ELEM

Engineering By Design

Advancing Technological Literacy

A Standards-Based Program Series

Moon Munchies

Human Exploration Project
Engineering Design Challenge

A Standards-Based Elementary School Model Unit Guide

Moon Munchies

Design and Evaluate (Lessons 1-3)

International Technology Education Association
Center to Advance the Teaching of Technology & Science

Inspiration + Innovation + Discovery = Future

Preface

Moon Munchies

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The ITEA-CATTS Human Exploration Project (HEP)
People, Education and Technology

In May 2005, ITEA was funded by the National Aeronautics and Space Administration (NASA) to develop curricular units for Grades K-12 on Space Exploration. The units focus on aspects of the themes that NASA Engineers and Scientists—as well as future generations of explorers—must consider, such as Energy and Power, Transportation and Lunar Plant Growth Chambers (the STS-118 Design Challenges). Moreover, the units are embedded within a larger Model Program for technology education known as Engineering byDesign™.

The Human Exploration Project (HEP) units have several common characteristics. All units:

- Are based upon the Technological Literacy standards (ITEA, 2000/2002).
- Coordinate with Science (AAAS, 1993) and Mathematics standards (NCTM, 2000).
- Utilize a standards-based development approach (ITEA, 2005).
- Stand alone and coordinate with ITEA-CATTS Engineering byDesign™ curricular offerings.
- Reflect a unique partnership between NASA scientists and engineers and education professionals.

These unit guides are designed to be practical and user-friendly. ITEA welcomes feedback from users in the field as we continually refine these curricular products, ensuring that the content remains as dynamic as the technological world in which we live. Please email ebd@iteaconnect.org or call 703-860-2100.

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Unit Overview

Design is a creative problem-solving process. In this unit, students will design and evaluate a lunar plant growth chamber.

> ***Big Idea***
> *The design process helps humans solve the problems of growing plans for food on the moon..*

Standards

Technology: Standards for Technological Literacy (*STL*) *(ITEA, 2000/2002)*

- Students will develop an understanding of the characteristics and scope of technology. (ITEA/*STL* – 1)
- Students will develop an understanding of the attributes of design. (ITEA/*STL* 8)
- Students will develop an understanding of engineering design. (ITEA/*STL* 9)

Science: Benchmarks for Science Literacy *(AAAS, 1993)*

- The Nature of Technology/Issues in Technology (AAAS 3C)
- The Living Environment/Diversity of Life (AAAS 5A)
- The Living Environment/Cells (AAAS 5C)
- The Living Environment/Flow of Matter and Energy (AAAS 5E)
- The Human Organism/Human Identity (AAAS 6A)
- The Human Organism/Physical Health (AAAS 6E
- Common Themes/Systems (AAAS 11A)
- Habits of Mind/Values and Attitudes (AAAS 12A)
- Habits of Mind/Communication Skills (AAAS 12D)

Mathematics: Principles and Standards for School Mathematics *(NCTM, 2000)*

- Geometry
- Data Analysis and Probability

Science: National Science Education Standards *(NRC, 1996)*

- Earth and Space Science/All students should develop an understanding of properties of earth materials. (NCR D)
- Earth and Space Science/All students should develop an understanding of objects in the sky. (NCR D)

Social Studies: Expectations of Excellence *(NCSS, 1994)*

- Social studies programs should include experiences that provide for the study of people, places and environments, so that the learner can consider existing uses and propose and evaluate alternative uses of resources and land in home, school, community, the region and beyond.

English Language Arts: Standards for the English Language Arts *(NCTE, 1996)*

- Students read a wide range of print and non-print texts to build an understanding of texts, of themselves and of the cultures of the United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among these texts are fiction and nonfiction, classic and contemporary works.

- Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.
- Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.
- Students adjust their use of spoken, written and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.
- Students use spoken, written and visual language to accomplish their own purposes. (e.g., for learning, enjoyment, persuasion and the exchange of information).

Benchmarks

Technology: Standards for Technological Literacy *(ITEA, 2000/2002)*

- The natural world and human-made world are different. (ITEA/*STL* 1A)
- Everyone can design solutions to a problem. (ITEA/*STL* 8A)
- Design is a creative process. (ITEA/*STL* 8B)
- The engineering design process includes identifying a problem, looking for ideas, developing solutions and sharing solutions with others. (ITEA/*STL* 9A)
- Expressing ideas to others verbally and through sketches and models is an important part of the design process. (ITEA/*STL* 9B)

Science: Benchmarks for Science Literacy *(AAAS, 1993)*

- When a group of people wants to build something or try something new, they should try to figure out ahead of time how it might affect other people. (AAAS 3C)
- Plants and animals have features that help them live in different environments. (AAAS 5A)
- Magnifiers help people see things they could not see without them. (AAAS 5C)
- Most living things need water, food and air. (AAAS 5C)
- Plants and animals both need to take in water, and animals need to take in food. In addition, plants need light. (AAAS 5E)
- People need water, food, air, waste removal and a particular range of temperatures in their environment, just as other animals do. (AAAS 6A)
- Eating a variety of healthful foods and getting enough exercise and rest help people to stay healthy. (AAAS 6E)
- People, alone or in groups, are always inventing new ways to solve problems and get work Most things are made of parts. (AAAS 11A)
- Raise questions about the world around them and be willing to seek answers to some of them by making careful observations and trying things out. (AAAS 12A)
- Draw pictures that correctly portray at least some features of the thing being described. (AAAS 12D)

Mathematics: Principles and Standards for School Mathematics *(NCTM, 2000)*

- Represent data using concrete objects, pictures and graphs. (NCTM Data Analysis and Probability)
- Recognize, name, build, draw, compare and sort two- and three-dimensional shapes. (NCTM Geometry)
- Describe attributes and parts of two- and three-dimensional shapes. (NCTM Geometry)

Science: National Science Education Standards *(NRC, 1996)*

- Earth materials are solid rocks and soils, water and the gases of the atmosphere. The varied materials have different physical and chemical properties, which make them useful in different ways, for example, as building materials, as sources of fuel or for growing the plants we use as food. Earth materials provide many of the resources that humans use.
- The sun, moon, stars, clouds, birds and airplanes all have properties, locations and movements that can be observed and described.
- Resources are things that we get from the living and nonliving environment to meet the needs and wants of a population.
- Some resources are basic materials, such as air, water and soil; some are produced from basic resources, such as food, fuel and building materials; and some resources are nonmaterial, such as quiet places, beauty, security and safety.

Purpose of Unit

To understand and apply the design process as it relates to plant growth on the moon.

Unit Objectives

Lesson 1: Natural Resources on Earth

Students will:

- Identify natural resources on Earth.
- Identify the natural resources that help seeds/plants grow.
- Identify plants that provide food for people.

Lesson 2: Exploring the Moon

Students will:

- Identify and describe properties of the moon.
- Compare and contrast the properties of the moon and Earth.
- Determine a growth chamber is needed to grow plants on the moon.

Lesson 3: Designing the Growth Chamber

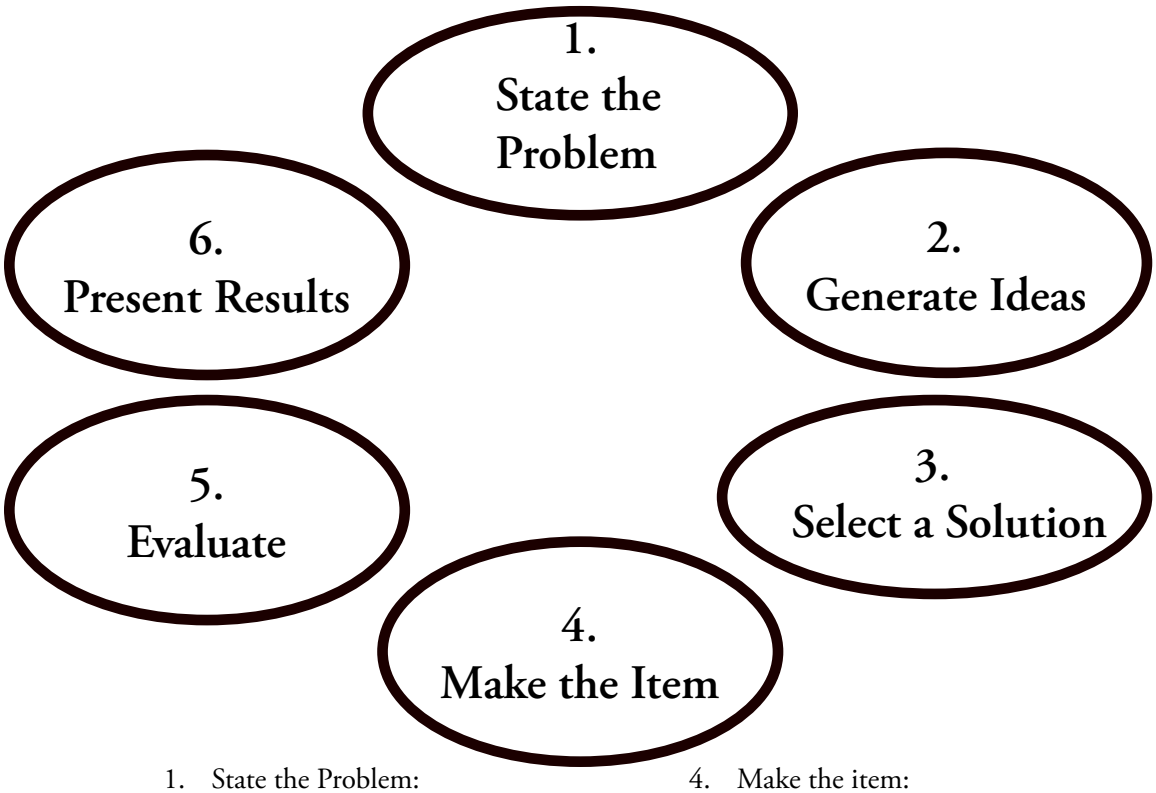
Students will:

- Sketch a diagram of their lunar plant growth chamber.
- Verbally explain their design to others.

Teacher Preparation and Resources

As children look up at the night sky, they are certain that the lunar "ball" changes its shape. This unit is designed to help children understand the design process as well as engage them in activities that will help them learn more about our Earth and moon.

The Engineering Design Process



1. State the Problem:
   - Explain the problem
   - Explain the guidelines
   - Set goals or desired results (teacher explanation)
2. Generate Ideas:
   - Brainstorm with others
   - Read books
   - Search the Internet
3. Select a Solution:
   - Sketches
   - Trial and error
4. Make the item:
   - Use resources
5. Evaluate:
   - Test, Revise; Test, Revise
   - Make adjustments/Changes
   - Improve
6. Present Results:
   - Verbal explanations
   - Share models

Lesson 1: Natural Resources on Earth

Lesson Snapshot

Overview

Big Idea: Earth offers many natural resources that help us to live.
Teacher's Note: Big ideas should be made explicit to students by writing them on the board and/or reading them aloud.

Purpose of Lesson: This lesson introduces students to the natural resources that help plants grow.

Lesson Duration: A total of three hours, which may be spread over several days.

Activity Highlights

Engagement: Students work in small groups to explore natural resource items. Groups list the items on a worksheet and record their importance to humans. The teacher leads a discussion to determine the importance of these items to humans.

Exploration: The teacher guides students through a booklet about the natural environment. Students read, discuss and illustrate. Students observe and answer questions about seeds. Students also read, discuss and illustrate a booklet about seeds. Students observe and answer questions about plants. Students also read, discuss and illustrate a booklet about plants.

Explanation: Students verbally identify natural resources that help seeds and plants grow. Students identify plants that provide food for humans.

Extension: Students can also create a shoebox scene, short play, song, story or factual cartoon.

Evaluation: Rubrics guide and assess:

- Poster/mobile
- Assessment

Lesson 1: Overview

Lesson Duration

- Three hours.

Standards/Benchmarks

Technology: Standards for Technological Literacy (*STL*) *(ITEA, 2000/2002)*

- Students will develop an understanding of the characteristics and scope of technology. (ITEA/*STL* 1)
  - The natural world and human-made world are different. (ITEA/*STL* 1A)

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- Plants and animals have features that help them live in different environments. (AAAS 5A)
- Magnifiers help people see things they could not see without them. (AAAS 5C)
- Most living things need water, food and air. (AAAS 5C)
- Plants and animals both need to take in water, and animals need to take in food. In addition, plants need light. (AAAS 5E)
- People need water, food, air, waste removal and a particular range of temperatures in their environment, just as other animals do. (AAAS 6A)
- Raise questions about the world around them and be willing to seek answers to some of them by making careful observations and trying things out. (AAAS 12A)

Science: National Science Education Standards *(NRC, 1996)*

- All students should develop an understanding of properties of earth materials. (NSES – Earth and Space Science)
- All students should develop understanding of personal health and types of resources.
- Resources are things that we get from the living and nonliving environment to meet the needs and wants of a population.
- Some resources are basic materials, such as air, water and soil; some are produced from basic resources, such as food, fuel and building materials; and some resources are nonmaterial, such as quiet places, beauty, security and safety.
- Earth materials are solid rocks and soils, water and the gases of the atmosphere. The varied materials have different physical and chemical properties, which make them useful in different ways, for example, as building materials, as sources of fuel or for growing the plants we use as food. Earth materials provide many of the resources that humans use.

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- Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.

- Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.
- Students adjust their use of spoken, written and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.
- Students use spoken, written and visual language to accomplish their own purposes. (e.g., for learning, enjoyment, persuasion and the exchange of information).

Learning Objectives

Students will learn to:

1. Identify natural resources on Earth.
2. Identify the natural resources that help seeds/plants grow.
3. Identify plants that provide food for humans.

