define the following words using context clues from the article: novelty, tangible, relevant
    - What does the library director mean when she says, “You have to be fleet of foot if you’re going to stay relevant?”
    - What are some reasons why “a public library is the perfect location for a seed collection?”
    - How is gardening in Western Colorado similar to gardening in Southern Nevada? How is it different?
    - Do you think it is important to save seeds? Why or why not?

3. As a whole group, review answers.

- Day 2

1. Move out to the school garden and identify plants that are thriving and should be saved to go to seed. Students should record the identified plants, location, and date in their science journals as well as a brief description of how they currently look. It is important to keep a detailed account of the identified plants throughout the growing season (see Part 2).

- PART 2

- Day 3

1. At least weekly, designate a ten-minute period to observe the plants selected for seed saving in the garden. Allow students time to record observations in their science journals focusing on signs of health and vitality. Students should also note if they see signs of pests or disease. From the *Generation to Generation Seed Saving Guide*:

    - *"To maintain resilient plants for the range of unforeseen conditions of future generations, save seed from healthy plants with a wide range of characteristics. Rascals to the seed-saver are weak, diseased plants or those with less desirable traits or not true-to-type. Save seed from the strongest, healthiest plants with the qualities you want to pass on."*

2. Watch “Seed Saving: How to Collect and Save Arugula Seed” video (https://www.youtube.com/watch?feature=player_embedded&v=mSvUOZygsa8) featuring California and Las Vegas resident John from GrowingYourGreens.com. This video is about 15 minutes long, but full of useful information and a good recap on some of the vocabulary and tools that students will use in this lesson. John is harvesting seeds from arugula. It is very likely that you will harvest arugula from your school garden! Before the video starts, explain to the students that John uses the word *“sieve”* to describe the strainers or filters he uses. This word sounds similar to “seed” but the context is clear. Other vocabulary words that may be useful to review are *“bolt”* and *“threshing.”* Guide students to answer the following questions using information from the video:

   - What tools does John use? (Answers at minute 2:25)
   - How do you know when seeds are ready to harvest? (Answer at minute 3:08)
   - What is the most important debris or extra material to filter out from your seeds? (Answer at minute 12:25)
   - What are the ideal conditions for storing seeds? (Answer at minute 14:15)
   - What other tool would be helpful for this step? (Answer at minute 14:20)

3. Discuss answers to the video with the whole group. Start a class list of tools needed for the seed harvest day. Your list should include:

   - 5 gallon buckets
   - Tarps
   - Strainers with different size holes
   - Large bowls
   - Ziploc bags or glass jars
   - Funnels
   - Markers

▶ Day 4

1. Hand out copies of the "Seed-Saving Guide" for students to tape or glue into their science notebooks for future reference.

2. Have students read through the "Seed-Saving Guide" and highlight the varieties of plants that you have chosen to save seed from.

3. Discuss with the whole group the processes required to save seeds from your chosen plants. Review your material list and determine if any additional materials may be needed.

4. Explain to the fourth graders that on the day of the seed harvest they will be partnered with first graders who have been learning about the life cycle of plants. Have the students discuss what behaviors they should model for the younger students.

▶ PART 3

▶ Day 5

Coordinate this date with the first grade classes and when your plants have gone to seed. Talk to your farmer or use information on the seed packets for an approximate date. This would be a good date to arrange for volunteers from your sponsor or parent organizations to assist.

1. Gather materials and move out to the school garden.

2. Partner first grade students with fourth grade students. Allow the first grade students to identify what type of plant (flower, root vegetable, or above-ground vegetable) and where the seeds are located. As often as possible, encourage your fourth grade students to allow the first grade students to touch, feel, and assist in the seed harvest.

3. Follow directions in "Seed-Saving Guide."

▶ PART 4

▶ Day 6

1. Divide students into teams of three to locate information on seed packets (an assortment of different commercial and heirloom varieties).

2. Hand out one packet of seeds to each team. Students will write down on a piece of paper a list of the different types of information found on a seed packet.

3. As a whole group, teams will discuss their lists as the teacher keeps a master list on the whiteboard. The following items should be located and discussed:

   - Name or kind of seeds
   - Name of variety
   - How much seed is in packet
   - Price, if applicable
   - Picture of plant
   - What plant looks like
   - When it is ready to pick
   - Where, when and how to plant
   - Instruction for care
   - Year the seeds should be used

▶ Day 7

1. Explain to the teams that they will create their own seed packets for the seeds saved from their school garden. Displays the lists of seeds saved on the white board and designate each team by a specific type of seed that they will be in charge of (Team Dragon Carrot, Team Icicle Radish, etc.)

2. Hand out the "Seed Information" worksheet and review what information teams will need to provide. Suggest that one member of the team be the “artist” and work on an accurate detailed drawing of the plant for the packet (or a photograph of the plant growing in the school garden can be used instead) while the other two members can research and write the additional information.

3. Allow teams to fill in the "Seed Information" worksheet using information from the original seed packets, science journal notes, and/or research from on line sources like Seed Savers Exchange http://www.seedsavers.org/Education/Seed-Saving-Resources/

- Day 8

1. Once the information has been gathered, edited, and finalized, teams will make final versions of the seed packets using the seed packet template.

- Day 9

1. Students then can fold and glue the seed packet flaps on the sides and bottom. Place the seeds inside and glue the top flap. Seed packets should be kept in a dry, cool, and dark place to prevent any moisture infiltration.

2. Have students brainstorm ideas for ways to use the seed packets. Will they donate to a seed library? Sell as a fundraiser for the Garden Committee? Keep for the following year? Give as gifts?

ASSESSMENT

Student observations and recordings in science journal, written responses to questions from “Saving a Library: Make It a Seed Bank” article, written responses to “Seed Saving: How to Collect and Save Arugula Seed” video, completed seed packets.

ADAPTATIONS

Read with students in a small group setting. Provide a sheet with vocabulary words written out with a clear definition.

DIGGING DEEPER

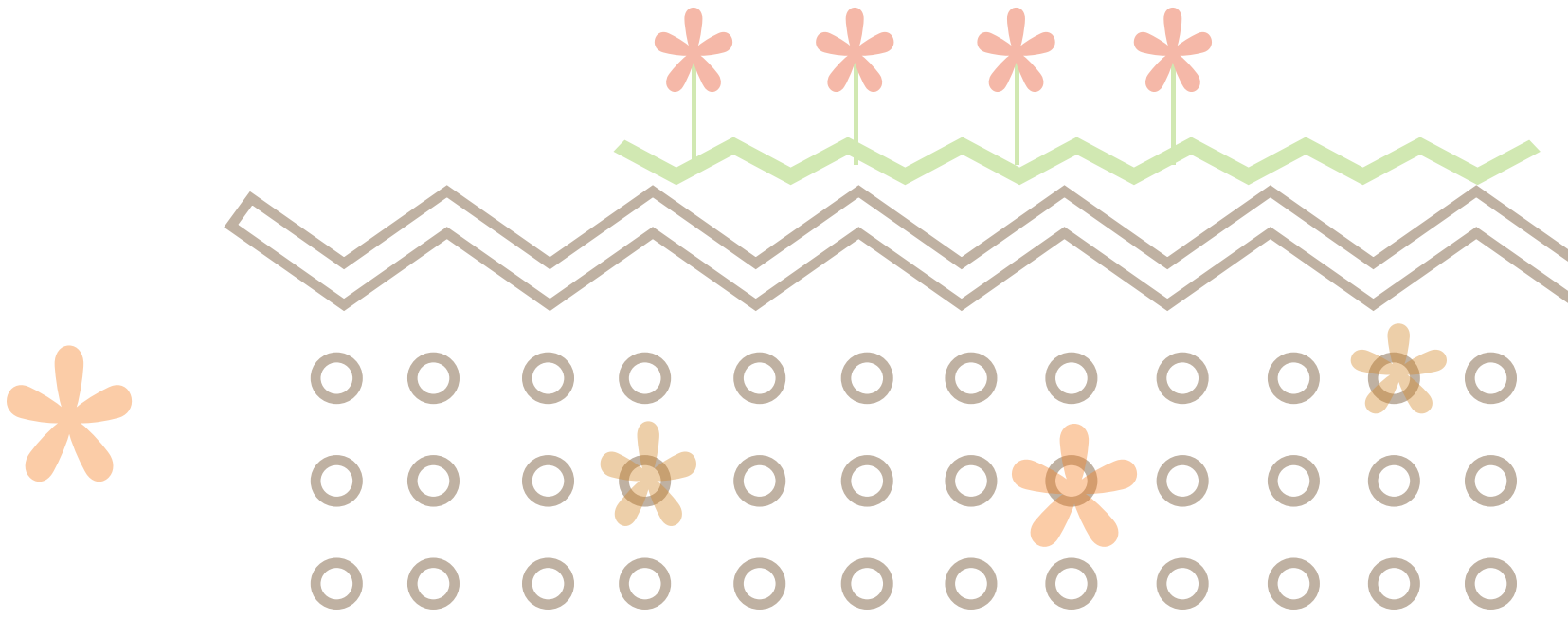
- Have students create their own seed saving program and for future crops OR they could have a seed swap with other schools.

DID YOU KNOW?