Student Assessment Tools and/or Methods

1. Rubric for Natural Environment Booklet

Category	Below Target – 0	At Target – 1	Above Target – 2
Illustrations	Illustrations are incorrect.	Illustrations are correct.	Illustrations are correct with many details.
Labels	Labels are incorrect.	Most labels are correct.	All labels are correct.
Application –Question 1	Student did not apply what he/she knows about natural resources to answer the question.	Student partly applied what he/she knows about natural resources to partially answer the question.	Student applied what he/she knows about natural resources to correctly answer the question.
Organization	Explanation is incomplete, unorganized and not logical.	Explanation is somewhat complete, well-organized and/or logical.	Explanation is complete, well-organized and logical.
Conventions	Many errors interfere with the meaning and confuse the reader.	Some errors, some of which interfere with the meaning and confuse the reader.	No errors; the reader can read easily.
Application –Question 2	Student did not apply what he/she knows about natural resources to answer the question.	Student partly applied what he/she knows about natural resources to partially answer the question.	Student applied what he/she knows about natural resources to correctly answer the question.
Organization	Explanation is incomplete, unorganized and not logical.	Explanation is somewhat complete, well-organized and/or logical.	Explanation is complete, well-organized and logical.
Conventions	Many errors interfere with the meaning and confuse the reader.	Some errors, some of which interfere with the meaning and confuse the reader.	No errors; the reader can read easily.
Teacher Comment			

2. Rubric for Poster/Mobile

Requirements	Requirement Achieved
Title/Heading	1
Name	1
Four or more facts	1
Words spelled correctly	1
Neat	1
Colorful	1
Score:	6

Above Target	6
On Target	4-5
Below target	0-3

2. Rubric for Assessment

Requirements	Requirement Achieved
Question 1	3
Question 2	4
Question 3	4
Score:	11

Above Target	10-11
On Target	7-9
Below target	0-6

Resource Materials

Print Materials

1. Berger, M. (1992). *All about seeds*. New York: Scholastic.
2. Berger, M & Berger, G. (2004). *Seed to plant*. New York: Scholastic.
3. Royston, A. (2003). *My world of science, natural and man-made*. Chicago: Heinemann Library.
4. Spilsbury, L. (2006). *How do plants grow?* Chicago: Heinemann Library.
5. Spilsbury, L. (2006). *What is a plant?* Chicago: Heinemann Library.
6. Spilsbury, L. (2006). *Where do plants grow?* Chicago: Heinemann Library.

Audiovisual Materials

1. Burrud, J. & Soto, R. (Producers), & Burrud, J. and Josephson, D. (Directors). (2005). *All about natural resources* (Video). Wynnewood, PA: Schlessinger Media.
2. Commisso, V. (Producer), & Bastien, C. E. (Director). (2001). *The magic school bus gets planted* (Video). New York: Kid Vision.
3. Giakoumis, H. (Producer), & Jacobs, L.. (Director). (1995). *The magic school bus goes to seed* (Video). New York: Kid Vision.

Internet Sites

1. Sample, S. (NASA Official). (December 1, 2004). *Fun and games: The earth*. Retrieved April 14, 2007, from http://science.hq.nasa.gov/kids/earth.html

Lesson 1: 5-E Lesson Plan

Engagement

1. The teacher organizes the students into groups of two to four and gives each group the following items: cup of water, bag of air (the students should focus on what is inside the bag, not the bag itself), cup of soil, rock, picture of an animal or a jar with a worm or bug in it and a plant.
2. Each team receives ***Natural Resources on Earth 1***. Students complete this worksheet.
3. Groups discuss their answers. The teacher asks students: *Where can we find all of these items*?

Exploration

1. Each student receives the booklet, Natural Environment (***Natural Resources on Earth 2***). (Students only complete Pages 1–11 at this time.) The teacher explains to the students that they are going to explore natural resources that are on Earth. The students read page 1, discuss the information on the page and draw pictures. The teacher guides the students through each page in the same manner, allowing time for the students to cut their pages in half and staple the booklets.

   The teacher asks the following questions:
   - What are natural resources?
   - How do people use natural resources?
   - Could we survive without natural resources?
   - Which resource do you think is the most important? Why?
   - Who can recall the objects we looked at before reading the booklet?
   - What are all of those objects called?

2. The teacher shows the students a packet of seeds. The teacher asks the following questions:
   - What are these?
   - What can these seeds produce?
   - Do you think seeds are important to people? Why or why not?
   - Are seeds a natural resource?

3. Each student receives the booklet, Seeds on Our Earth (***Natural Resources on Earth 3***). The students read page 1, discuss the information on the page and draw a picture. The teacher guides the students through each page in the same manner, allowing time for students to cut their books out and staple them.

   The teacher asks the following questions:
   - Where can we find seeds?
   - Why are they important to people?
   - What do seeds need in order to grow?
   - What would happen to a seed if we didn't give it water, air or warmth?

4. The teacher shows students a lima bean seed and the tiny plant inside of it. *Suggestion*: Allow the students to use magnifying glasses.

   The teacher asks the following questions:
   - What do we need to do to this seed to help it grow?
   - How is this baby plant getting its food?
   - What will this seed become?

5. The teacher gathers the students in a circle and places a variety of plants in front of them.

   The teacher asks the following questions:
   - What is the same about these plants?
   - What is different about these plants?
   - Are all plants the same?
   - Where can you find plants?
   - Why do you think there are plants on Earth?
   - Are plants important to people?
   - How do people use plants?
   - What do you think plants need in order to grow?

6. Each student receives the booklet, Plants (***Natural Resources on Earth 4***). The students read page 1, discuss the information on the page and draw a picture. The teacher guides the students through each page in the same manner, allowing time for students to cut their pages out and staple them.

   The teacher asks the following questions:
   - What natural resources do plants need in order to grow?
   - Why are plants important to people?
   - What do people get from plants?
   - Why do most plants need soil?
   - Why do most plants need light?
   - Why do plants need water?

7. The teacher asks the students to close their eyes and picture all the plants that provide food for them to eat. Students complete Food From Plants (***Natural Resources on Earth 5)***. Students share their answers. The teacher writes all responses on a piece of chart paper.

   The teacher asks the following questions:
   - How do people benefit from plants?
   - What would happen if Earth did not have plants?

8. Students explore new terms and concepts by reading selected books or listening to the teacher read.
9. Students explore new terms and concepts by viewing selected videos.
10. Students explore new terms and concepts by viewing selected Internet sites.

Explanation

1. Students verbally name the natural resources we have on Earth that help plants and humans.
2. Students identify natural resources needed for seeds and plants to grow.
3. Students verbally contribute to a list that identifies plants that provide food for humans.

Extension

1. Students may create a poster, mobile, shoebox scene, short play, song or story pertaining to Earth's natural resources.
2. Students respond to questions on a written assessment, Seeds and Plants on Earth. (***Natural Resources on Earth 6***).

Evaluation

Rubrics guide and assess:

1. Student poster/mobile of Earth, containing all the natural resources.
2. Students written assessment to Seeds and Plants on Earth. (***Natural Resources on Earth 6***).

Teacher Note: Remember a seed only needs warmth, water and air to begin its growing process. It does not need light in order to germinate. Plants have different needs than seeds do in order to grow. They need more natural resources to survive (soil, sunlight [light], water, air).

Enrichment

1. Students can write a report about Earth.
2. Students can create a skit about the natural resources and the importance of them.
3. Students can make an ABC book about seeds and plants that provide foods for people. They can read it to younger children.
4. Students can research which seeds germinate quickly and/or slowly.
5. Students can research the plants that produce foods that are very nutritious.

Lesson 1: Lesson Preparation

Teacher Planning

1. Gather all the items listed in the "Tools/Materials/Equipment" section so that there is enough for four to five groups of students.
2. Make copies of the worksheets/assessments:
   a. Natural Resources on Earth ***(Natural Resources on Earth 1)***
   b. Food From Plants ***(Natural Resources on Earth 5)***
   c. Seed and Plants on Earth ***(Natural Resources on Earth 6)***
3. Make copies of the booklets:
   a. Natural Environment (***Natural Resources on Earth 2***)
   b. Seeds on Our Earth (***Natural Resources on Earth 3***)
   c. Plants (***Natural Resources on Earth 4***)

Tools/Materials/Equipment

Group work:

- Cups of water
- Bags of air
- Cups of soil
- Rocks
- Pictures of animals or worms/bugs in jars
- Variety of plants or pictures of plants
- ***Natural Resources on Earth 1***

Other work:

- Variety of Seeds
- Dry lima beans
- Magnifying glasses
- Chart paper
- Marker
- Natural Resources on Earth ***(Natural Resources on Earth 1)***
- Natural Environment ***(Natural Resources on Earth 2)***
- Seeds on Our Earth ***(Natural Resources on Earth 3)***
- Plants ***(Natural Resources on Earth 4)***

- Food From Plants ***(Natural Resources on Earth 5)***
- Seeds and Plants on Earth ***(Natural Resources on Earth 6)***

Classroom Safety and Conduct

Students are expected to follow normal classroom and school safety rules.

Lesson 2: Exploring the Moon

Lesson Snapshot

Overview

Big Idea: The moon does not provide natural resources that would allow plants to grow, but astronauts can provide an environment to grow plants.

Purpose of Lesson: This lesson introduces students to the characteristics of the moon.

Lesson Duration: Two hours.

Activity Highlights

Engagement: The teacher places lava rocks and "moon dust" (crushed lava rocks) around the room. The students enter a dark room and are asked to "leap" around the room. The students determine where they are for the day. The KWL worksheet is used to obtain some understanding of student knowledge about the moon.

Exploration: The teacher reads a book about the moon. Using their prior and acquired knowledge, students work in small groups to draw pictures of the moon and are asked to write facts. Each group shares their illustrations and facts. The teacher shows students a picture of the moon and Earth. During a discussion led by the teacher, students complete a Venn diagram comparing the moon and Earth. The teacher shows students a packet of seeds. Each student responds to the following on a worksheet: *If we planted seeds on the moon, do you think they would grow? Use information from what we have read to explain your answer*. Students discuss their responses. The teacher asks questions and guides a conversation about what seeds would be best for astronauts to take to the moon to provide food. Students complete a worksheet determining what would need to be in a lunar plant growth chamber.

Explanation: Students verbally identify and describe characteristics of the moon and how the moon and Earth differ. Students verbally explain why plants couldn't grow on the moon; what seeds and plants would be best to grow on the moon; what astronauts would need to take to the moon so that plants could grow and what should be included in a lunar plant growth chamber.

Extension: Students complete a KWL chart, make a model of the moon and complete pages in booklets.

Evaluation: Rubrics guide and assess:

- KWL chart
- Model of the coon
- Natural Environment Booklet (***Natural Resources on Earth 2***)

Lesson 2: Overview

Lesson Duration

- Two hours.

Standards/Benchmarks

Science: Benchmarks for Science Literacy (AAAS, 1993)

- Eating a variety of healthful foods and getting enough exercise and rest help people to stay healthy.
- People, alone or in groups, are always inventing new ways to solve problems and get work done. The tools and ways of doing things that people have invented affect all aspects of life.
- When a group of people wants to build something or try something new, they should try to figure out ahead of time how it might affect other people.

Science: National Science Education Standards *(NRC, 1996)*

- All students should develop an understanding of objects in the sky.
  - The sun, moon, stars, clouds, birds and airplanes all have properties, locations and movements that can be observed and described.

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- Represent data using concrete objects, pictures and graphs. (NCTM Data Analysis and Probability)

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- Students use spoken, written and visual language to accomplish their own purposes. (e.g. for learning, enjoyment, persuasion and the exchange of information).

Learning Objectives

Students will learn to:

1. Identify and describe properties of the moon.
2. Compare and contrast the properties of the moon and Earth.
3. Determine that a growth chamber is needed to grow plants on the moon.

Student Assessment Tools and/or Methods

1. Rubric for KWL Chart

Category	Below Target – 0	At Target – 1	Above Target – 2
Completeness	Some sections are not complete. Many sentences do not have a lot of details. The "L" section offers little information about what student learned.	All sections are complete. A few sentences do not have a lot of details. The "L" section offers some information about what student learned.	All sections are complete with a lot of details. The "L" section offers exceptional information about what student learned.
Teacher Comment			

2. Rubric for Model of the Moon

Category	Below Target – 0	At Target – 1	Above Target – 2
Color	Color is incorrect.	Color is somewhat correct.	Color is correct.
Surface	No surface has been represented. It is smooth.	Surface includes several landforms.	Surface includes all landforms discussed in class.
Teacher Comment			

Resource Materials

Print Materials

1. Branley, F. M. (1987). *The moon seems to change*. New York: HarperCollins Publisher.
2. Carle, E. (1986). *Papa, please get the moon for me*. New York: Scholastic, Inc.
3. Fowler, A. (1994). *When you look up at the moon*. Chicago, Illinois: Children's Press
4. Gibbons, G. (1997). *The moon book*. New York: Holiday House.
5. Lassieur, A. (2000). *A true book: The moon*. New York: Children's Press.
6. McNulty, F. (2005). *If you decide to go to the moon*. New York: Scholastic Press.
7. Rustad, M. E. H. (2002). *The moon*. Minnesota: Pebble Books.
8. Sorensen, L. (1993). *Moon*. Florida: The Rourke Corporation, Inc.
9. Willis, S. (1999). *Whiz kids tell me why the moon changes shape*. New York: Franklin Watts.

Audiovisual Materials

1. Gross, M. & Kriegman, M. (Directors). (1993). *Bill Nye the science guy: Outer space way out there* (Video). Buena Vista Home Video.
2. Schlessinger A. & Mitchell, T. (Executive Producers). (1999). *All about the moon: Space science for children* (Video). Wynnewood, PA: Schlessinger Media.

Internet Sites

1. Canright, S. (Editor) & Dunbar, B. (NASA Official). (March 28, 2007). Kids' main page. Retrieved April 14, 2007 from http://www.nasa.gov/audience/forkids/home/
2. Fisher, Diane. (August 25, 2006). *What do we know about our moon*? Retrieved April 14, 2007, from http://spaceplace.nasa.gov/en/kids/phonedrmarc/2002_august.shtml
3. Grayzeck, E. (NASA Official) & William, D. K. (Curator). (October 31, 2006). The moon. Retrieved April 14, 2007 from http://nssdc.gsfc.nasa.gov/planetary/planets/moon-page.html
4. Keating, S. (Curator) & Gabrys, B. (NASA Official). (October 7, 2004). *Moon links*. Retrieved April 14, 2007 from http://learners.gsfc.nasa.gov/challenge/moonlinks.html
5. Lee, J. (NASA Official) & Varros, G. (Curator). (March 29, 2000). *Our moon*. Retrieved April 14, 2007 from http://spacekids.hq.nasa.gov/osskids/animate/moon.html
6. Whitlock, L. (Project Leader) & Newman, P. (NASA Official). *The moon: Earth's satellite*. Retrieved April 14, 2007 from http://starchild.gsfc.nasa.gov/docs/StarChild/solar_system_level2/moon.html

Required Knowledge and Skills

1. Students should be able to identify and describe properties of Earth.
2. Students should know what seeds and plants need in order to grow.
3. Students should understand how to complete a Venn diagram.

Lesson 2: 5-E Lesson Plan

Engagement

1. The teacher places lava rocks and small piles of crushed lava rock ("moon dust/soil") on plastic sheeting around the room and turns the lights out before the students enter the room. The teacher asks students to take "leaps" instead of steps as they move around the room to look at the lava rocks and moon dust/soil. The students are given time to feel the lava rocks and moon dust/soil. The lights are turned out because the sky on the moon is always black. There is no atmosphere on the moon to scatter the Sun's light and create the blue sky we see on Earth.

   The teacher asks the following questions:
   - Where do you think we are today?
   - Why?

2. Students complete the first two columns of the Moon KWL Worksheet (***Exploring the Moon 1***). After students complete their columns, they share information. As the students share their information, the teacher writes responses on a piece of chart paper.

Exploration

1. The teacher reads a book about the moon to the students.

2. Place students in groups of two to four. Each group receives a large piece of white paper and large round pattern pieces, if needed.

   The Task:
   - Students draw a moon and include the various characteristics that were discussed in the book—landforms (craters, hills, mountains, rocks, plains, "seas"), dark spots and natural resources (rocks and soil).
   - Students write facts they learned about the moon on index cards.
   - Students share their drawings and facts.

3. Each student receives the worksheet Venn Diagram (***Exploring the Moon 2***). The teacher shows students a picture of the moon and Earth.

   The teacher asks the following questions:
   - What is the same about the moon and Earth?
   - How is the moon different from Earth?
   - How is Earth different from the moon?

4. Students fill in their Venn diagram during the discussion.

5. The teacher shows students various packets of seeds. Include packets of fruits, vegetables and flowering plants. Students complete the worksheet Seeds on the Moon (***Exploring the Moon 3***). The teacher leads a discussion of student responses.

   The teacher asks the following questions:
   - Why can't seeds and plants grow on the moon?
   - What do we have on Earth that allows seeds/plants to grow?
   - If astronauts wanted to grow seeds/plants on the moon, what would they need to take with them? (The teacher lists the responses on chart paper.)

- Which type of seeds/plants would be the most beneficial for astronauts? Why? (The teacher points out the ones that provide food.)
- What kinds of food seeds/plants would be the best to grow on the moon? Why? (Plants that provide a lot of nutritional value would be the best to grow. Tomatoes provide a lot of Vitamin C. Plants that provide little food and a lot of "debris" would not be the best [e.g., wheat].)
- Which of these packets of seeds do you think would be most beneficial to astronauts? Why? (The teacher should make sure students are looking at the packets in the room.)
- If you were to go to the moon, which seeds would you want to plant? Why? (The teacher may graph student responses.)
- Did you choose your favorite food that you had recorded on the worksheet Food From Plants (***Natural Resources on Earth 5***)? Why or why not?

6. The teacher directs student attention to the chart paper that lists what astronauts should take to the moon to grow seeds/plants.

   The teacher asks the following questions:
   - Why are these items important?
   - What could astronauts build to give seeds/plants the best environment so they can grow on the moon?
   - What would you call this "building?"

7. Students complete the worksheet Plant Growth Chamber Engineer (***Exploring the Moon 4***). Students share their answers. The teacher lists student answers on chart paper.
8. Students explore new terms and concepts by reading selected books or listening to the teacher read.
9. Students explore new terms and concepts by viewing selected videos.
10. Students explore new terms and concepts by viewing selected Internet sites.

Explanation

1. Students verbally identify and describe characteristics of the moon.
2. Students verbally identify and describe how the moon and Earth differ.
3. Students verbally explain why plants couldn't grow on the moon.
4. Students verbally explain what seeds and plants would be the best to grow on the moon.
5. Students verbally explain what astronauts would need to take to the moon so that plants could grow.
6. Students verbally explain what should be included in a lunar plant growth chamber so that plants can grow.

Extension

1. KWL chart.
2. Students make a model of the moon (i.e., papier machè).
3. Students pages 12 and 13 in ***Natural Resources on Earth 2***.

4. Student booklet, Our Moon (***Exploring the Moon 5***).

Evaluation

Rubrics guide and assess:

1. Students Moon KWL charts (***Exploring the Moon 1***).
2. Students models of the moon.

3. Student answers to the questions in the booklet, Natural Environment (***Natural Resources on Earth 2***).

Enrichment

1. Students can write stories about the moon and read to younger children.
2. Students can write a letter to NASA asking for information about the moon and/or asking for someone to be a guest speaker.

Lesson 2: Lesson Preparation

Teacher Planning

1. Crush lava rocks.
2. Prepare a chart with a bar graph for Exploration 5, Bullet 7.
3. Make copies of the following worksheets:
   a. Moon KWL Chart ***(Exploring the Moon 1)***
   b. Venn Diagram ***(Exploring the Moon 2)***
   c. Seeds on the Moon ***(Exploring the Moon 3)***
   d. Plant Growth Chamber ***(Exploring the Moon 4)***
4. Make copies of the Moon booklet (***Exploring the Moon 5***).
5. Prepare flour and water for the papier machè moons.
6. Cut newspaper pieces.

Tools/Materials/Equipment

- Lava rocks (Can be purchased at a garden center)
- Plastic sheeting (Can be purchased at hardware stores)
- Chart paper
- Large white pieces of construction paper
- Crayons/colored pencils/markers/construction paper
- Index cards
- Moon and Earth pictures
- Variety of seed packets
- Suggestion: NASA has done experiments with the following seeds: lettuce, tomato, bell pepper, spinach, strawberries and dried beans.
- Newspaper
- Flour
- Bowls
- Round balloons (inflated)
- Spoons
- Paints for papier machè moon

Classroom Safety and Conduct

1. Students are expected to follow normal classroom and school safety rules.

Lesson 3: Designing the Lunar Plant Growth Chamber

Lesson Snapshot

Overview

Big Idea: Growing plants on the moon will require a chamber that offers an environment like Earth.
Teacher's Note: Big ideas should be made explicit to students by writing them on the board and/or reading them aloud.

Purpose of Lesson: This lesson requires that students create a design of a lunar plant growth chamber.

Lesson Duration: One hour.

Activity Highlights

Engagement: The teacher shows pictures of greenhouses and asks questions.

Exploration: The phrase "plant growth chamber" is discussed and defined. Students design a chamber using paper.

Explanation: Students share their models. Students verbally explain why an electrical system and watering system will be needed with the plant growth chambers. Students define the term "chamber"."

Extension: Students sketch and label a diagram of their lunar plant growth chambers.

Evaluation: A rubric guides the assessment of the diagram of a lunar plant growth chamber.

Lesson 3: Overview

Lesson Duration

- One hour.

Standards/Benchmarks

Technology: Standards for Technological Literacy (*STL*) *(ITEA, 2000/2002)*

- Students will develop an understanding of the attributes of design. (ITEA/*STL* 8)
  - Everyone can design solutions to a problem. (ITEA/*STL* 8A)
  - Design is a creative process. (ITEA/*STL* 8B)
- Students will develop an understanding of engineering design. (ITEA/*STL* 9)
  - The engineering design process includes identifying a problem, looking for ideas, developing solutions and sharing solutions with others. (ITEA/*STL* 9A)
  - Expressing ideas to others verbally and through sketches and models is an important part of the design process. (ITEA/*STL* 9B)

Science: Benchmarks for Science Literacy *(AAAS, 1993)*

- Draw pictures that correctly portray at least some features of the thing being described. (AAAS 12D)

Mathematics: Principles and Standards for School Mathematics *(NCTM, 2000)*

- Recognize, name, build, draw, compare and sort two- and three-dimensional shapes. (NCTM Geometry)
- Describe attributes and parts of two- and three-dimensional shapes. (NCTM Geometry)

English Language Arts: Standards for the English Language Arts *(NCTE, 1996)*

- Students read a wide range of print and non-print texts to build an understanding of texts, of themselves and of the cultures of the United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among these texts are fiction and nonfiction, classic and contemporary works.
- Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.
- Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.
- Students adjust their use of spoken, written and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.
- Students use spoken, written and visual language to accomplish their own purposes. (e.g., for learning, enjoyment, persuasion and the exchange of information).

Learning Objectives

Students will learn to:

- Sketch a diagram of their lunar plant growth chamber.
- Verbally explain their design to others.

Student Assessment Tools and/or Methods

1. Rubric for Diagram of Lunar Plant Growth Chamber

Category	Below Target – 0	At Target – 1	Above Target – 2
Diagram	Few pictures are accurately drawn, with few or no details.	Most pictures are accurately drawn, with some details.	All pictures are accurately drawn, with many details.
Labels	Few labels are correct, with few or no details.	Most labels are correct, with some details.	All labels are correct, with many details.
Neatness	Diagram is not neat. A small amount of text is neat. There are many visible stray marks and/or smears.	Diagram is neat. Most text is neat. There are few visible stray marks and/or smears.	Diagram is neat. All text is neat. There are no visible stray marks and/or smears.
Spelling	Many words are misspelled.	Most words are spelled correctly.	All words are spelled correctly.
Teacher Comment			

Resource Materials

Print Materials

1. Ring, S. (1999). *Design it! Build it!* New York: Newbridge Educational Publishing.

Required Knowledge and Skills

1. Students should have an understanding of an electrical circuit.
2. Students should have an understanding of a watering system.
3. Students should be familiar with the design process.

Lesson 3: 5-E Lesson Plan

Engagement

1. The teacher shows students a variety of greenhouses. The teacher asks the following questions:
    - What do you see in these pictures?
    - What are they called?
    - Why do people have them?
    - What materials were used to build them?
    - Why do you think they used glass/plastic for the sides?
    - How do they help people?
    - How would astronauts benefit from a greenhouse on the moon?

Exploration

1. The teacher asks the following questions:
    - Has anyone heard of the phrase, "plant growth chamber"?
    - What do you think it means?

    The teacher defines the phrase "plant growth chamber," as he/she feels appropriate for the students (a structure or room that will represent a little piece of Earth and will be placed on the moon to allow seeds/plants to grow so that astronauts will have food.).
2. The teacher asks the following question:
    - What shape do you think a plant growth chamber can be?

3. The teacher gives each student a sheet of paper and a couple pieces of tape, then asks the students to make a three-dimensional model of what they think a lunar plant growth chamber would look like.

    The teacher walks around asking the following questions as students are working:
    - What shape are you making?
    - Why do you feel that is the best shape?

4. The teacher asks the following questions:
    - If we were to put this structure up on the moon to grow plants for astronauts, what else should be in it?
    - Why should those items be in it?

Explanation

1. Students share their paper model and explain why they think this would be the best shape for the lunar plant growth chamber.
2. Students verbally explain why both a watering system and an electrical system are needed in their plant growth chamber.
3. Students verbally define the phrase "plant growth chamber."

Extension

1. Students sketch and label a diagram of their lunar plant growth chamber. The electrical system and watering system should be included in the diagram. See the ***Engineering Portfolio and Journal***, Worksheet 4.

Evaluation

Assessment rubric for the following is provided:
Students' sketches of their lunar plant growth chambers.

Enrichment

Students research the things that are grown in a greenhouse.

Lesson 3: Lesson Preparation

Teacher Planning

1. Prepare containers with all necessary materials so that they can be distributed to students.
2. Make copies of Engineering Worksheet 4 (***Engineering Portfolio and Journal***).

Tools/Materials/Equipment

- Paper
- Pencil
- Tape
- Scissors
- Rulers

Classroom Safety and Conduct

Students are expected to follow normal classroom and school safety rules.

References

American Association for the Advancement of Science (AAAS). (1993). *Benchmarks for science literacy*. New York: Oxford University Press: Author.

Berger, M. (1992). *All about seeds*. New York: Scholastic.

Berger, M and Berger, G. (2004). *Seed to plant*. New York: Scholastic.

Branley, F. M. (1987). *The moon seems to change*. New York: HarperCollins Publisher.

Burrud, J. & Soto, R. (Producers), & Burrud, J. and Josephson, D. (Directors). (2005). *All about natural resources* (Video). Wynnewood, PA: Schlessinger Media.

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Commisso, V. (Producer), & Bastien, C. E. (Director). (2001). *The magic school bus gets planted* (Video). New York: Kid Vision.

Fisher, Diane. (August 25, 2006). *What do we know about our moon*? Retrieved April 14, 2007, from http://spaceplace.nasa.gov/en/kids/phonedrmarc/2002_august.shtml

Fowler, A. (1994). *When you look up at the moon*. Chicago, Illinois: Children's Press

Giakoumis, H. (Producer), & Jacobs, L.. (Director). (1995). *The magic school bus goes to seed* (Video). New York: Kid Vision.