- Seed saving allows your students to select varieties of plants that thrive well in your garden and will help reduce overall costs, about $160 per year!
- Seeds provide the world with their daily food. Everything from your breakfast cereal, to your pasta dinner all begins from seeds from different grasses.
- In fact, the largest seed in the world is the double coconut, measuring 1.6 feet around the middle. All coconuts have a fibrous coating with air space inside in order for them to be able to float to a new home. Some have floated over 1200 miles before finding dry land!
- There are many different kinds of seeds that people eat, such as corn, wheat, oats, rice, beans, peas, sunflower, pumpkin and nuts.
- Some seeds are safe to eat raw, while other seeds must be cooked in some way before they can be eaten.
- Seeds are an excellent source of food for people all over the world.

NUTRITION FACTS

- Seeds may be small, but they can be packed with loads of protein, fiber, and vitamins. The healthiest seeds to eat include amaranth, chia, pomegranate, pumpkin, sunflower, and sesame seeds.



LESSON 11 STANDARDS & LESSON MAP

NG Reading CCSS.ELA-Literacy RL.4.7 Make connections between the text of a story or drama and a visual or oral presentation of the text, identifying where each version reflects specific descriptions and directions in the text.

NG Wrting W.4.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information.

Math 4.G.A.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along theline into matching parts.

Lesson 11: Saving Seeds

Day 1

- Procedures Part 1:
- Complete steps : 1, 2, 3

Day 2

- Step 4

Day 3

- Procedures Part 2:
- Step 1 (ongoing)
- Step 2-4

Day 4

- Step 5, 6, and 7

Day 5

- Procedures Part 3:
- Complete steps 1 and 2 and 3

Day 6

- Procedures for Part 4
- Complete steps 1-3

Day 7

- Steps 4 -6

Day 8

- Step 7

Day 9

- 8-9

Day(s) _____
Math

Day(s) _____

Literacy DVD: __Seeds, Seeds, Seeds by: Nancy Elizabeth Wallace_____

Book *Miss Rumphius* by Barbara Cooney

Make connections between text and students engaging in seed saving

Day(s) _____

Science/Social Studies Extension

Have students create their own seed saving program and for future crops or they could have a seed swap with other schools.

HOW TO SAVE A PUBLIC LIBRARY: MAKE IT A SEED LIBRARY

Despite the cold and snow, some signs of spring are starting to break through in Colorado. The public library in the small town of Basalt is trying an experiment: In addition to borrowing books, residents can now check out seeds.

In a corner of the library, Stephanie Syson and her 4-year-old daughter, Gray, are just finishing a book with a white rabbit on the cover. When Gray approaches the knee-high shelves filled with seed packets, she zeroes in on a pack labeled "rainbow carrots."

"We just read two books with bunnies in them, so we've got bunnies on the brain," Syson says. Syson flips through a wicker bin labeled "carrots" and offers other varieties to Gray, like "atomic red" and "cosmic purple."

Here's how it works: A library card gets you a packet of seeds. You then grow the fruits and vegetables, harvest the new seeds from the biggest and best, and return those seeds so the library can lend them out to others.

Syson says tending a garden in Western Colorado can be frustrating. The dry climate, alkaline soils and short growing season keep many novices from starting. She'll take seeds from the plants that withstand pests and persevere through drought.

"If you save seed from those plants, already, in one generation, you will now be able to grow a plant that has those traits," Syson says.

The seed packets are a novelty within the library's more mainstream collection of books, CDs and DVDs. The library's director, Barbara Milnor, says in the age of digital, downloadable books and magazines, the tangible seed packets are another way to draw people in.

"You have to be fleet of foot if you're going to stay relevant, and that's what the big problem is with a lot of libraries, is relevancy," she says.

Milnor says that while a library may seem like an odd location for a project like this, seeds and plants should be open to everyone. That makes a public library the perfect home for a seed collection. The American Library Association says there are at least a dozen similar programs throughout the country.

Back at the front desk, Syson and Gray place the rainbow carrot seed packets on the counter. Syson says the library has always been a place for her daughter to learn. The seeds just add another lesson.

"For her to see a little pot of dirt and to plant a seed into it, and then 30 days later being able to eat something from it is really exciting for her," she says. "She really enjoys seeing that whole process."

A process that now includes a trip to the local library.

Radio Segment Adapted from Aspen Public Radio, February 2, 2012
http://www.npr.org/blogs/thesalt/2013/02/02/170846948/how-to-save-a-public-library-make-it-a-seed-bank

SEED INFORMATION WORKSHEET

Team _____

1. Name or kind of seed

2. Name of variety

3. How much seed is in packet

4. Price (Will you be selling your seeds or participating in a Seed Exchange or Library?)

5. Picture of plant

6. Description of what plant looks like (describe the shape, size, and color of the leaves, flowers, and fruits and any other identifying features of the plant)

7. Where to plant (in what kind of soil, sun, water conditions)

8. When to plant (growth period and days to harvest)

9. How to plant (germination and how deep)

10. Instructions for care (The best temperature to grow the plant, plant spacing, amount of light and water needed)

11. Year the seeds should be used

Seed-Saving Guide

Self-Pollinating Annual Vegetables

Beans *Phaseolus vulgaris*	The beans are ready to harvest when the pods are dry and brittle, and the beans rattle inside.
Eggplant	Harvest when very ripe. Scoop out seeds, wash away pulp and dry.
Lettuce *Composite*	Cut stalks when about half of the tiny flowers are white and fluffy. Hang over tarp or put in buckets over tarp. Rub off seeds. Winnow.
Peas	Harvest when pods turn yellow or brown and peas rattle inside. If not completely dry, pull up the whole plant and hang upside down to dry indoors.
Pepper	Although peppers are self-pollinating, bees occasionally cross-pollinate. Separate by 50 feet. Harvest when very ripe. Scrape out seeds, rinse and dry.
Tomato	Pick the best ripest fruits. Ferment for three days. Remove floating mold, Rinse till clean. Dry.

Cross-Pollinating Annual Vegetables

(I – insect pollinated. W – wind pollinated)

Broccoli *Brassica oleracea,* I	Start early indoors and transplant outside for fall seed harvest. Cut the stalks when the seeds are dry and brittle, dry on trays, thresh and clean.
Chinese cabbage, Pac Choi, *Brassica oleracea,* I	Same as broccoli
Corn *Zea mays* W	Plant at least ten rows of twenty feet three feet apart (at least two hundred plants) Why? Corn needs to cross-pollinate with a wide population to stay strong. Pollen is carried by wind from tassels of one plant to silks of another. Seeds which are not pollinated do not form kernels. When kernels are mature and dry, strip down husks and hang together till dry on cob.
Cucumber *Cucumis sativus,* I	Let grow on vine till large, yellow/brown and hard. Cure for 2-3 weeks. Scoop out seeds and ferment for 3-4 days. Rinse. Discard floating seed. Dry. Cucumbers cross each other (except Armenian cucumbers, *C. melo*) unless isolated by 1/2 mile .
Mustard Greens (yellow flowers) *Brassica juncea,* I	Isolate by half a mile or grow in screen shed. Let grow seed stalks, harvest and dry.
Radish *Raphanus sativus,* I	Harvest seed stalks, Hang or put in buckets with tarp underneath till dry.
Spinach *Chenopod - Spinacia oleracea,*	Pick later slower bolting seed stalks. Cut, strip off seeds.

W	Winnow.
Squash, Pumpkin, Gourd *Cucurbita pepo* *Cucurbita maxima* *Cucurbita moschata* *Cucurbita argyrosperma*	Let grow big and hard. Let sit to cure and mature for about a month after picking. Scoop out seeds, rinse and dry. Pollinated by insects.
Sunflower, I	Harvest when mature. Store and plant in shell.

Biennial Vegetables

Beets *Chenopod- Beta vulgaris,* W	Over-winter means to dig up in the Fall, store in a box of moist sand in a root cellar and replant in the garden next spring. Cut stalks when seed clusters are dry and brown. Hang to finish drying then thresh seeds. Swiss chard and beets are in the same species and will cross.
Brussel Sprout *Brassica oleracea,*	Over-winter. Cut the stalks when dry and brittle, dry, thresh and clean.
Cabbage *Brassica oleracea,* I	Over-winter. Isolate from other *B. oleracea* (see list under ***Cabbage Family***) by one mile. Plant 10 or more plants together. Make a shallow X in the cabbage head in the spring to help seed stalk grow out and push up from the head. This is amazing to watch.
Carrots *Umbelliferae Daucus carota,* I	Over-winter. When seed heads are mature and brown, cut stalks and hang to dry. Rub seeds from heads and clean. Wild carrots (Queen Anne's Lace) and cultivated carrots will cross-pollinate. Separate by 1/2 mile.
Cauliflower *Brassica oleracea,* I	Over-winter. Cut the stalks when the seeds are dry and brittle, dry, thresh and clean. Do not harvest heads for food, but let them sprout seeds. Grow at least ten plants together for good genetic diversity.
Kale & Collard *Brassica oleracea,* I	This hardy vegetable can survive a mild winter with a protective covering of mulch or plastic and bear seed stalks next summer. Try it. Otherwise dig up, over-winter indoors and replant next spring.
Kohlrabi *Brassica oleracea,* I	Over-winter. Cut the stalks when the seeds are dry and brittle, dry, thresh and clean.
Leeks *Allium*	Try over-wintering in garden protected with plenty of mulch. Otherwise overwinter inside.

ampeloprasum, I	
Onions *Allium,* I	Over-winter the best ones. Replant in spring. Harvest when seeds are dry. Bend over seedheads into sack and cut off stalk.
Parsley *Petroselinum crispum,* I	Over winter. Harvest seeds in second year.
Parsnips *Pastinaca sativa,* I	Leave in soil all winter. Harvest seeds next year.
Rutabaga, Broccoli Raab, Turnip, *Brassica rapa,* I	In mild climates, plant in fall and harvest seed the following summer. In cold climates dig up and over-winter inside in the root cellar or greenhouse and replant in spring. Harvest dry brown seedpods in early fall.
Swiss Chard *Chenopod- Beta vulgaris,* W	Cut stalks when seed clusters are dry and brown. Hang to finish drying then thresh seeds. Swiss chard and beets are in the same species and will cross.