Gibbons, G. (1997). *The moon book*. New York: Holiday House.

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Lassieur, A. (2000). *A true book: The moon*. New York: Children's Press.

Lee, J. (NASA Official) & Varros, G. (Curator). (March 29, 2000). *Our moon*. Retrieved April 14, 2007 from http://spacekids.hq.nasa.gov/osskids/animate/moon.html

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Rustad, M. E. H. (2002). *The moon*. Minnesota: Pebble Books.

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Schlessinger A. & Mitchell, T. (Executive Producers). (1999). *All about the moon: Space science for children* (Video). Wynnewood, PA: Schlessinger Media.

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Spilsbury, L. (2006). *What is a plant?* Chicago: Heinemann Library.

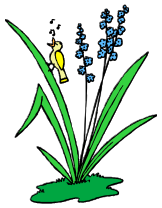
Spilsbury, L. (2006). *Where do plants grow?* Chicago: Heinemann Library.

Whitlock, L. (Project Leader) & Newman, P. (NASA Official). *The moon: Earth's satellite*. Retrieved April 14, 2007 from http://starchild.gsfc.nasa.gov/docs/StarChild/solar_system_level2/moon.html

Willis, S. (1999). *Whiz kids tell me why the moon changes shape*. New York: Franklin Watts.

Natural Resources on Earth

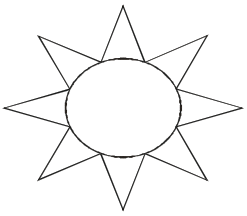
Name _____

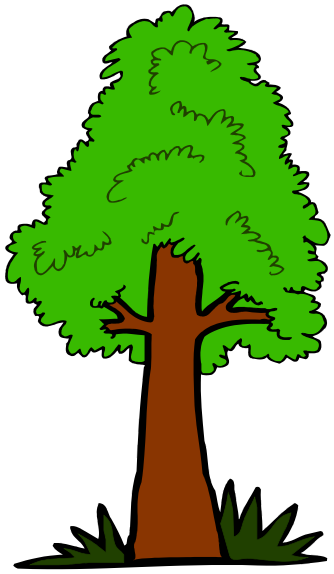


On the lines below, list your group's items.

Explain why each of these items is important to people.

Where can you find all of these items?





Natural Environment

Name _____

---

physical features

weather

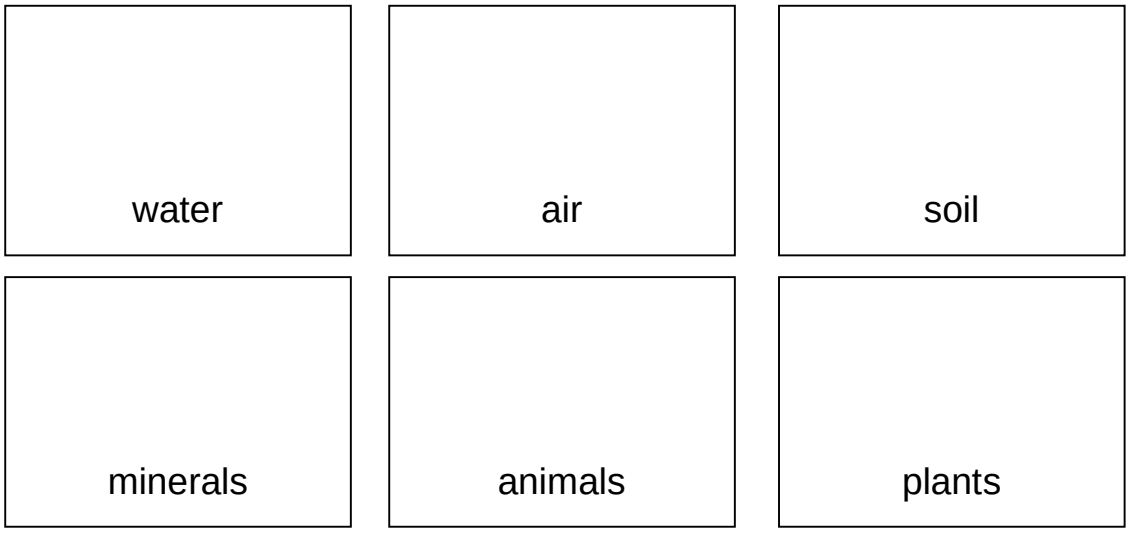
soil

vegetation (plants)

animals

Our Earth is a special place. It has many **physical features,** such as mountains, beaches, plains, deserts, islands, peninsulas, oceans and rivers. The **weather** can vary each day and from place to place. There are different types of **soil** and **vegetation** (plants). Many **animals** roam around Earth. All of these things make up our natural environment.

Natural Resources

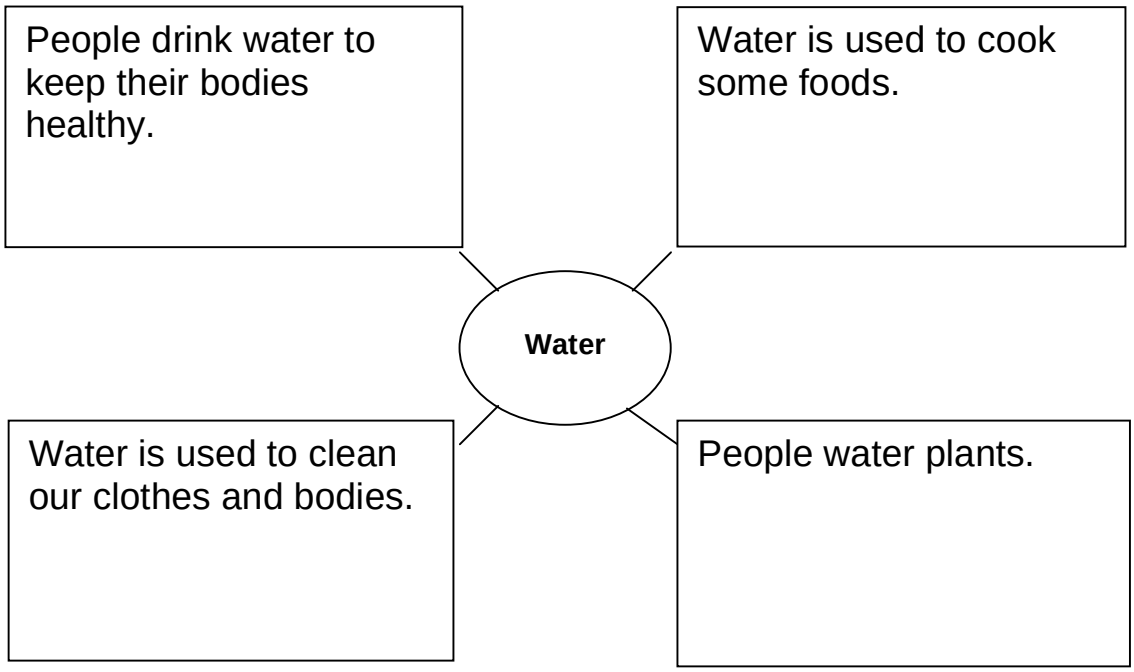


The natural environment provides many **natural resources** for people. Natural resources are always found in or on Earth. The basic natural resources are **water**, **air**, **soil**, **minerals**, **animals** and **plants**.

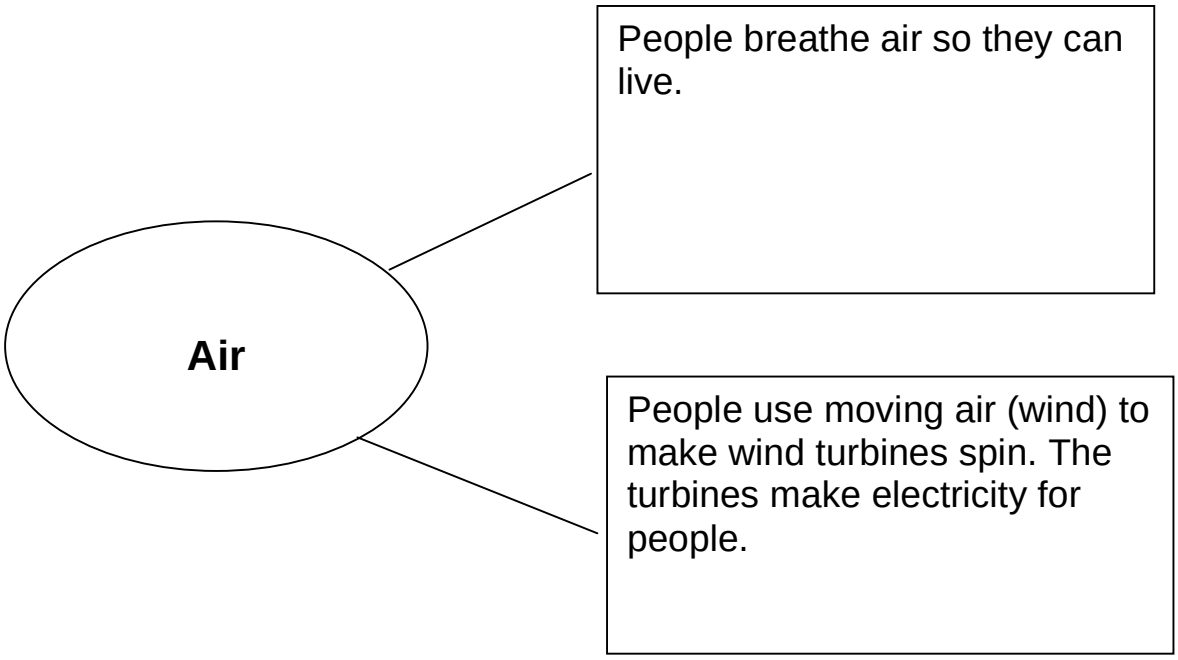
2

Which natural resources do you use?

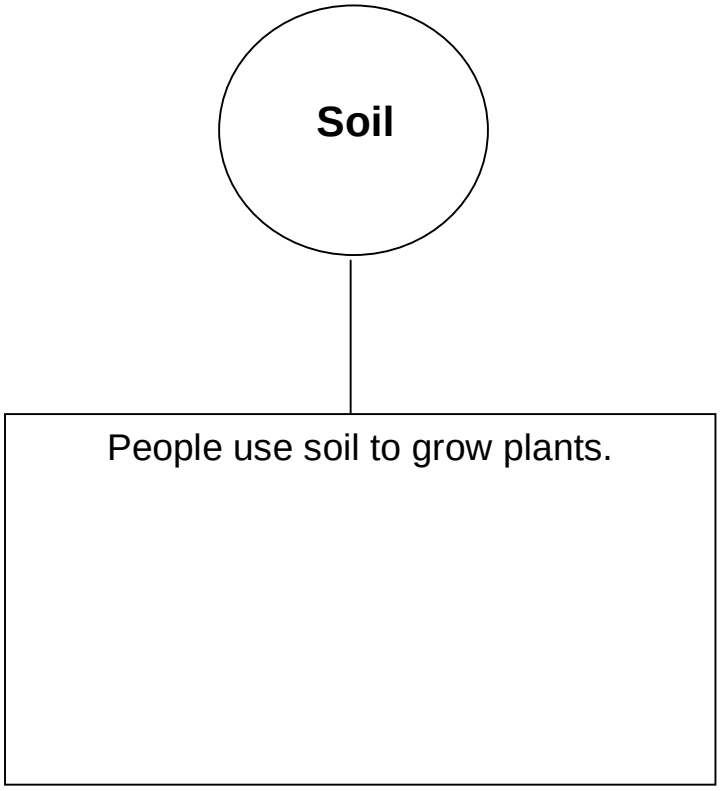
3


People drink water to keep their bodies healthy.
Water is used to cook some foods.
Water
Water is used to clean our clothes and bodies.
People water plants.

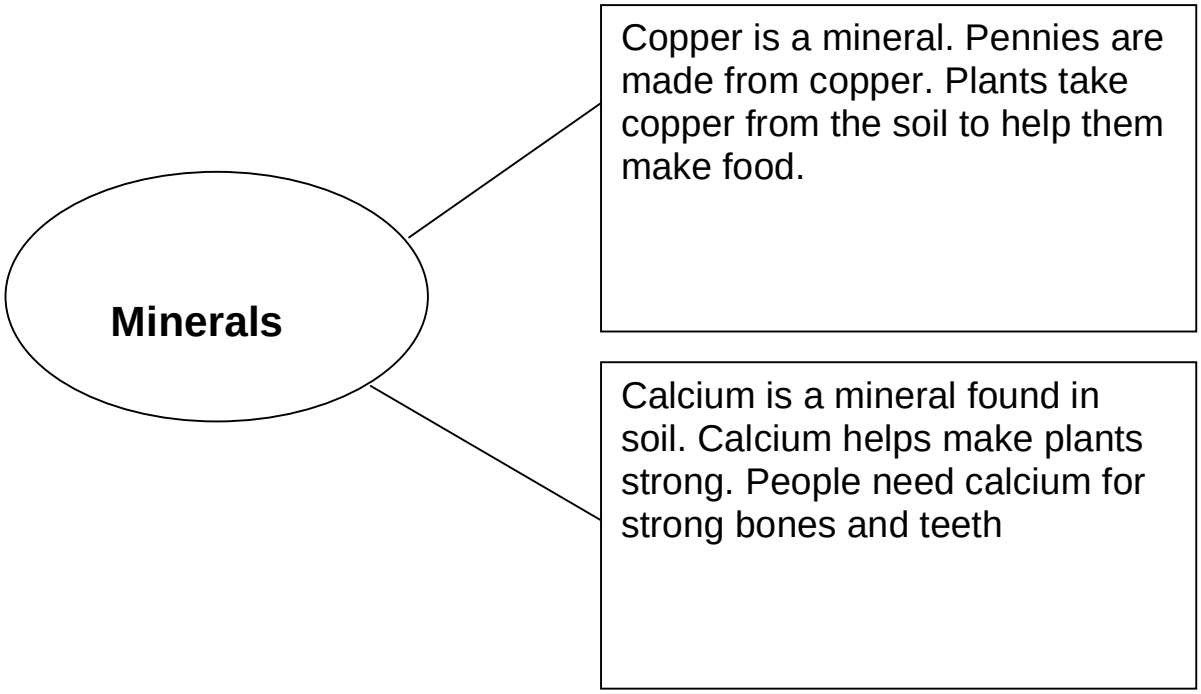
4


People breathe air so they can live.
Air
People use moving air (wind) to make wind turbines spin. The turbines make electricity for people.