Herbs and Flowers

Basil *Ocimum basilicum*	Harvest seed heads when brown and brittle. Hang to finish drying indoors. Remove seeds by crumbling the flower heads then blow away the chaff.
Garlic *Amaryllid - Allium sativum*	A wonderful project to start the program because you plant the individual garlic cloves in the fall, and harvest a full garlic bulb next summer. Garlic does not commonly produce seeds.
Flowers	Let any annual flowers go to seed. Hang to dry.

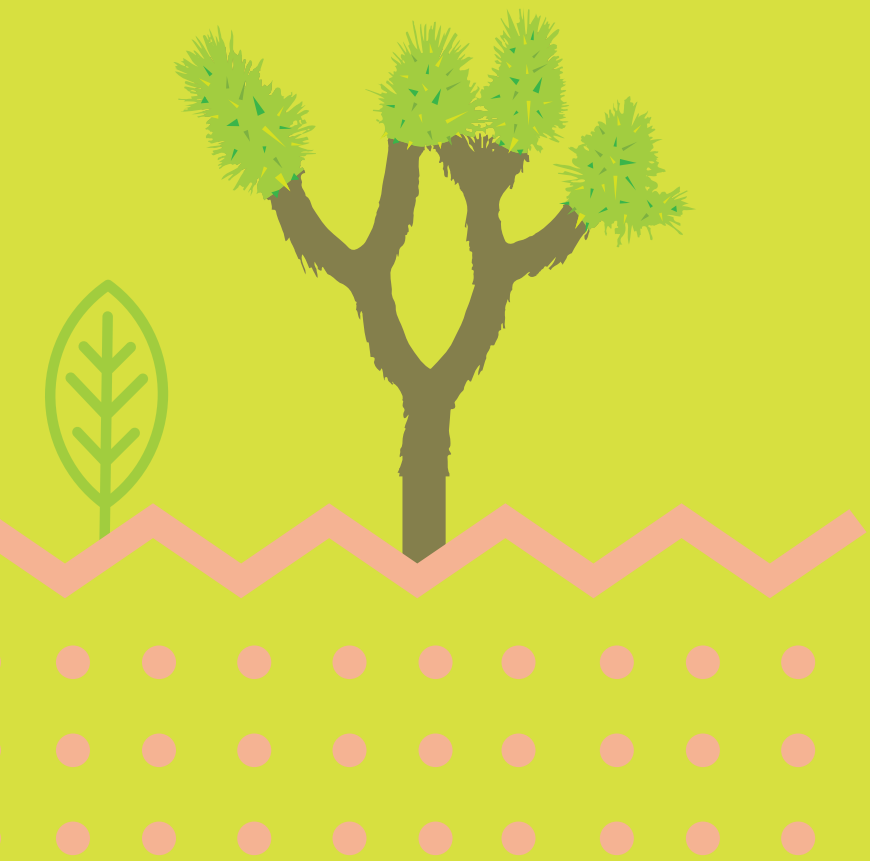
Fruits

Cantaloupe *Cucurbit - Cucumis melo*	The melon is ready to eat when it has a sweet fragrance and slips off the vine. These seeds can be harvested to save. Seeds from overripe melons are stronger. Scoop out and rinse the seeds.
Watermelon *Cucurbit -Citrulus vulgaris*	Practice thumb thumping on the melon for a resonant sound that tells when the melon is ripe. After you enjoy eating, separate out the seeds, rinse and save.

Grains

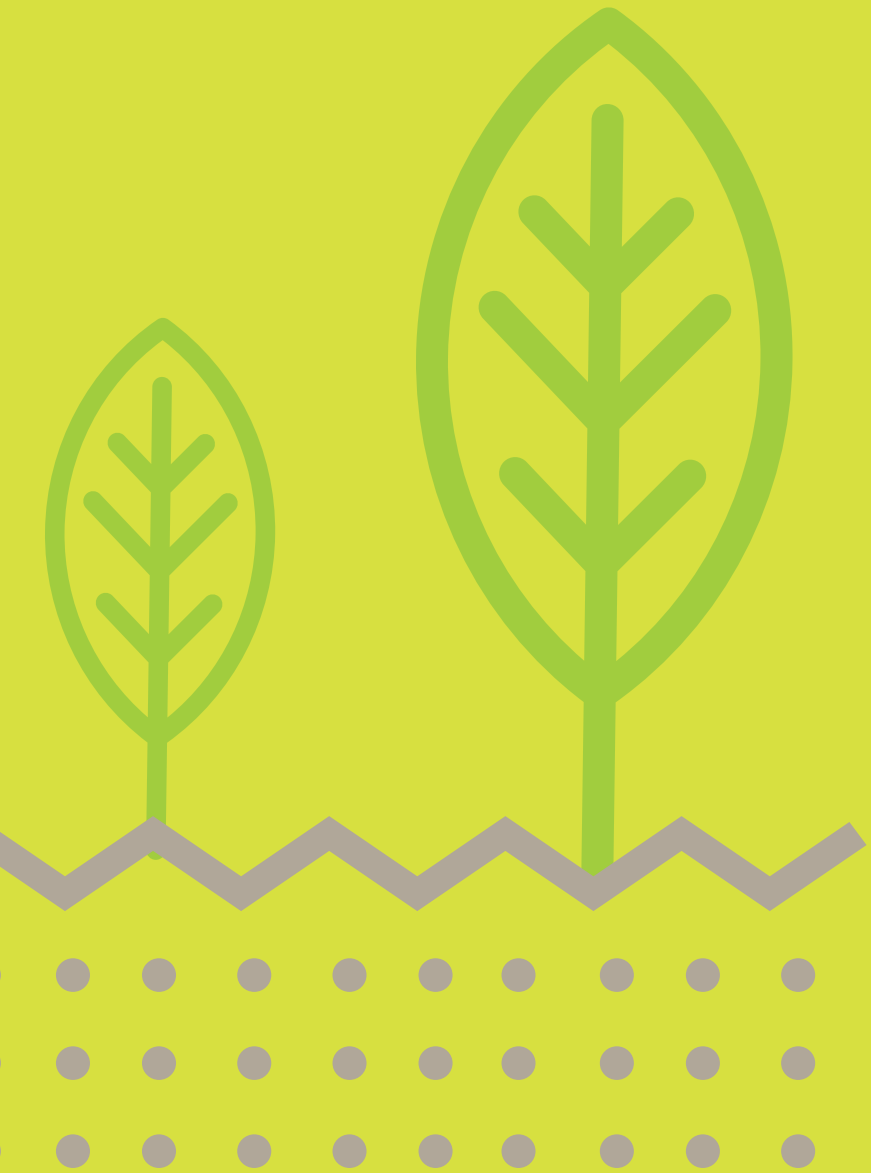
Amaranth *Amaranthus*	Collect seed heads as they dry on the plants and store in closed paper bags to finish drying (many of the seeds will shed naturally). Chaff easily blows away after seed heads are crumbled (watch for thorns or prickles in some plants).
Quinoa *Chenopod - Quinoa*	Harvest dry seed stalks. Allow to dry over a tarp. Collect.

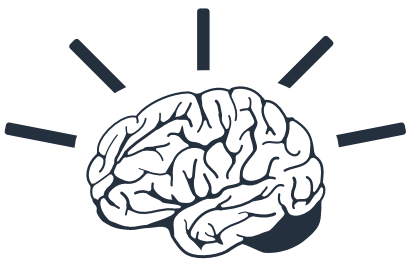
Sourced from FedCo Seed Company's book From Generation to Generation found at http://www.fedcoseeds.com/forms/seedschool.pdf



Lesson Twelve

Chef Program





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OVERVIEW

Fourth grade students will discover a local food heritage based on traditional native diets. Come harvest time, the students will design a menu and prepare the meal to share in a harvest celebration.

OBJECTIVES

- Students will research varieties of edible plants that thrive well in our Mojave Desert climate.
- Students will describe the diets and methods of food acquisition and preservation of regional native tribes.
- Students will partner with a local professional chef to design a menu and prepare a meal.

***If your school has not yet partnered with a chef, try reaching out to local restaurants or even parents for someone with a passion for cooking to spend some time harvesting and prepping a simple meal from the school garden.*

STANDARDS

Nevada State Standards

History

H1.4.3 Describe the lifestyles of Nevada's Native American cultures.

H3.4.1 Compare and/or contrast their daily lives with children in Nevada's past.

Health

(4)3.3 Plan a healthy menu emphasizing ethnic foods.

Next Generation Science Standards

4-LS1 From Molecules to Organisms: structures and processes.

4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

4-ESS3-2 Cause and effect relationships are routinely identified, tested, and used to explain change.

4-PS3-4 Science affects everyday life.