5


Soil
People use soil to grow plants.

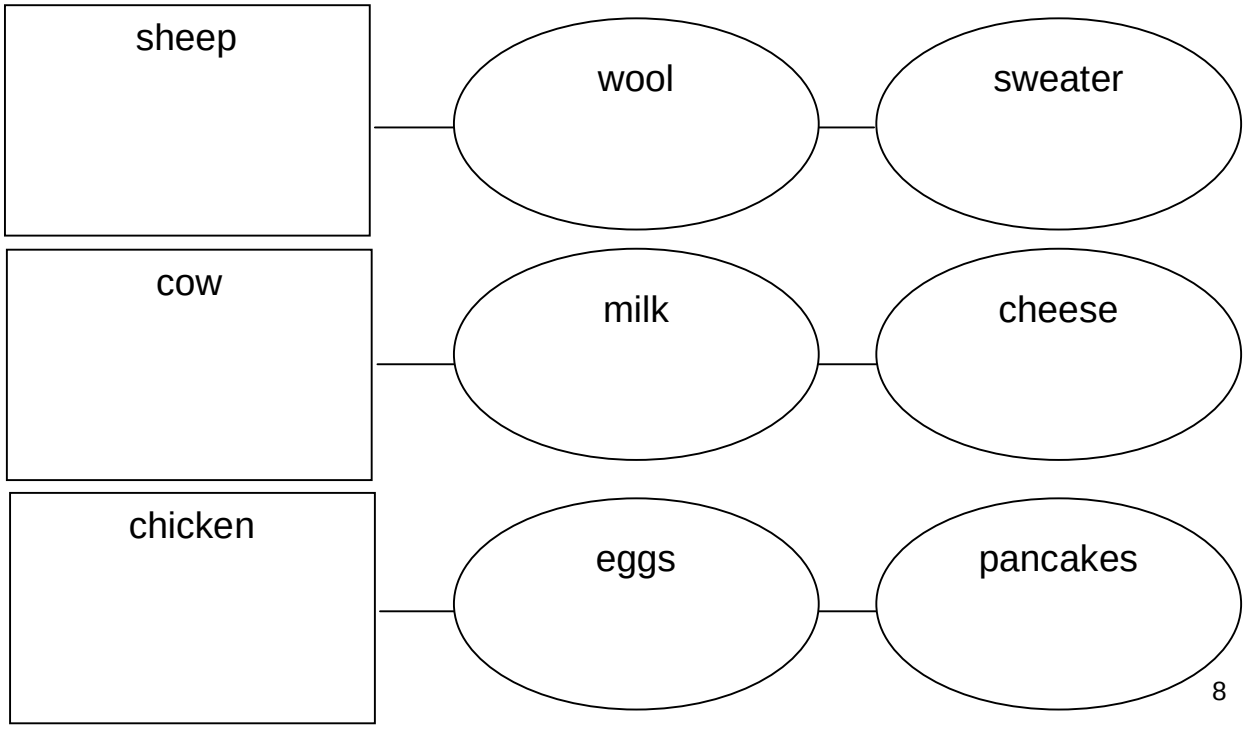
6


Minerals
Copper is a mineral. Pennies are made from copper. Plants take copper from the soil to help them make food.
Calcium is a mineral found in soil. Calcium helps make plants strong. People need calcium for strong bones and teeth

7

Animals

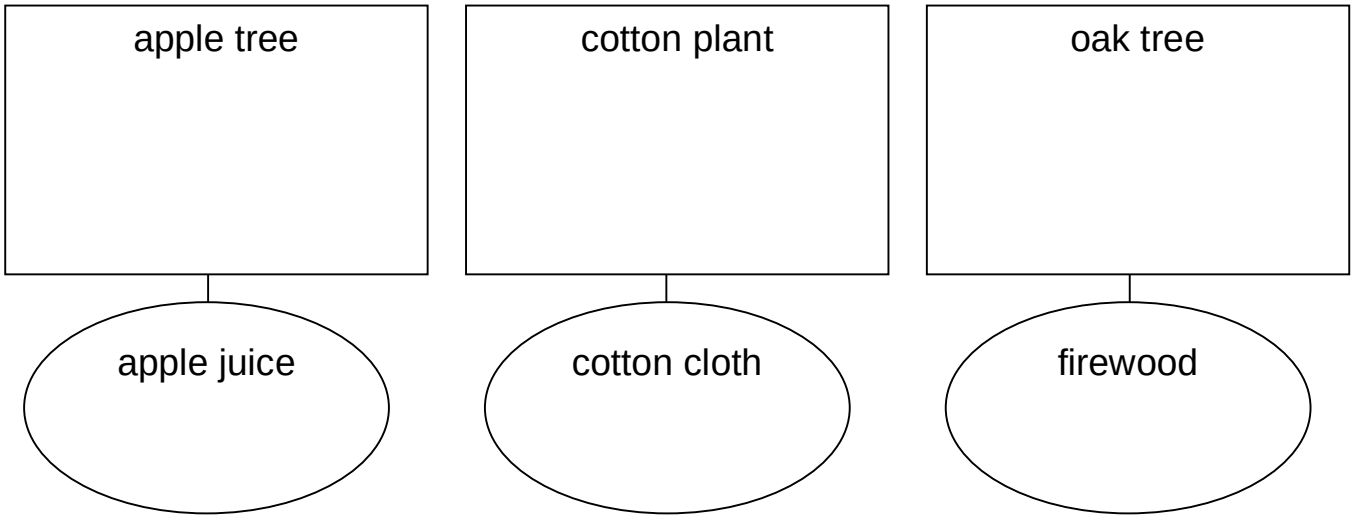
People use animals for food and clothing.



8

Plants

Many plants are used to produce food, clothing or fuel.



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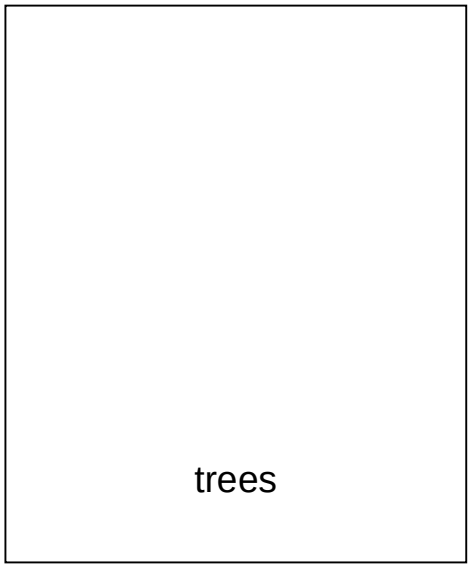
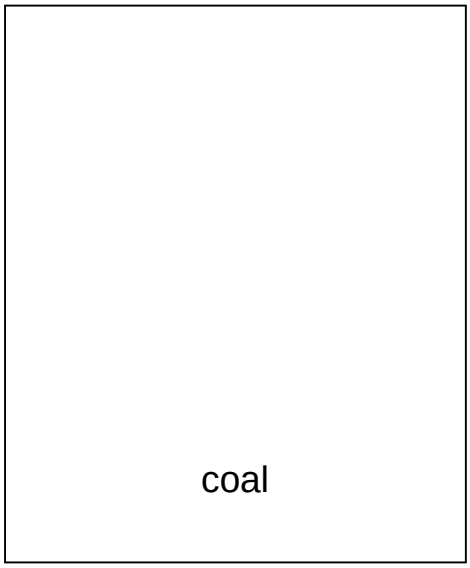
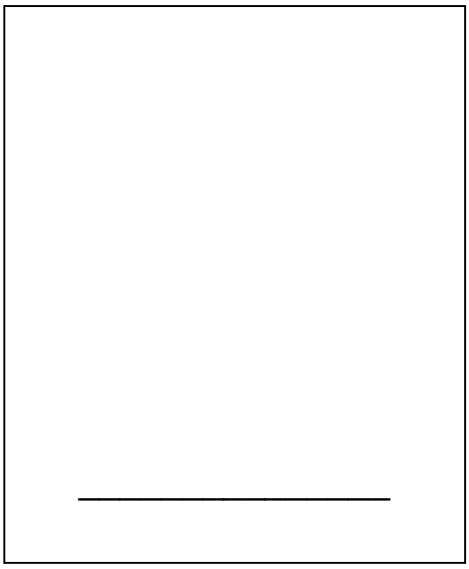
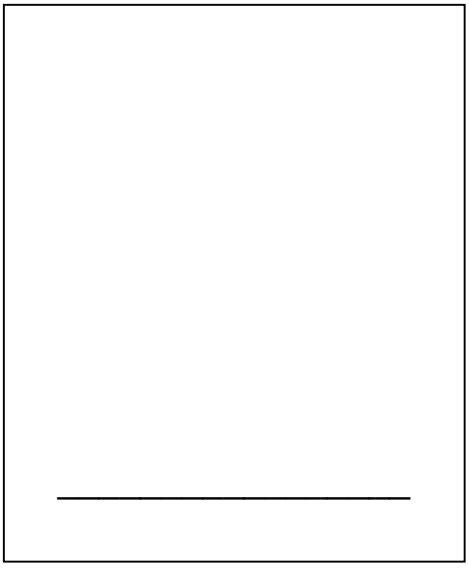




Some of our natural resources are limited. People need to use them wisely so the resources will be around for many years.

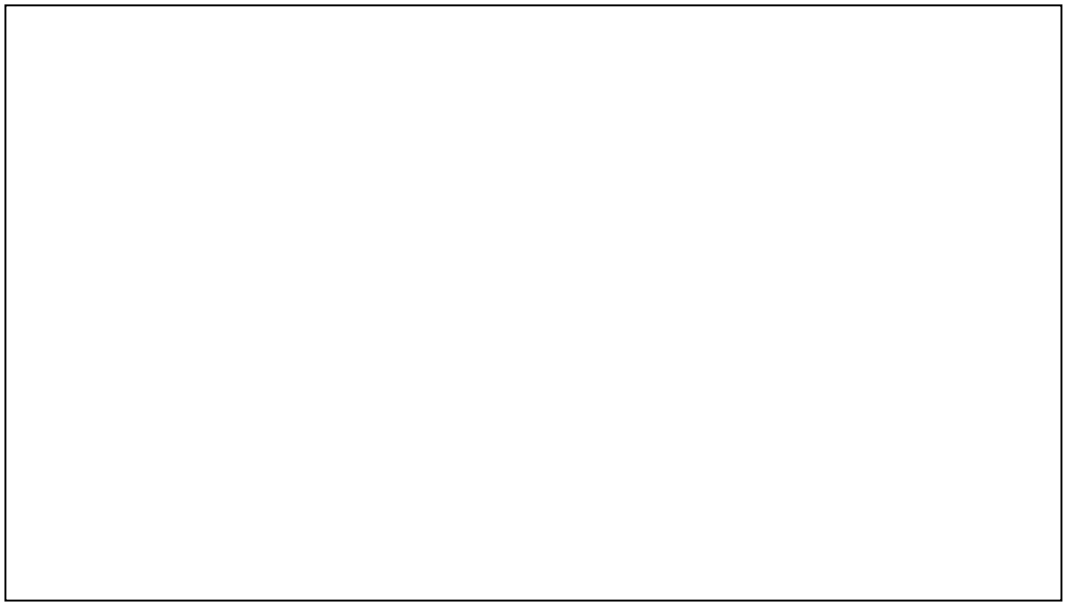
10





Draw and label two natural resources you use every day.

11



What natural resources can be found on the moon? Draw and label.

Do you think any of the natural resources would help plants to grow on the moon? Explain your answer.

Would any of the moon's natural resources be able to be used by astronauts to build a lunar growth chamber? Explain your answer.

Seeds on Our Earth

Name _____

Seeds are important to us because they give us different kinds of food.

1.

Many types of seeds are sent to factories to be made into food. Wheat seeds are ground to make flour. When you eat a peanut butter sandwich, you are eating crushed and ground peanut seeds.

2.

Some seeds are used in soups or desserts. The vegetable soup you eat may contain peas and corn. These are both kinds of seeds. Think about the cookies you eat with nuts in them. You are eating seeds!

3.

Have you ever eaten sunflower seeds, pumpkin seeds or popcorn? These are types of seeds that we enjoy.

4.

Apples, oranges, grapes, green beans, peaches, plums and pears all contain seeds.

5.

Seeds are unique because inside each seed is a tiny plant just waiting to grow. Each seed also has food inside to feed the tiny plant.

6.

Seeds need water, warmth and air to grow. Seeds do not need soil for food because seeds have food inside them. The sun warms the soil which helps seeds stay warm.