Common Core

RI.4.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

TIME

3 – 50 minute periods

QUESTIONS

- Why is it important to explore the different types of edible foods that grow well in the Mojave Desert?

MATERIALS

- Southern Paiute Bands map
- Southern Paiute Gardening Practices article, enough copies for each student
- Hand trowels
- Yellow and green highlighters
- Clark County map
- Las Vegas street map
- Native SEED/Search catalog (at this link: http://www.nativeseeds.org/pdf/seedlistingcatalog.pdf or email info@nativeseeds.org for a copy of the catalog)
- Cookbooks
- Copies of Recipe for Amaranth: http://www.nativeseeds.org/nss-blog/277-amaranth-grain
- Copies of Recipe for Flint Corn: http://www.nativeseeds.org/nss-blog/208-recipe-for-fresh-corn-tortillas

PROCEDURES

- DAY 1

1. Display the Southern Paiute Bands map for students to see. Identify the Southern Paiute Las Vegas tribe as the group of native people that lived in the Las Vegas Valley before the settlers arrived in the mid 1800s. See page 5 of Southern Paiute Student Booklet.

2. Distribute copies of Southern Paiute Gardening Practices article. Have students read independently.

3. Designate three small groups to gather information from the article as they re-read the article together:

- Group 1 - highlight plants the Paiutes grew in yellow and native plants the Paiutes gathered in green.
- Group 2 – highlight names of people and places.
- Group 3 - highlight the following vocabulary words: *berm, excavate, irrigation* and context clues to help define them.

4. As a whole group, share the information the groups found.

5. Prepare to take the class out to the garden. Explain that each group is responsible for completing the following tasks:

- Group 1 – identify any plants (farmed or native) that grow in the school garden currently, record the location and current condition of the plant in science journals.
- Group 2 – highlight places from article on Clark County map and Las Vegas Street map, mark a star where the school garden is located.
- Group 3 – locate and record examples by drawing detailed pictures of the vocabulary words *berm, excavate, and irrigation*. If examples do not already exist in your garden, allow group 3 to create them.

6. After sufficient time has passed for groups to complete tasks, gather students in a circle in the garden and have each group share what they did. Ask the following questions to stimulate group discussion:

- What plants are growing in the garden that was mentioned in the article?
- Where can you find the plants mentioned in the article on school grounds? Around campus? In the neighborhood? In Las Vegas?
- How close is the school to the places mentioned in the article? Corn Creek? Spring Mountains?
- What is an example of a *berm? Excavate? Irrigation?*

▶ DAY 2

1. Review list of edibles from article read on Day 1. Write the list on the whiteboard.

- Two types of corn
- Two of pumpkins
- Two different squashes
- Tepary and spotted beans
- Sunflower
- Amaranth
- Small-kerneled (Sonoran) wheat
- Quail beans or chick peas
- Hard-shelled watermelon

Identify small groups of students for each type of plant. Explain to the groups that they will collect information about growing, harvesting, and eating that plant.

*** Since most of the plants listed above are ready for harvest in the fall, you should plan on students planting seeds in late spring before school gets out so when they return in the fall, the plants will be ready to harvest.*

2. Introduce the two stations.

   - Station 1 - Set up the Smartboard, computer or iPad stations with the pdf of the Native SEED/Search catalog or make sufficient number of copies so partners can each have a copy. Students will use this resource to gather information about the different varieties of their edible plant available, growing and harvesting needs of each.
   - Station 2 - *** Invite the chef to participate in this step of the process.* Print out copies of the amaranth and corn recipes and an assortment of cookbooks. Students will use these resources to brainstorm different meals or foods they could make using those plants as a main ingredient.

3. Explain that the small groups will rotate through each station with a sufficient amount of time to gather information about growing, harvesting, and preparing the plant.

▶ PART 3 – Chef Demonstration

This will be scheduled after the harvest with your partner chef. For more information on scheduling and organizing the chef demonstration, please see The Chefs' Program.

ASSESSMENT

Science journal student observations

ADAPTATIONS

Visit the Old Mormon Fort, Springs Preserve, or the Clark County Heritage Museum for examples of native gardens and Early Settler gardens. Springs Preserve has a great example of a native garden right next to an Early Settler garden.

Invite local farmers to speak at your school about growing food in our region.

DIGGING DEEPER

- Visit the Old Mormon Fort, Springs Preserve, or the Clark County Heritage Museum for examples of native gardens and Early Settler gardens. Springs Preserve has a great example of a native garden right next to an Early Settler garden.
- Invite local farmers to speak at your school about growing food in our region.

DID YOU KNOW?

- Paiutes' used native plants for edible and medicinal purposes.
- While the harvest of pine nuts was very important to the Paiute people, they also needed to tend their gardens, planted at the springs and creeks of the valley foothills and valley floors. Tending gardens and harvesting nuts at the same time of year required that the people split their work force in the fall, with some moving into the mountains and others remaining at the valley camps.
- Seeds are an excellent source of food for people all over the world.

NUTRITION FACTS

- Canned fruits and vegetables can be just as healthy, and in some cases healthier, than fresh fruits and vegetables. When shopping for canned fruits and vegetables, be sure to buy ones with no added salt, no added sugar, and preserved in water rather than syrup.

STANDARDS FOR LESSON 12 LESSON MAP

NG 4-LS1 From Molecules to Organisms: structures and processes.

4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

4-ESS3-2 Cause and effect relationships are routinely identified, tested, and used to explain change.

4-PS3-4 Science affects everyday life.

Reading RI.4.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

Wrting W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic.

W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.

Speaking and Listening SL.4.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.

SL.4.4 Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace

Math 4.MD.A.1Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs [for example: (1, 12), (2, 24), (3, 36), and so on].

LESSON 12 LESSON MAP

Lesson 12: Chef Program

Day 1

- Procedure 1-6

Day 2

- Procedure 1-6
- (Include Garden observation)

Day 3-5 or more

- Procedure 1-3 stations and Part 3,
- Chef Demonstration

Day(s) _____

Math Conversion of measurements with cooking recipes.

Day(s) _____

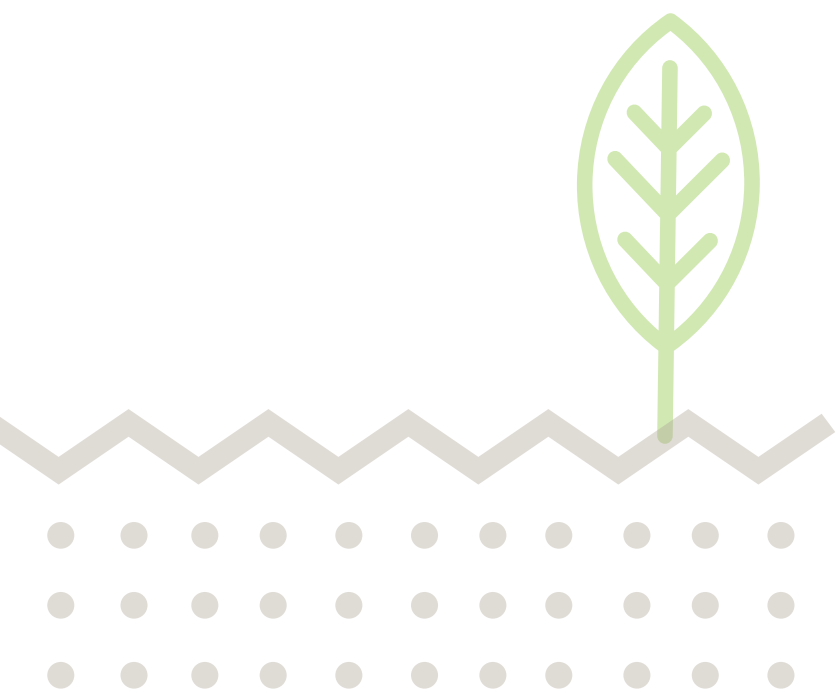
Literacy research writing extension, more days on research projects.

Group presentations on research and experiments

Day(s) _____

Science/Social Studies Extension

Scientific method and experiments more time or days.



SOUTHERN PAIUTE GARDENING PRACTICES

The Paiutes used spring and creek localities in a characteristic fashion. The planting site, up to an acre near or below a spring, was cleared, leveled, and banked with six to eight inches of dirt, just enough to keep the water from running off the garden. These banked lots were termed “ponds.” Irrigation ditches then were excavated to bring water to the rows of crops planted inside the berm. Pond construction or renewal began in November and December, to ready the land for early spring planting. Gardens were thoroughly soaked before planting, using pre-sprouted seeds. The same pond would be used for two to three years, then another site was cleared nearby and the irrigation ditch extended to it. Ideally, each crop had its own pond.

Favored crops included two types of corn, two pumpkins, two different squashes, tepary and spotted beans, sunflower, amaranth, small-kerneled (Sonoran) wheat, quail beans or chick peas, and a hard-shelled watermelon. The elders consulted at Corn Creek stated that besides corn, two kinds of squash were grown, one “like a pumpkin” and the other “like Italian squash” [*Patahuang* in Paiute]. All that is known about gardening methods at Corn Creek is that water was taken from the creek.