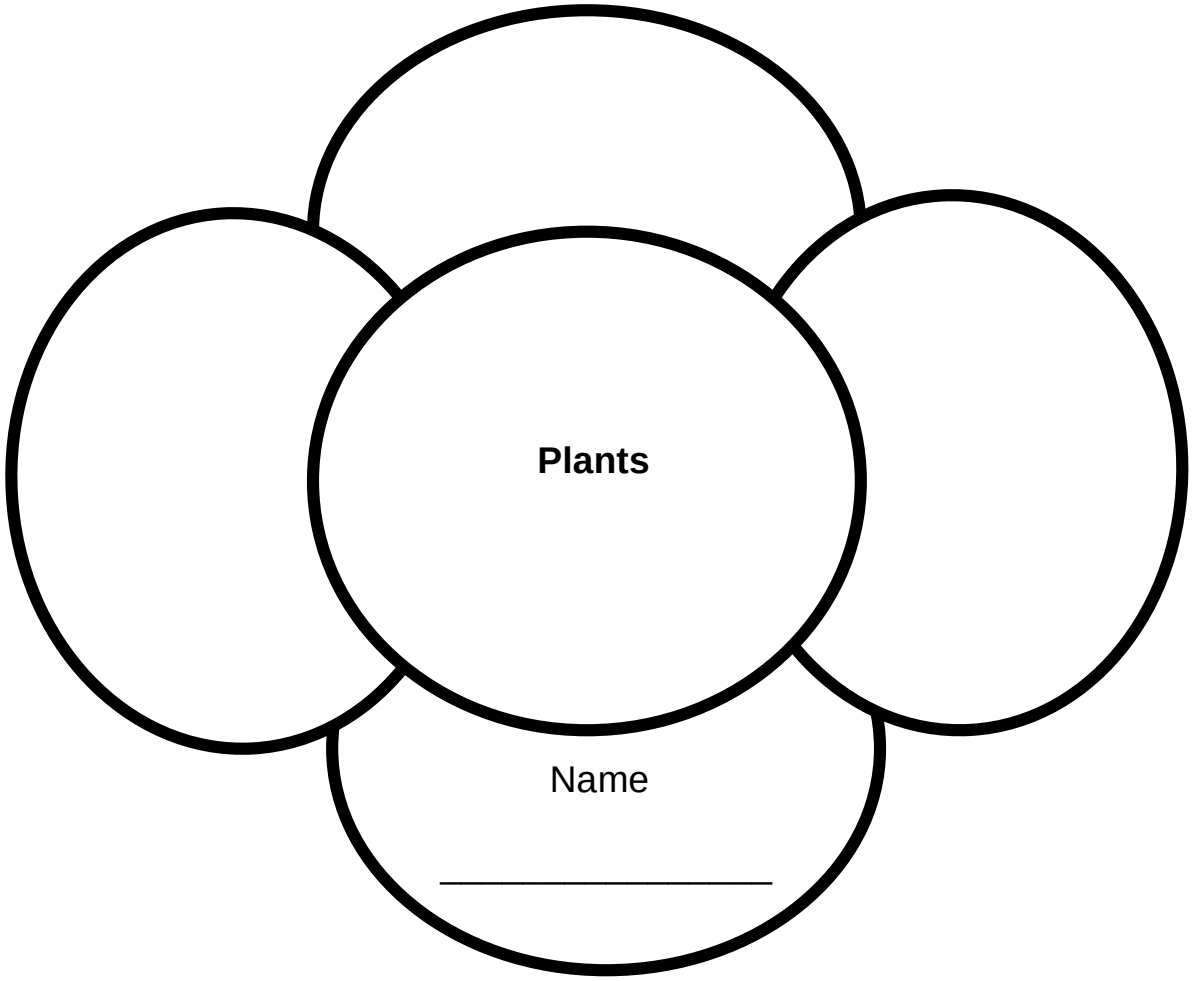
7.

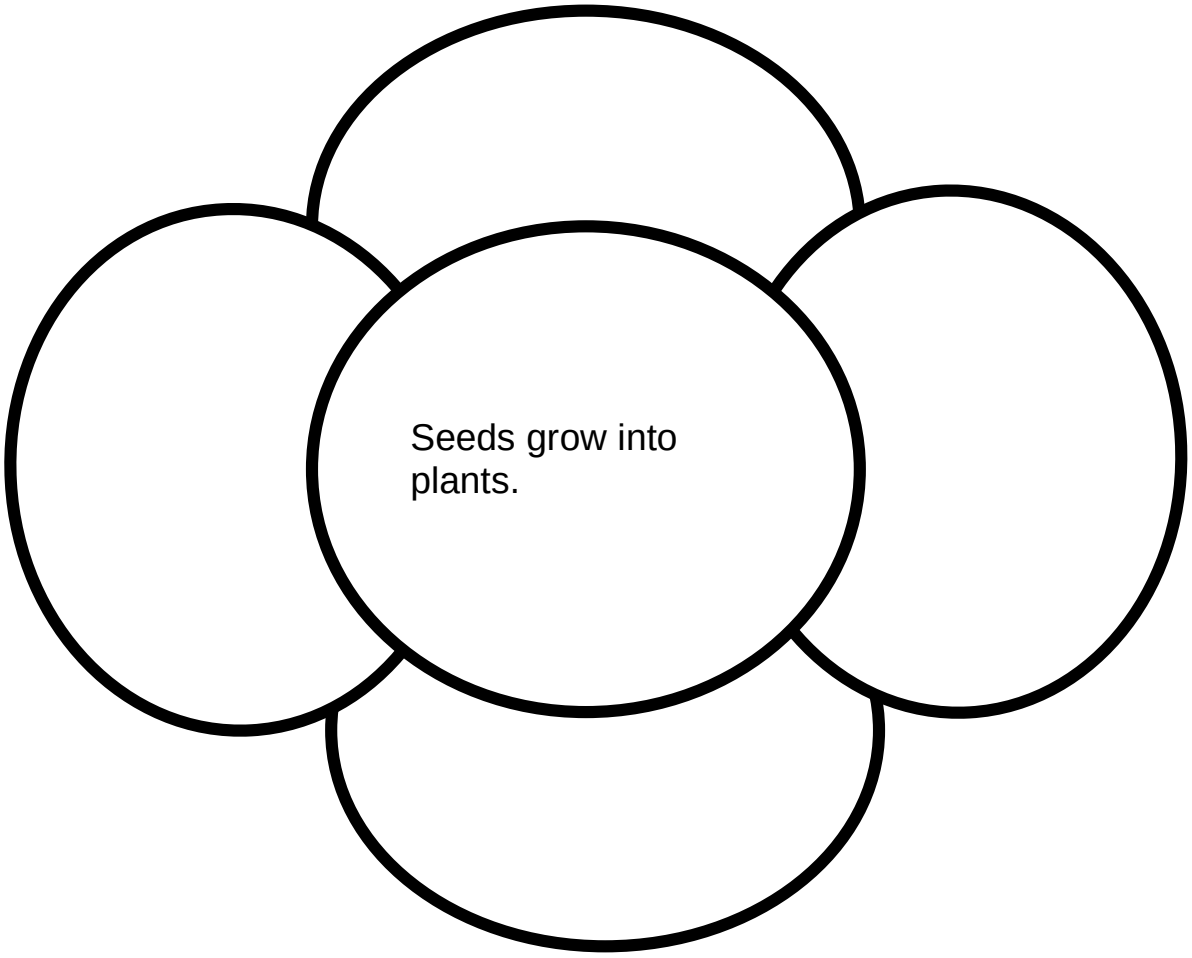
Seeds are an important part of our Earth. They give us foods to eat and new plants.

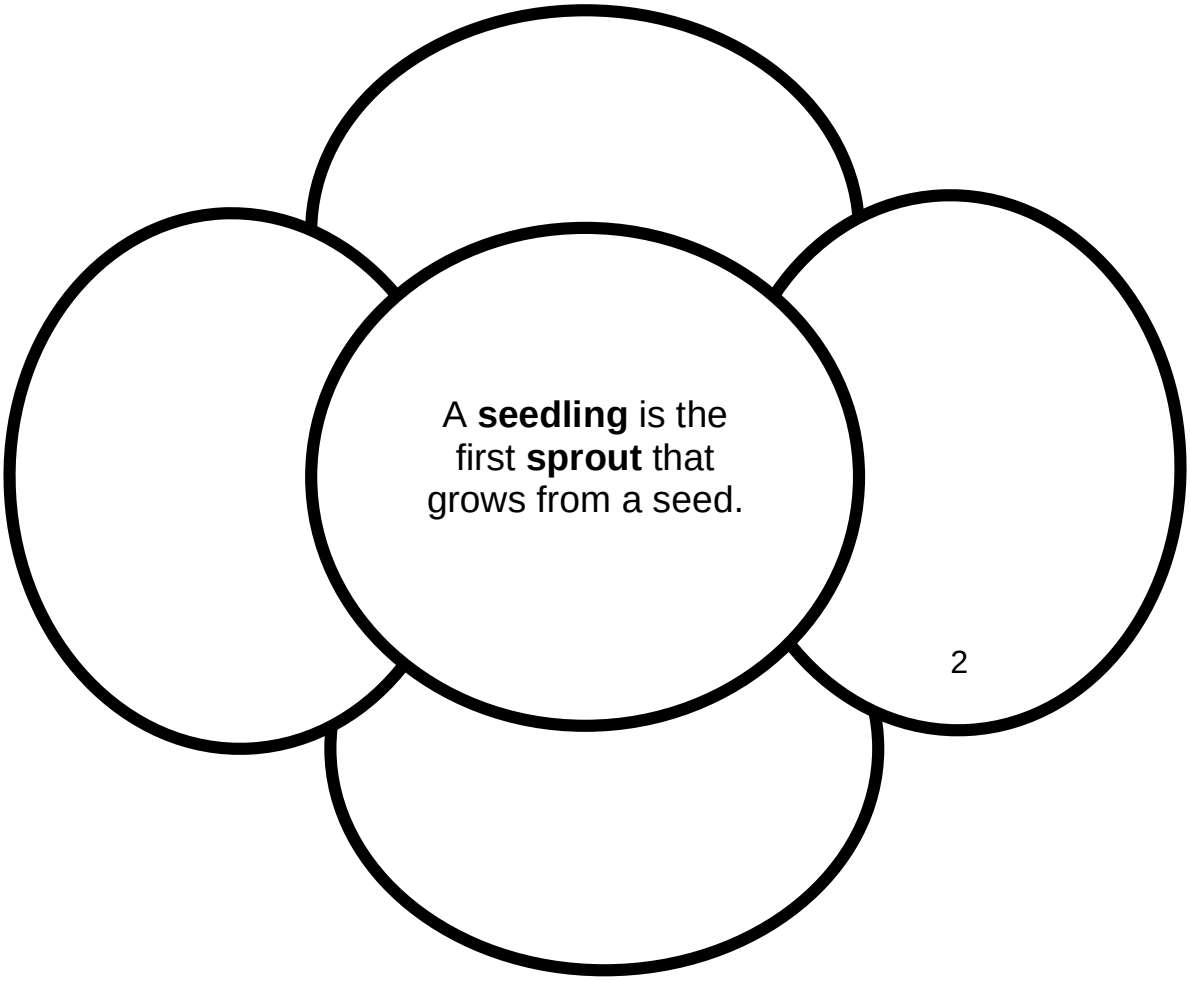
8.

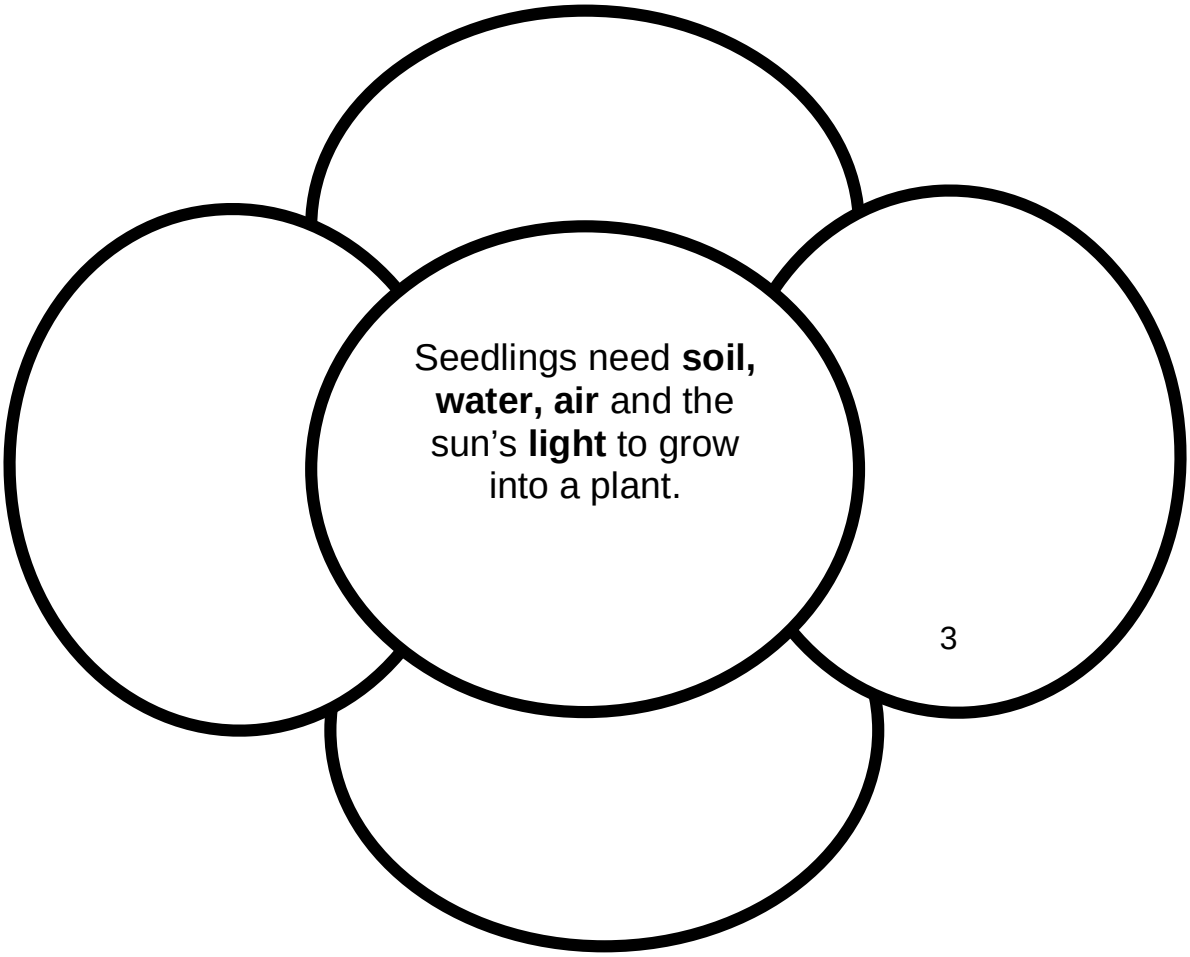
Draw and label at least four seeds you have seen.

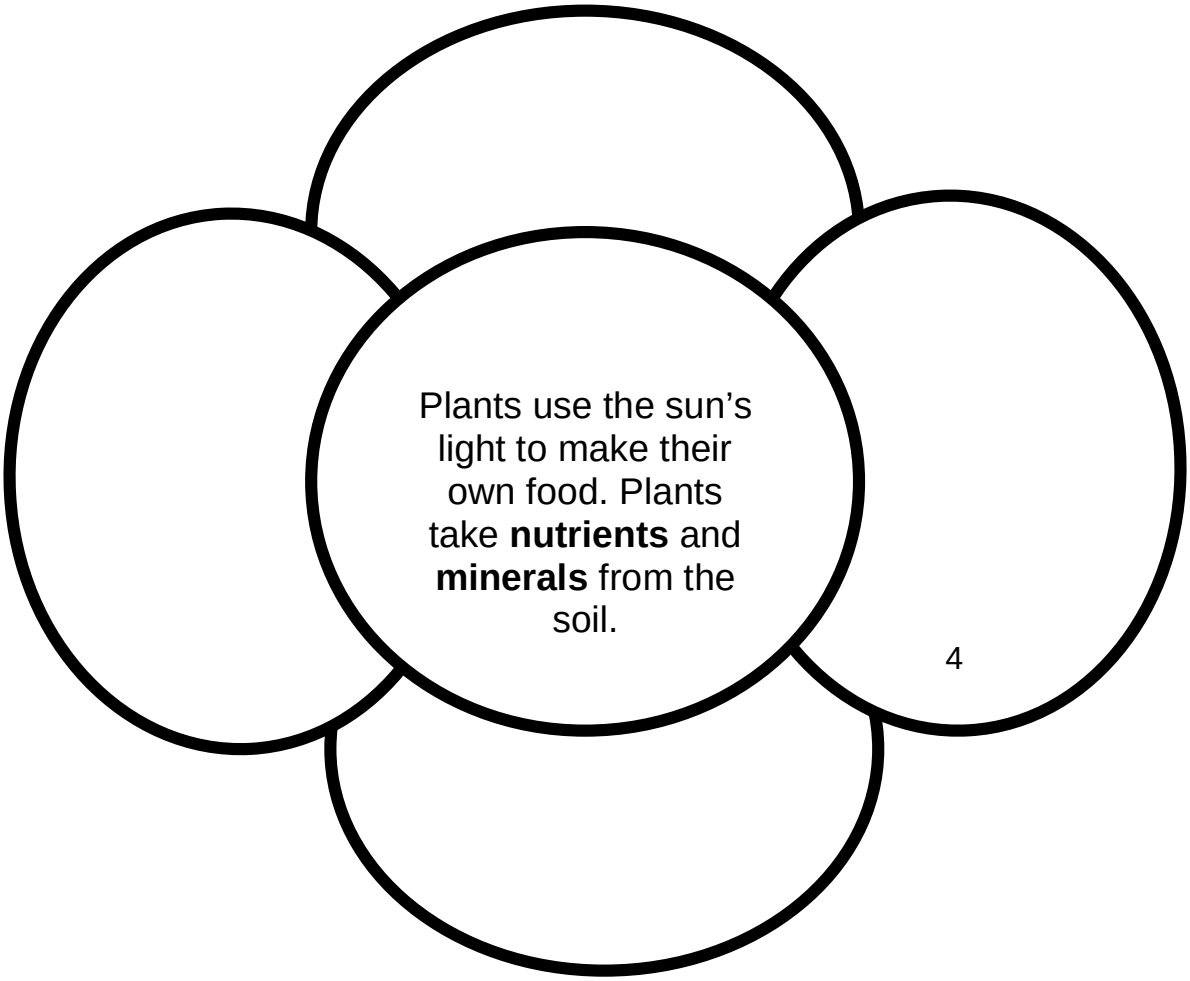
9.

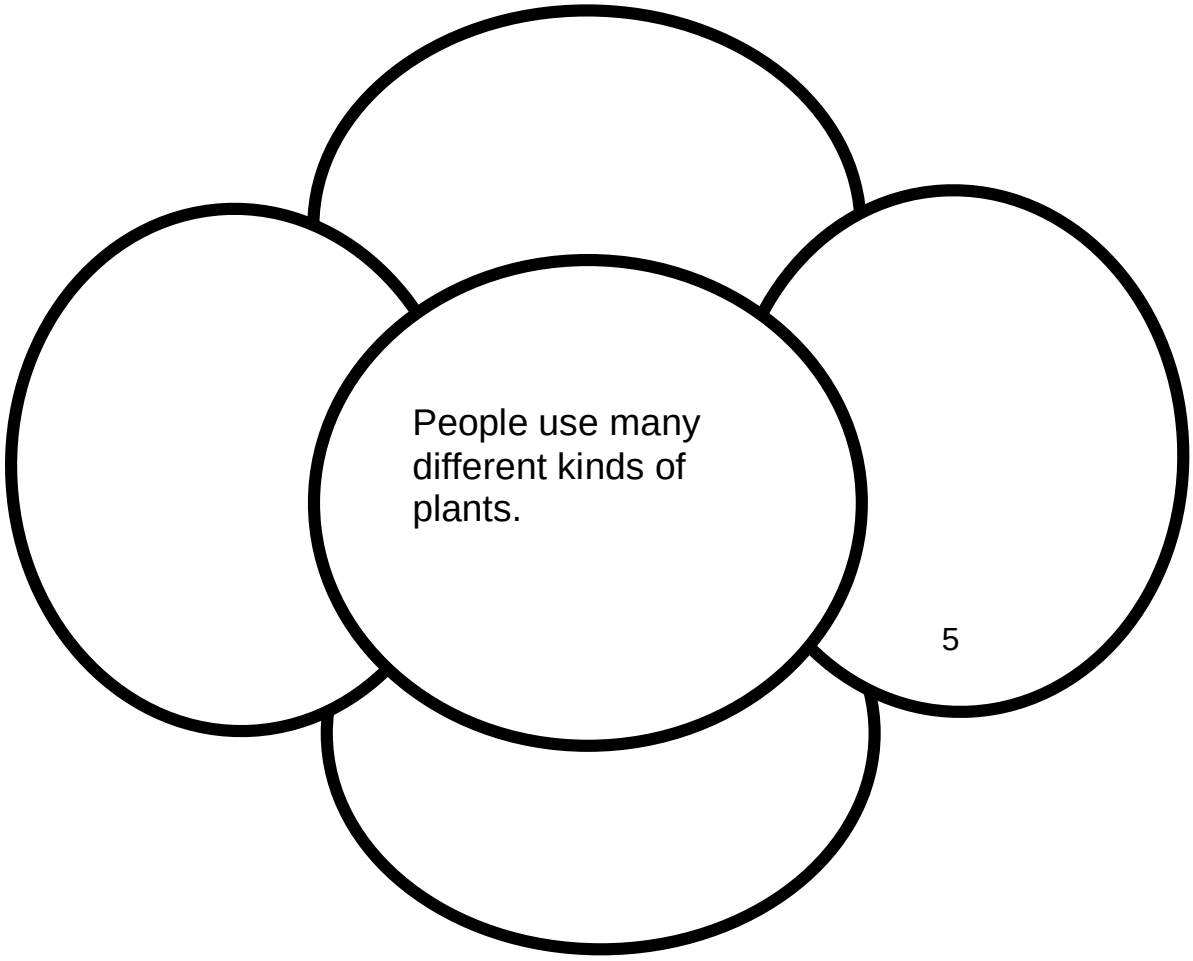

Plants
Name
_____

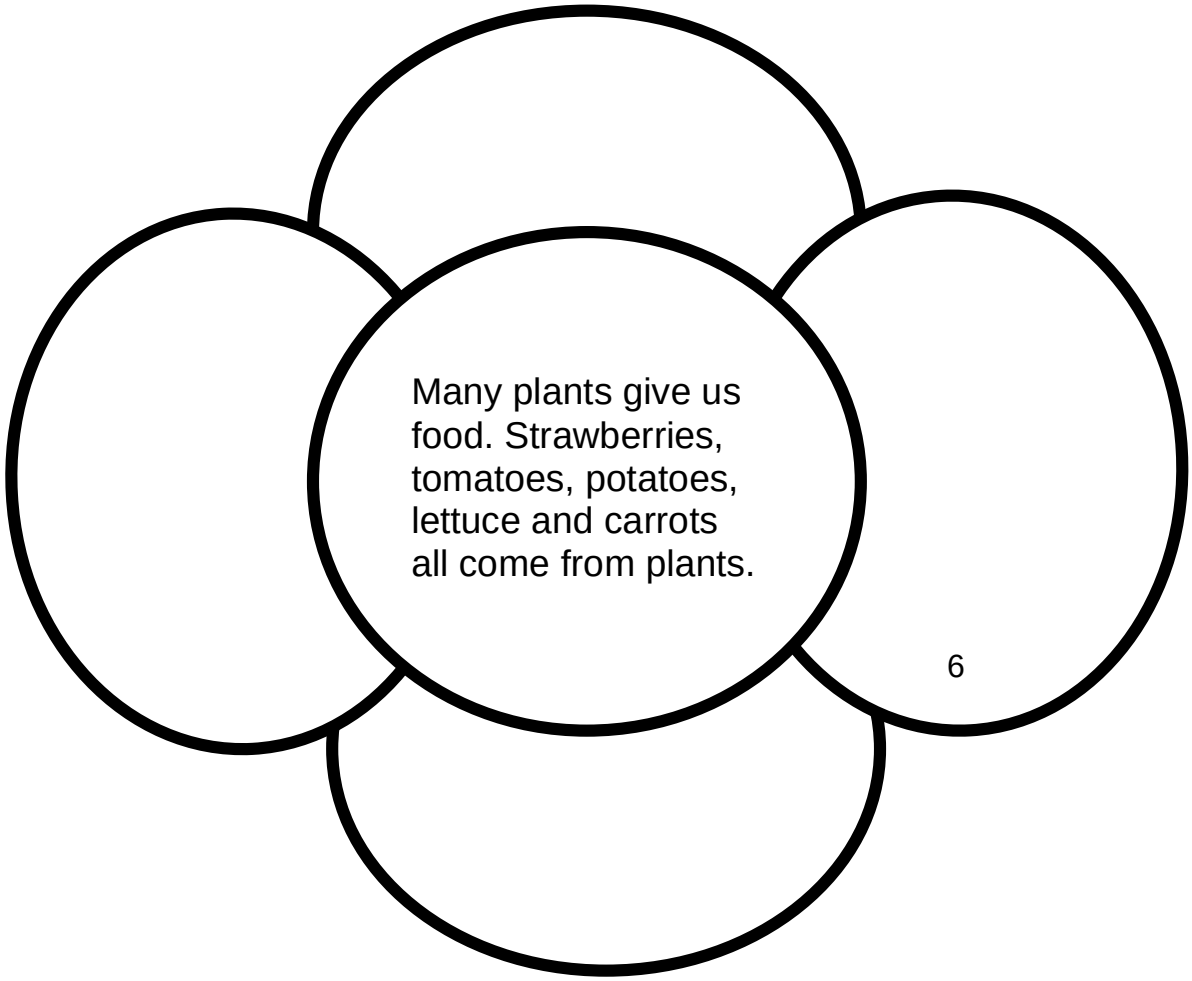

Seeds grow into plants.