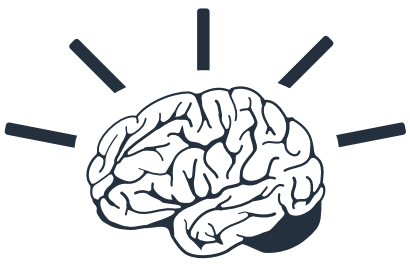
Native wild greens, seeds, and fruits, some of which were tended, supplemented the cultivated crops: pinyon pine, mesquite, agave, yucca, saltbush, rice grass, and grapes. At Corn Creek, the elders noted a number of important wild plants, some used for food, others for making tools such as needles: Indian spinach or prince’s plume (two types), mesquite beans, cattail, watercress, hedgehog and barrel cactus, and yucca. Insects, birds, reptiles, and mammals rounded out the diet. Pinyon pine trees do not grow at Corn Creek, but extensive stands flourish in the Spring Mountains, the Sheep and Las Vegas ranges, and other mountains within the Las Vegas Paiute territory. While the harvest of pine nuts was very important to the Paiute people, they also needed to tend their gardens, planted at the springs and creeks of the valley foothills and valley floors. Tending gardens and harvesting nuts at the same time of year required that the people split their work force in the fall, with some moving into the mountains and others remaining at the valley camps.

Excerpts from COYOTE NAMED THIS PLACE PAKONAPANTI - Elizabeth von Till Warren
http://mojavedesert.net/southern-paiute/paiute-gardening.html

For more information about how the Paiutes’ used native plants for edible and medicinal purposes:
http://mojavedesert.net/plant-use/

Lesson Thirteen

Preserving the Harvest



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OVERVIEW

Students will learn different methods of preserving foods.

OBJECTIVES

- Students will identify food that can be preserved by drying, canning and/or freezing.

STANDARDS

Nevada State Standards

(4)1.1 Generate investigative questions based on observations and interactions with objects, organisms and phenomena.

(4)1.2 Use science notebook entries to develop, communicate, and justify descriptions, explanations, and predictions.

(4) 1.3 Create and use labeled illustrations, graphs (number lines, pictographs, bar graphs, frequency tables), and charts to convey ideas, record observations, and make predictions.

(4)1.4 Conduct safe investigations with a partner and with a small group.

(4) 1.7 Identify observable patterns to organize items and ideas and make predictions.

Next Generation Standards:

4-ESS3-2 Cause and effect relationships are routinely identified, tested, and used to explain change.

4-ESS2-2 Science affects everyday life.

This lesson plan also addresses the following national standards:

- Life Skills: Working With Others — Displays effective interpersonal communication skills
- Language Arts: Writing — Gathers and uses information for research purposes
- Reading — Uses reading skills and strategies to understand and interpret a variety of informational texts.

TEACHER INFORMATION

Vocabulary for Food Categories:

- Drying: A method of food preservation that works by removing water.
- Canning: A method of preserving food by first heating it to a temperature that destroys contaminating microorganisms, then sealing it in airtight jars/tins.

- Freezing: A common method of food preservation, which slows both food decay and the growth of microorganisms.
- Pickling: A process of preparing a food by soaking and storing it in a brine (salt) or vinegar solution, a process which can preserve otherwise perishable foods for months.

TIME

2 – 60 minute sessions.

MATERIALS

- Pictures of unprepared food like from grocery store sale flyers
- Science Journals
- Chart (See Below)
- Scissors
- Glue
- Southern Paiute Student Handbook (one handbook for each pair of students)
- Two different colored pencils for each pair of students

PROCEDURES

- PART 1

1. Ask students why preserving food may have been important to the Southern Paiutes? The first settlers? Workers in town for the construction of Hoover Dam?

2. Have students pair up and hand out one handbook per pair of students.

3. Have students read through pages 6-12 of the Southern Paiute Student Handbook. One student will underline information about growing food with one color pencil, the other student will underline information about preserving or preparing food with a different colored pencil.

4. Ask partners to identify foods that, from the handbook they underlined, they are growing or they have seen growing in your school garden.

5. Have students write the answer to this question in their science journals: Why is it important for the Southern Paiutes to preserve food?

6. Ask students if they can identify any modern ways of preserving food. Display a canned food item, a pickled food item, and a dried food item. For the sake of simplicity, you can display a picture of a frozen food item or ask students to provide examples.

7. Discuss the history of canning, pickling, drying and freezing the harvest. Then, as a whole group, review and discuss vocabulary. For more information on these processes read *Saving the Seasons* by Mary Clemens Meyer and Susanna Meyer.

8. Have students write down definitions in their science journals.

9. Pass out shopping flyers. Explain to students that they will work in pairs to glue pictures into categories of how food could be preserved. Give students about 10 minutes to fill the chart with examples.

10. Next, ask students to share whether or not those food choices could be canned, frozen, pickled, or dried.

11. Think, pair, and share which process was the most efficient in past cultures and which would be the most efficient today.

▶ PART 2

1. Begin the lesson in the garden close to harvest time. Identify with students a crop that is over-abundant in your garden (can also coordinate this with your farmer if you have one). An example of a crop that you may have plenty of in the fall is okra. If you want to preserve a specific type of plant, plan ahead to plant more if it.

2. Ask students to recall the four common methods of preservation explored in part 1 of the lesson (canning, pickling, drying, freezing).

3. Have students draw a T-chart in their journals and record what is ready to harvest in the garden now and how they would preserve it:

Ready to Harvest	**How to Preserve**

4. Compile this information into a class T-chart and designate a student to type it up neatly to be sent to the chef you partner with. A good extension of this would be to designate another student to write a formal letter requesting a lesson in food preservation from the chef or a friend or family member with experience. Make sure to coordinate this with both your chef and gardener.

ASSESSMENT

Use the following three-point rubric to evaluate students' work during this lesson.

- Three points: Students were highly engaged in class and group discussions; used materials appropriately; produced a complete chart that included all requested information; and correctly identified all parts.
- Two points: Students participated in class and group discussions; used research materials with little assistance; produced an adequate chart, including most of the requested information; and correctly identified at least three parts.
- One point: Students participated minimally in class and group discussions; were unable to use research materials without teacher assistance; created an incomplete chart with little or none of the requested information; and identified two or fewer parts.

DIGGING DEEPER

- Discuss Food Borne Illness and Food Safety Risks associated with sun-drying foods.
- Native American Food Preservation Methods: Sun Drying.

DID YOU KNOW?

- People have been preserving food for centuries.
- People found ancient beans in some Native American ruins they had never seen before. They planted them, and they GREW! That's why we have Anasazi beans today.
- One way people save seed for the future is to make seed balls.

LESSON 13 STANDARDS & LESSON MAP

NG 4-ESS2-2.Analyze and interpret data from maps to describe patterns of Earth's features.

4-ESS3-2 Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS3-2).

ELA Reading :R.I.4.5 Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.

ELA Wrting W.4.1 write opinion pieces on topics or texts, supporting a point of view with reasons and information

Math 4.OA.C.5 Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself.

Lesson 13: Preserving the Harvest

Day 1

- Procedures 1-3

Day 2

- Procedures 4-8

Day 3

- Procedures 9-11

Day 4

- In the garden Part 2 Procedures 1-3

Day(s) _____

Math Patterns using t-chart inputs and outputs.

Day(s) _____

Literacy Compare and contrast preservation methods and eat raw or fresh foods.

Opinion piece on preservatives in foods today

Day(s) _____

Science/Social Studies Extension

Timeline of food preservation, or a compare and contrast then and now.

Garden Observation

CHART FOR LESSON 13-PRESERVING THE HARVEST

Pickling	Drying	Freezing	Canning

SOUTHERN PAIUTE

SOUTHERN PAIUTE
Table of Contents

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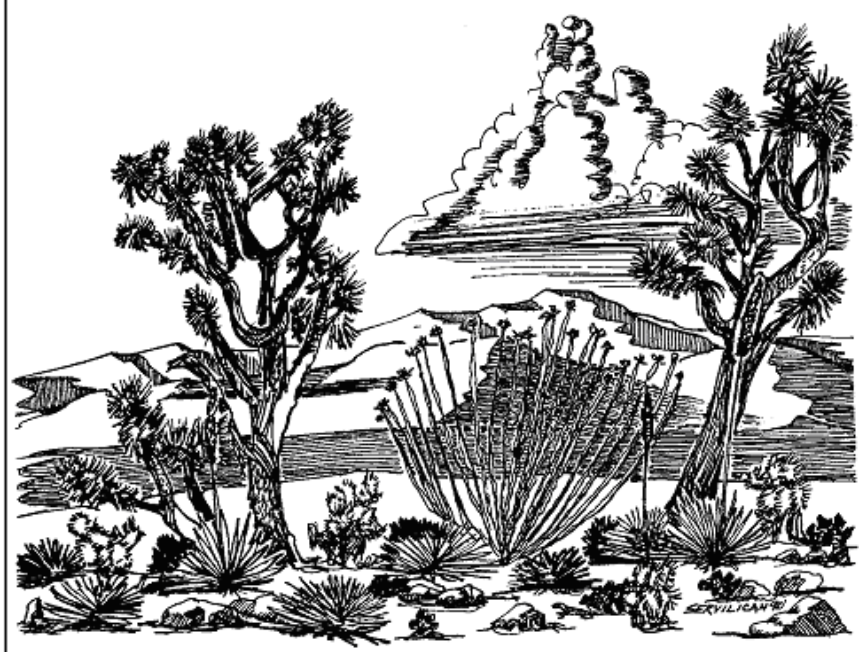
SP-3	Southern Paiute Bands
SP-4	Southern Paiute Bands Map
SP-5	Yearly Survival
	Spring
SP-6	Summer
SP-7-SP-9	Fall
SP-10	Winter
SP-11	Pottery
SP-12	Government and Family Structure
SP-13	Songs and Stories
SP-14	Southern Paiute Language
SP-15	Present Day Notable Southern Paiute
SP-16	Topsy Chapel Swain
SP-17	Ilee Morfy Castillo
SP-18	Stella Smith
SP-19-SP-20	Toney Tillohash
SP-21 - SP-24	Significant Historical Dates

The Southern Paiute

The Southern Paiute or "the Nuwuvi," call themselves "the People." The Shoshone and Northern Paiute are related to the Southern Paiute. They share many similar cultural traits such as foods, basketry, and animals used for hunting. These similarities are due to the same environmental factors.

The Nuwuvi people live in southern Nevada, southern Utah, southern California, and northern Arizona. They have many characteristics that are unique to their culture and traditions.

The Southern Paiute are divided into individual bands. Although they belong to the same tribe, each band is unique. For example, the Kaibab Band pronounces words differently than the Moapa Band. In the Kaibab dialect, the word snake is pronounced "quats" and in the Moapa dialect it is pronounced "tugav."



The Southern Paiute bands are listed here:

NEVADA
Las Vegas - Las Vegas
Moapa - Moapa
Pahrumpats - Pahrump
Pahranagats - Pahranagat Valley
Panaca - Panaca

ARIZONA
Chemehuevi - Parker
Kaibab - Kaibab Plateau
San Juan - San Juan River
Shivwits - Shivwits Plateau
Uinkaret - Uinkaret Plateau

UTAH
Antarianunts - Henry Mountains
Cedar - Cedar City
Kaiparowits - Escalante
Saint George - Saint George
Beaver - Beaver
Gunlock - Gunlock
Panguitch – Panguitch

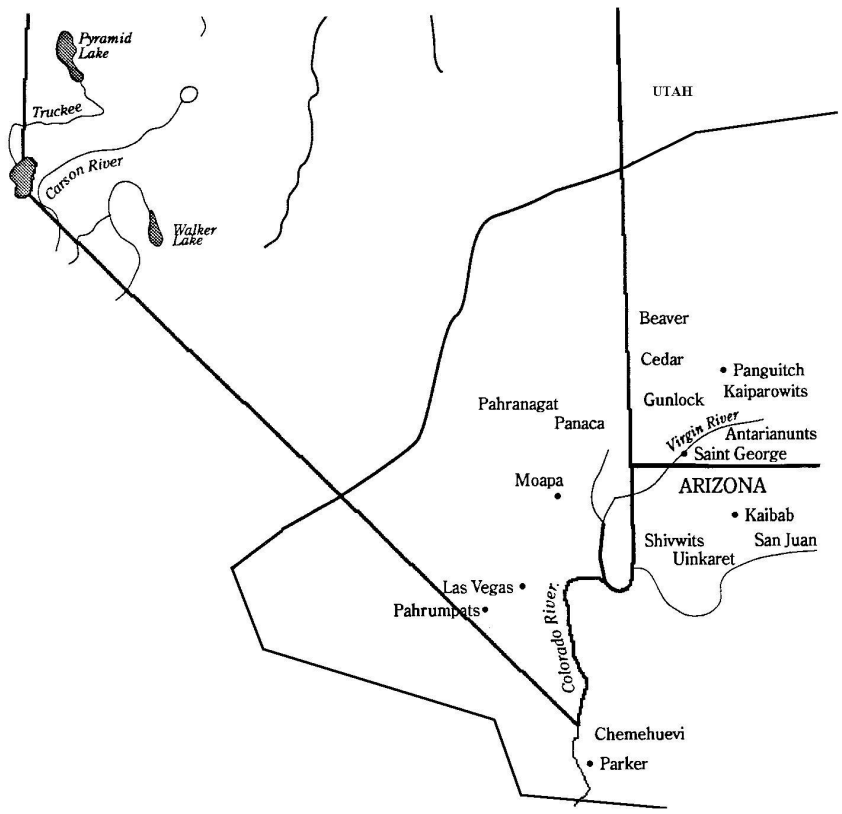
Each band had its own territory and land areas in which it traveled and gathered food, or planted its crops.

Bands would trade with other bands and tribes to acquire various items such as food, clothing, cloth, and tools.

Southern Paiute Bands

LOCATION: Seventeen identifiable groups at Southern Paiute were located in the previously mentioned areas of southern Nevada, southern Utah, southern California, and northern Arizona.

The names for these bands are listed for the communities they are located near. The original names of the bands were based upon the type of food gathered or the animals hunted in a particular area.



YEARLY SURVIVAL

The Southern Paiute moved to different areas according to a carefully planned cycle. This cycle evolved around the seasons of the year.

Spring

Small insects and rattlesnakes were eaten in the spring. Big game was not hunted because the animals were producing offspring and the hides and furs were not of a quality that could be used.

The Nuwuvi cultivated and fanned crops such as corn, cowpeas, mushmelons, watermelons, amaranth, winter wheat, squash, beans, pumpkin, and sunflowers. They would plant their corns in early spring, leave to gather early season plants, and return to tend and harvest the crops.

Planting methods included:

1. A flood irrigation system using ditches that diverted water from rivers, streams, and springs.

2. Digging pits three feet across by six feet deep. These pits would collect rain or spring water. This would water the plants growing in small mounds inside the pit. A wooden shovel and spade-type instrument were the only tools used.

SUMMER

The summer shelter was a shade or windbreak type structure made from willows, juniper, and/or brush. These structures could be either flat or dome shaped.

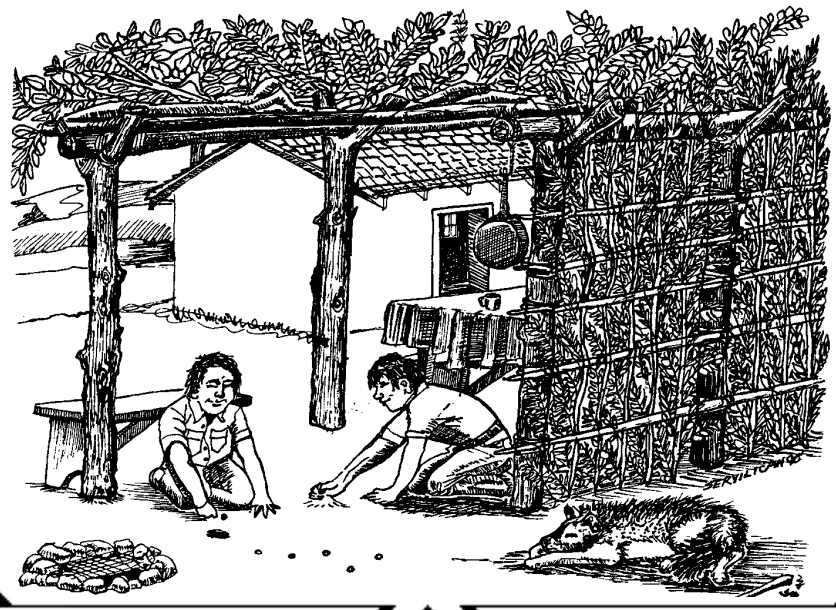
Berries, mesquite beans, and other plants were picked during the summer to supplement the diet. In late summer, big game such as deer, antelope, and mountain sheep were hunted and the meat was dried. Hides were dried and saved for tanning in the winter months.

Bows and arrows were used for hunting, especially big game. Nets and clubs were used for the small game. Knives were made from bone or certain types of stone.

bighorn sheep

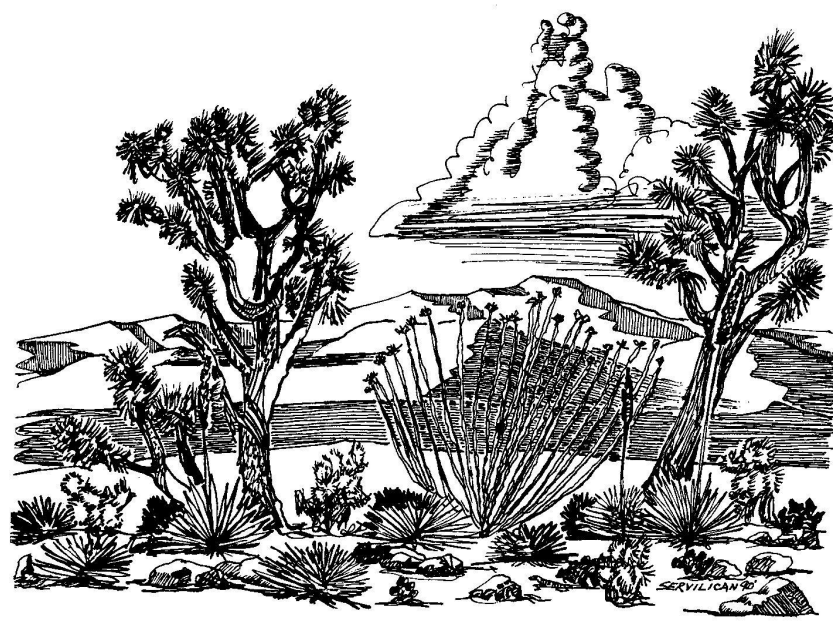
deer

pronghorn antelope

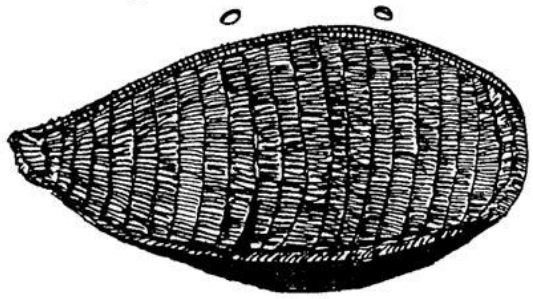


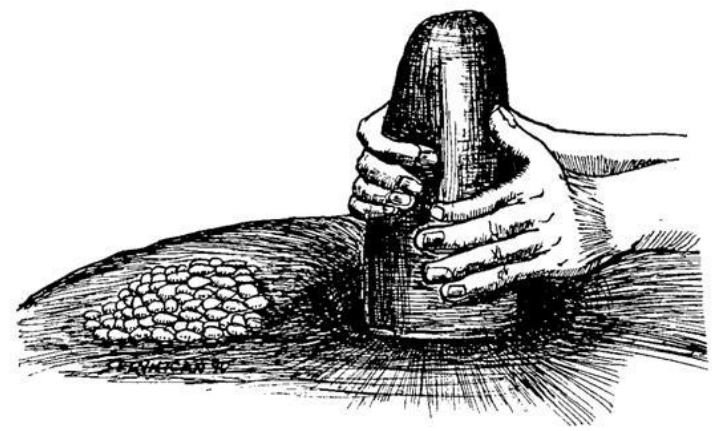
FALL

The bands would travel to different areas at just the right times to gather the ripening foods, or hunt migrating game in specific locations. Food was stored in caves and other safe places where the Nuwuvi would return in the winter months. Foods gathered included mesquite, screw beans, Indian spinach, agave, pinenuts, various seeds, Indian tea, sunflowers, berries and prickly pear cactus.

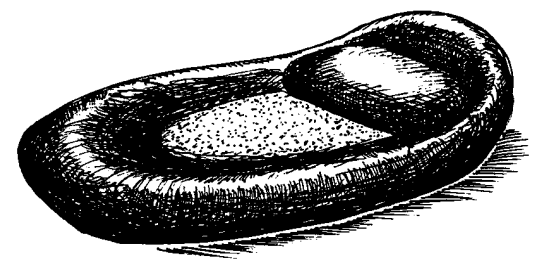


Winnowing trays were
used to separate the nutmeats
from the shells.
The nuts were gently tossed into
the air and a breeze
would carry away the shells
and other debris, leaving the
clean nutmeats
in the tray.





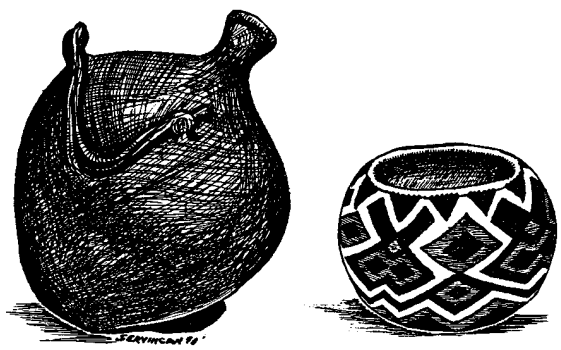
Grinding stones were used to hull seeds and mill flour. Hulling of the seeds was done to remove the shells from the nutmeats. The nutmeats were ground into flour for soups and breads.



WINTER

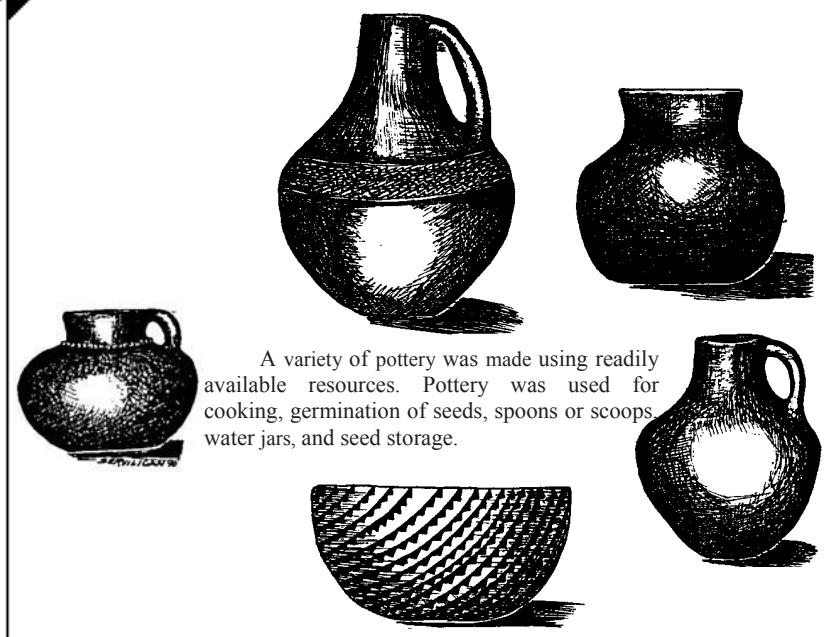
Winter homesites varied with each band. Some chose to winter at the higher elevations where they had plenty of fuel, food stores, and snow could be utilized for water. If the pinenuts were not a staple food, winter was generally spent at the foot of hills or in canyons. Caves were used as winter dwellings, or if no caves were available, a dirt covered shelter was made.

Small game was the chief source of protein. Rabbits were hunted individually or in drives. Other small game included woodrats, mice, gophers, squirrels, chipmunks, and birds. Some groups also ate lizards, snakes, chuckwallas, and tortoise. Tanned hides such as buckskin, antelope skin, and rabbit fur provided clothing for warmth and shoes. Cloth made from various plants such as sage, grass, and pine were used for skirts, shirts, hats, and leggings. Awls were made from bone or stone and used for serving and cooking.



Baskets were made from a variety of grass, willow, and bark. These included winnowing/parching trays, burden baskets, and seed beaters, cooking baskets, water jugs, and cradleboards. These baskets were made in the wintertime and were lightweight so that they could be carried with the group when they traveled.

Winter was also a favorite time for the family for telling stories and songs.

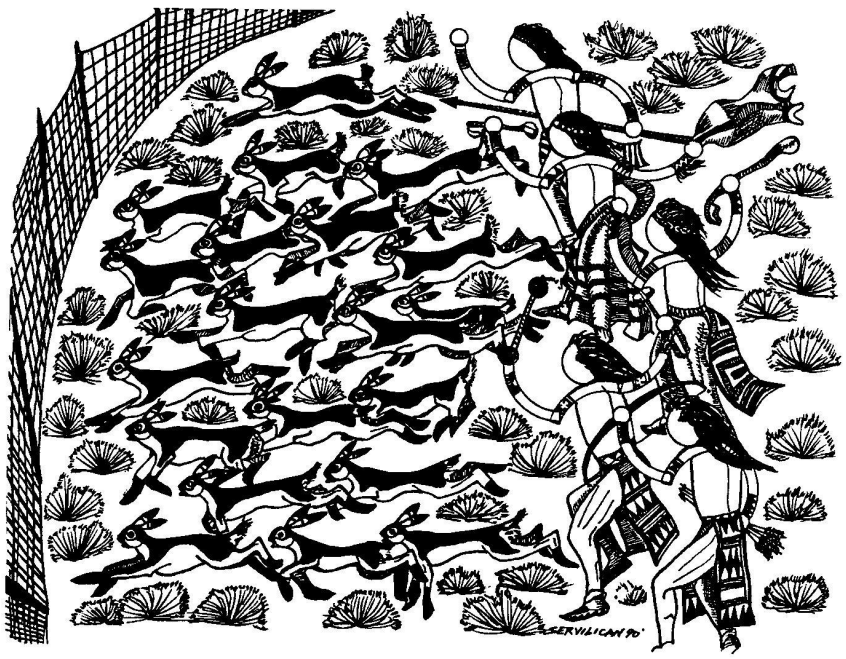


A variety of pottery was made using readily available resources. Pottery was used for cooking, germination of seeds, spoons or scoops, water jars, and seed storage.

One group of Southern Paiute made a large pot for ferrying children across the river.

GOVERNMENT AND FAMILY STRUCTURE

The Southern Paiute lived in small groups or bands. Various leaders were in charge of different group activities, such as food gathering, hunting, and social gathering. These leaders were different for various activities. The group could change a leader if they were dissatisfied with the person. Leadership was not passed down from a father to son. A person had to earn the respect of the group in order to become a leader.



SONGS AND STORIES

Songs served many purposes. Most songs served to identify places or events. Songs were used for events or activities which included funerals, salt gatherings, and hunting animals such as deer, mountain sheep, bird and quails. Coyote songs were used to tell stories for entertainment.

Four types of musical instruments have been identified. They are as follows:

1. Flageolet - a length of elderberry wood with the pith removed, similar to a flute. This was used by young boys but not used for love songs as is popularly believed.

2. Rasp - two sticks that were either rubbed against each other or held in the same hand and shaken.

3. Basket Drum.

4. Gourd rattle.

Stories

Stories served to record the history of a group. Stories were used to teach values, customs, social norms, and for entertainment. Many women knew the tales, but the men were the storytellers. Stories were told on winter evenings because if stories were told in the summer, it was believed, snake bite might occur.

SOUTHERN PAIUTE LANGUAGE

English	Southern Paiute
Rabbit	Kamu
Fish	Pagu'ts
Deer	Tuhu'i
House	Kan
One	Suwi
Two	Wai
Three	Pahi
Four	Watsu'i
Five	Manu'gi
Six	Na'vai
Seven	Mukw'ca
Eight	Nahnsuwi
Nine	Yuwi'pe
Ten	Masu

PRESENT DAY

The Nuwuvi of today live in many places. Some live on the Moapa Indian Reservation, east of Las Vegas. Others live and work off the reservation in communities that were built at the homesites of their forefathers. Some of these include Kaibab, Las Vegas, Cedar City, Konash, and Richfield.

Nuwuvi of today work in many occupations including ranchers, farmers, teachers, food services personnel, business men and women and a number of other vocations.

Many Nuwuvi carry on the culture and ways of their ancestors today. These include hunting, fishing, and crafts such as beadwork, basketry, and buckskin work Rodeos, pow-wows, hand games, and sporting events continue to carry on the music, dances, and social interaction that was so vital to the Nuwuvi of yesterday.

The tribal bands of today are governed by tribal councils which are elected by the people. Today the tribal governments are actively involved in the welfare of their people. For instance, the Las Vegas Paiute Tribe is financially stable due to economic growth from the smokeshop on the reservation. The Moapa Band of Southern Paiutes is engaged in farming enterprises and firework sales. Presently, the tribal council is negotiating a multi-million dollar cogeneration plant. Today the Nuwuvi live in modem homes with all modern facilities. Children attend the schools located in the nearby communities.

The Utah Paiutes were restored to federal status on April 3, 1980. Federal status allows tribes to operate their own government structure.

TOPSY CHAPEL SWAIN

Topsy Chapel Swain does not know when she was born. Topsy grew up in the ways of the old ones. She traveled from place to place, harvesting the crops of the ranches in Glendale, Overton, and Logandale. She remembers when the federal government ordered the Paiutes to move to the reservation. She said, "We didn't really know why the white people were taking our land. Now the younger people know why, and they're getting some of our land back" *(Nevada Magazine*, 7/89). Known for her skill as a basketmaker, she is one of the few who still have the knowledge of this art that was so vital to the survival of the Paiute. Topsy Swain passed away in 1990.

ILEE MORFY CASTILLO

Ilee Morfy Castillo was born in 1913 west of Las Vegas, Nevada. Her father was Joe Morfy and her mother was Tutupaum. When she was eleven years old, she was taken away to the Indian Boarding School at Ft Mohave, Arizona.

Ilee's experience at the Ft Mohave school were not happy ones. Students were not allowed to speak their native language. Ilee said, If we did, we had our mouths washed out with soap and sometimes were locked up in the attic for days with only bread and water to eat and drink." Many of the students ran away from school, Ilee ran away twice and was whipped after she was caught. The dormitory matron permitted Ilee to choose the size of whip, thick or thin, Ilee said, "I always chose the thick one because it didn't hurt much." Another punishment was to make the students march back and forth "for what seemed like an hour to us." The boys would have to wear leg irons.

All the students at the school had to dress alike and were divided in companies - A, B, and C. Each student wore an identification number. Ilee was in company B, number 107.

Ilee went to Los Angeles as many of the students did in the summer. The girls who went there would go to school and work as domestic help. These jobs included working in the laundry, kitchen, waiting on tables, and sewing clothing. While in Los Angeles, the students were taken to movies, baseball games and picnics.

Ilee returned home to Las Vegas in 1929, where she resided thereafter.

STELLA SMITH

Stella Smith, one of the oldest residents on the Las Vegas Indian Colony, was born somewhere around 1895. Her parents were Southern Paiutes, Tracy Domache Smith and Bishop Smith. They lived in the traditional ways of the people in the area. When she was a child her family farmed melon, corn, and black-eyed peas. She remembers living in a willow home that was comfortable and pleasant, especially the fresh air.

Stella was sent to school at Fort Mohave at an early age. She then moved to Phoenix, where she became sick and had to spent two years in the hospital. Returning to the Las Vegas Indian Colony in 1932, she realized things had changed. Many of the Indian people now worked on ranches and various jobs in the city. Stella worked as a housekeeper for many years in Las Vegas. At that time, many of the Indian people also lived in houses similar to the white man. Stella remembers that brush homes were still used in the colony until about 1950. Stella also remembers when she ate pinenut mush, cactus, deer meat, turtle meat, and fish. Although she does not depend on these foods now because canned foods are available, she still enjoys eating the foods she ate as a child.

TONEY TILLOHASH

Toney Tillohash was born about 1885. He and his parents lived on a small farm and garden in Moccasin, Arizona, that the Mormons had given them. Toney lived in Moccasin until his parents died. He then lived and worked on the farm of Jonathan and Alvin Heatton, two Mormons who also lived in the area. He left Moccasin in 1904 and attended school at the Teller Institute in Grand Junction, Colorado. In 1905, he moved to Pennsylvania and attended school at Carlisle. There he learned harness-making skills and served as an informant for the linguist Edward Sapir. The information Toney provided was used as the basis of Sapir's book, *Southern Paiute, A Shoshonean Language*.

Toney was not allowed to return home for vacations so he spent his summers working on farms in Pennsylvania. Toney returned from Carlisle after five years and moved to the Shivwits Reservation. There he married a Shivwit woman, Bessie, and they worked a small farm. During his life he worked as a cattle driver, a horse breaker, a farmhand and a miner in the mines around Moapa, Nevada. Tony was employed at Zion National Park where he supplied the Paiute names for the different geographical features in the area. The Indian specialist accused Toney of giving the wrong names for some of the areas. Toney said, "I give the names of my grandfather's land. It's there. It was there. Those are the names put there by the Indians."

Toney served as the Chairman of the Shivwits Tribal Council and was instrumental in the formation of the Shivwits tribal government. During this time, Toney read in a newspaper about a land claims hearing that was to be held in Moapa, Nevada. The claims hearing officials had not notified all the Southern Paiute of this meeting. Realizing important decisions might be made that would affect them, Toney and some other people went to the hearing. Toney discussed the land claims issue with the land claims attorneys, and was instrumental in helping to win the claim for the Paiute people.

SIGNIFICANT HISTORICAL DATES

Several historical occurrences permanently altered the way of life of the Nuwuvi.

1776: The Escalante-Domingues expedition became the first Europeans to enter the Nuwuvi territory. The purpose of this expedition was to find a shorter travel route from Santa Fe to current day Monterey, California This expedition was named after the Spanish friar whose purpose was also to "civilize" and "save" the Indians by converting them to Christianity.

Effect: This expedition opened the way for other explorers who had previously not explored the Great Basin area.

1800s: The Spanish explorers, traders, and slavers established the Old Spanish Trail connecting Santa Fe to Monterey, California. The Spanish, Utes, and Navajo would steal the Nuwuvi women and children and sell them as slaves. The livestock herders would also use the Nuwuvi crops to forage their animals. This destroyed the food that was to be used in the winter months.

Effect: The population of the Nuwuvi was reduced by about one half. The Nuwuvi also moved away from the prime farming areas to avoid contact with the traders. There was fear of kidnapping and destruction.

Mid-1800s: The Mormon settlements moved into southern Nevada. The best land was claimed for homesites. This was also the home of the Nuwuvi. The Utah Territory legalized indentured servitude, which allowed the Mormons to use the Nuwuvi as slave labor. Also the Nuwuvi were not allowed to attend school.

Effect: The Nuwuvi were forced to move from their homes and work for the people who claimed the land. Their way of life changed from one of gathering, planting, and hunting to one of working for wages. The Nuwuvi became dependent on the ranchers for employment and worked for minimum wages. They were unable to develop their own ranches because the Mormon settlers claimed the land and told the Nuwuvi that they were the ones who were trespassing.

1873-1875: President U.S. Grant created the Moapa reservation of 3,900 acres. Two years later the reservation was reduced to 1,000 acres. This reservation was to be set aside for all of the Southern Paiute of Nevada

1980: An additional 70,000 acres were restored to the Southern Paiute Tribe in 1980.

Effect: The original land base on which the Nuwuvi lived and roamed for subsistence was drastically reduced from approximately 2 million acres to 1,000 acres with the creation of the reservation. The Nuwuvi were unable to continue to live the way they had before. There was not enough land for all the Nuwuvi to live on, so many did not or could not live on the reservation. They lived on ranches or near the towns where they originally lived. The reservation was reduced in 1875 because white settlers had claimed the land that was part of the reservation and the U.S. Government was unwilling to make the settlers move. During this time the agents who were to assist in managing the reservation would sell the Nuwuvi crops and pasture. The agent would keep the money he received for himself.

1890: The State of Nevada created the Stewart Indian School located in Carson City, Nevada. Stewart Indian School was created to educate the children of Nuwuvi in the skills and ways of the white culture. Most of the Nuwuvi children were forced to go to Stewart or another boarding school to get an elementary and secondary education, and to also learn a trade.

Effect: The Nuwuvi children were removed from their families and homes and placed in a military school type of environment that was completely different from any they had known. The Nuwuvi language and culture was forbidden from being spoken and recognized so that is become almost non-existent today. The values and knowledge of the Nuwuvi was destroyed and replaced by the values of the European culture.

Sourced from Celebrating Nevada Indians at http://celebratingnevadaindians.info/files/CNI_14_S._Paiute_Student_booklet.pdf