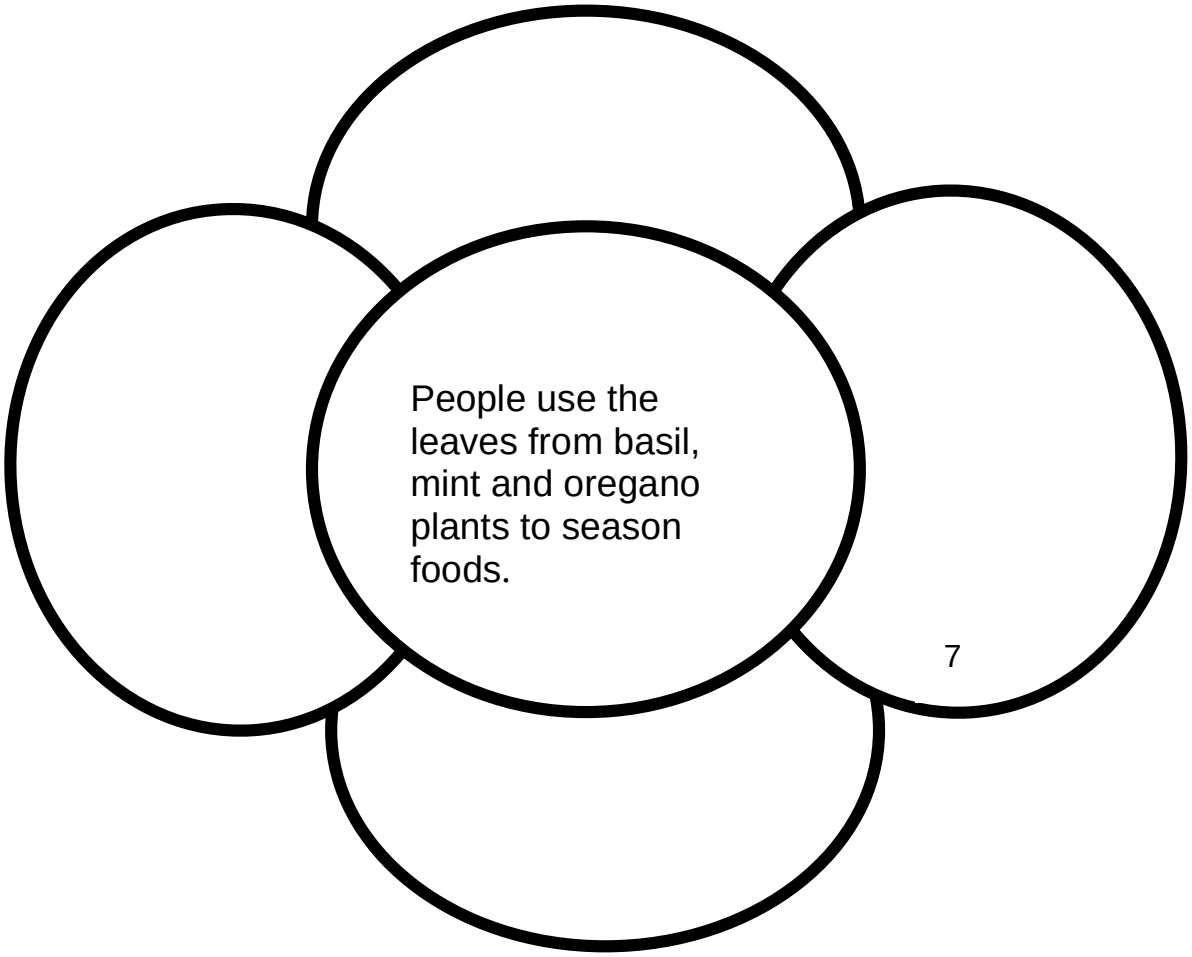

A **seedling** is the first **sprout** that grows from a seed.
2

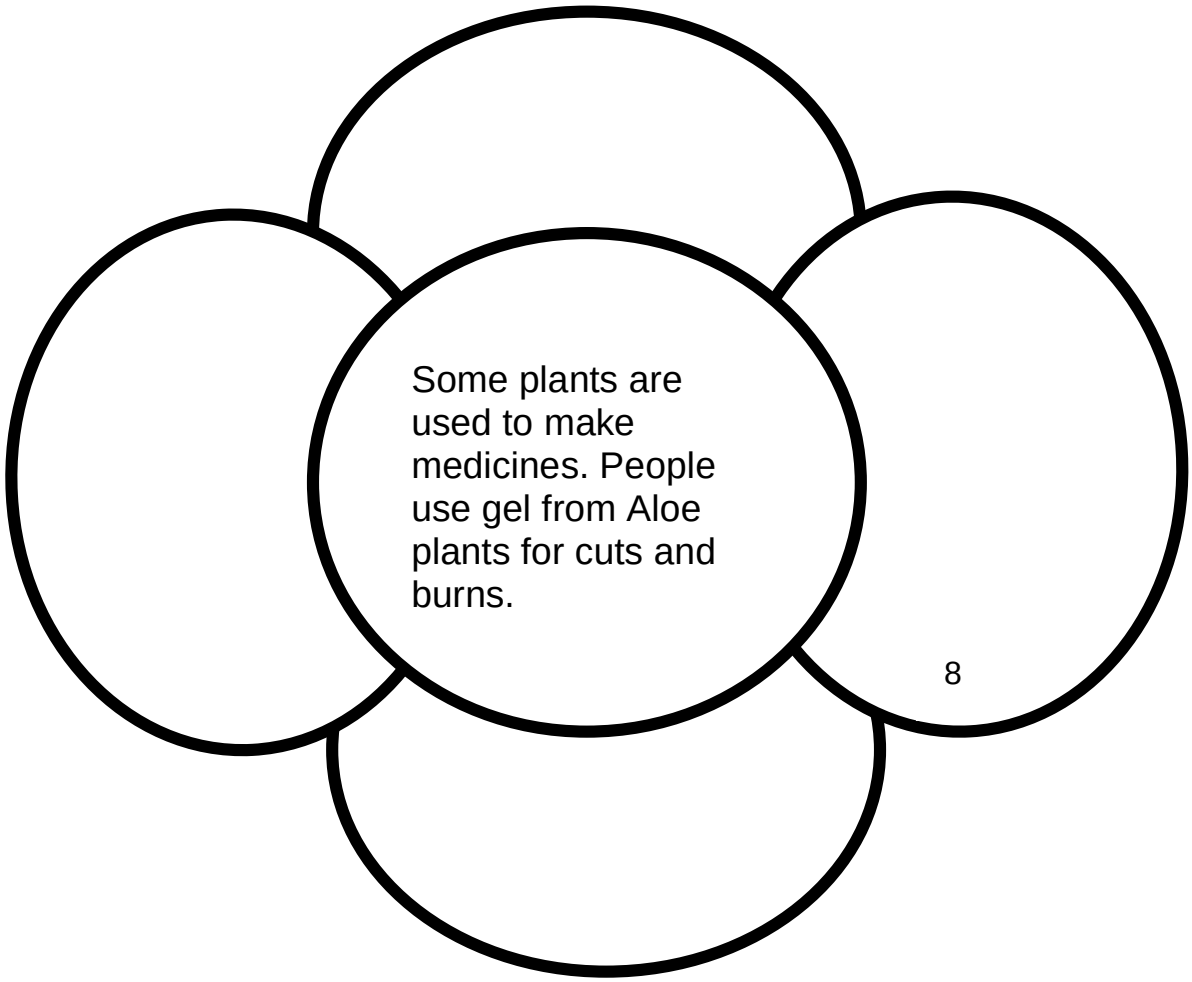

Seedlings need **soil, water, air** and the sun's **light** to grow into a plant.
3

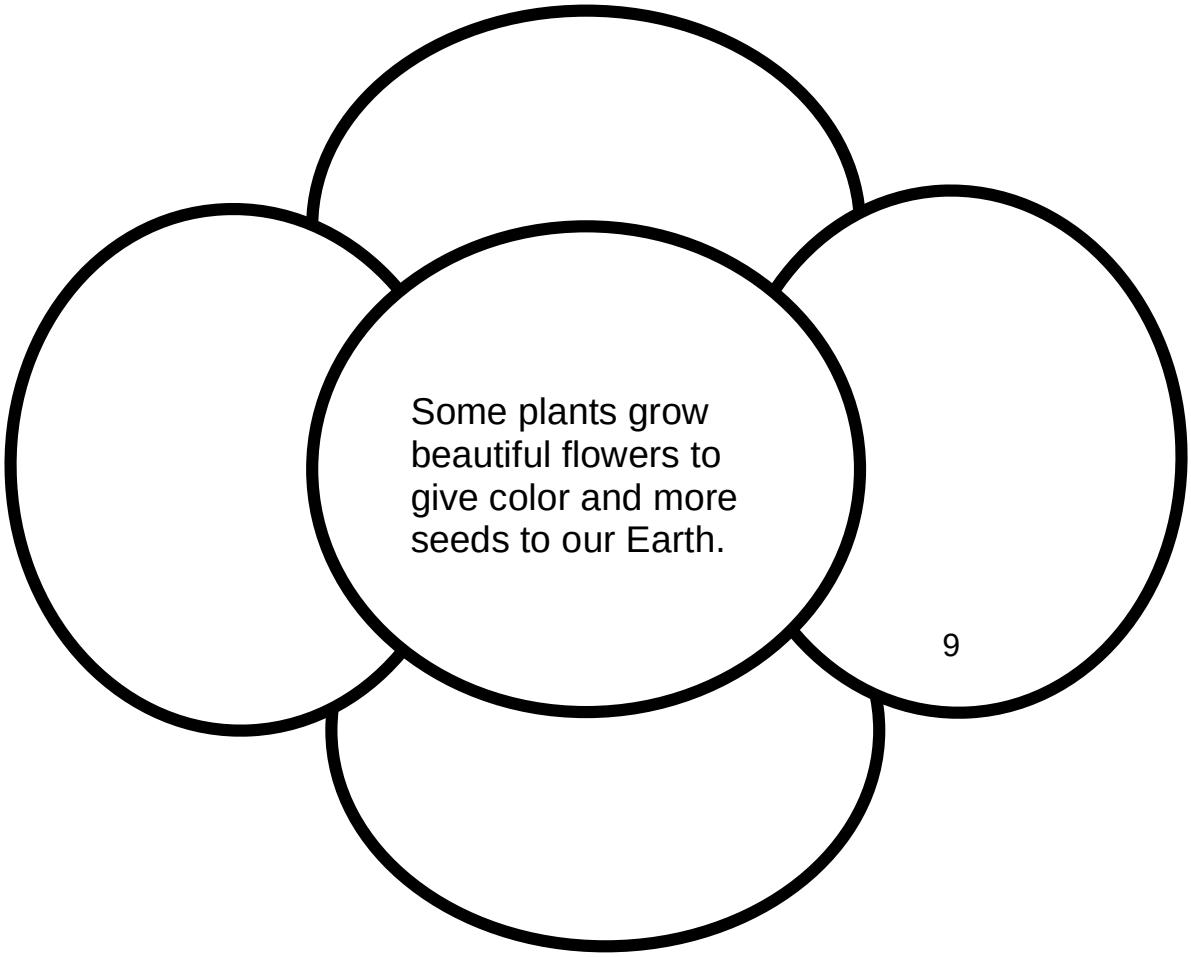

Plants use the sun's light to make their own food. Plants take **nutrients** and **minerals** from the soil.
4

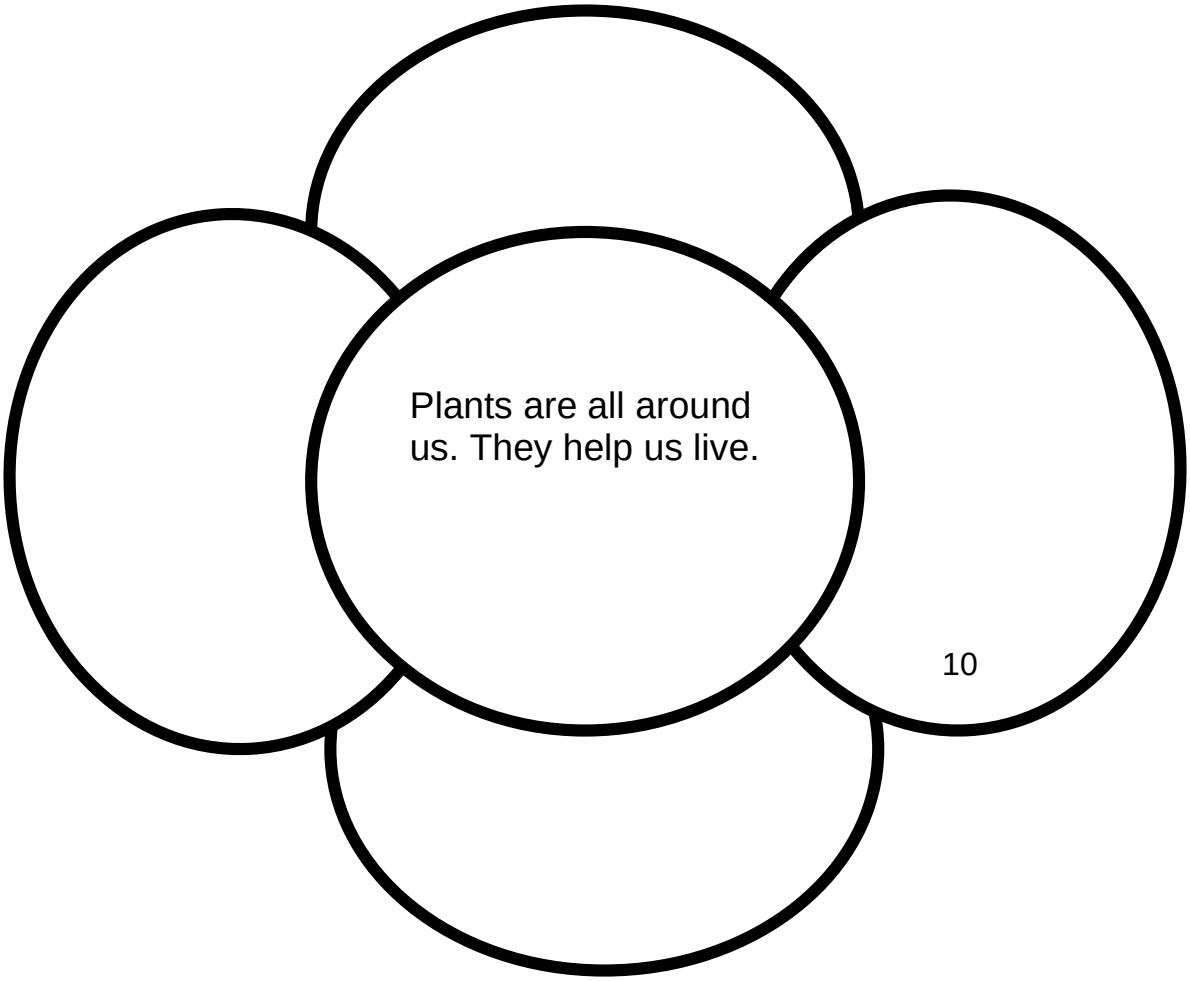

People use many different kinds of plants.
5

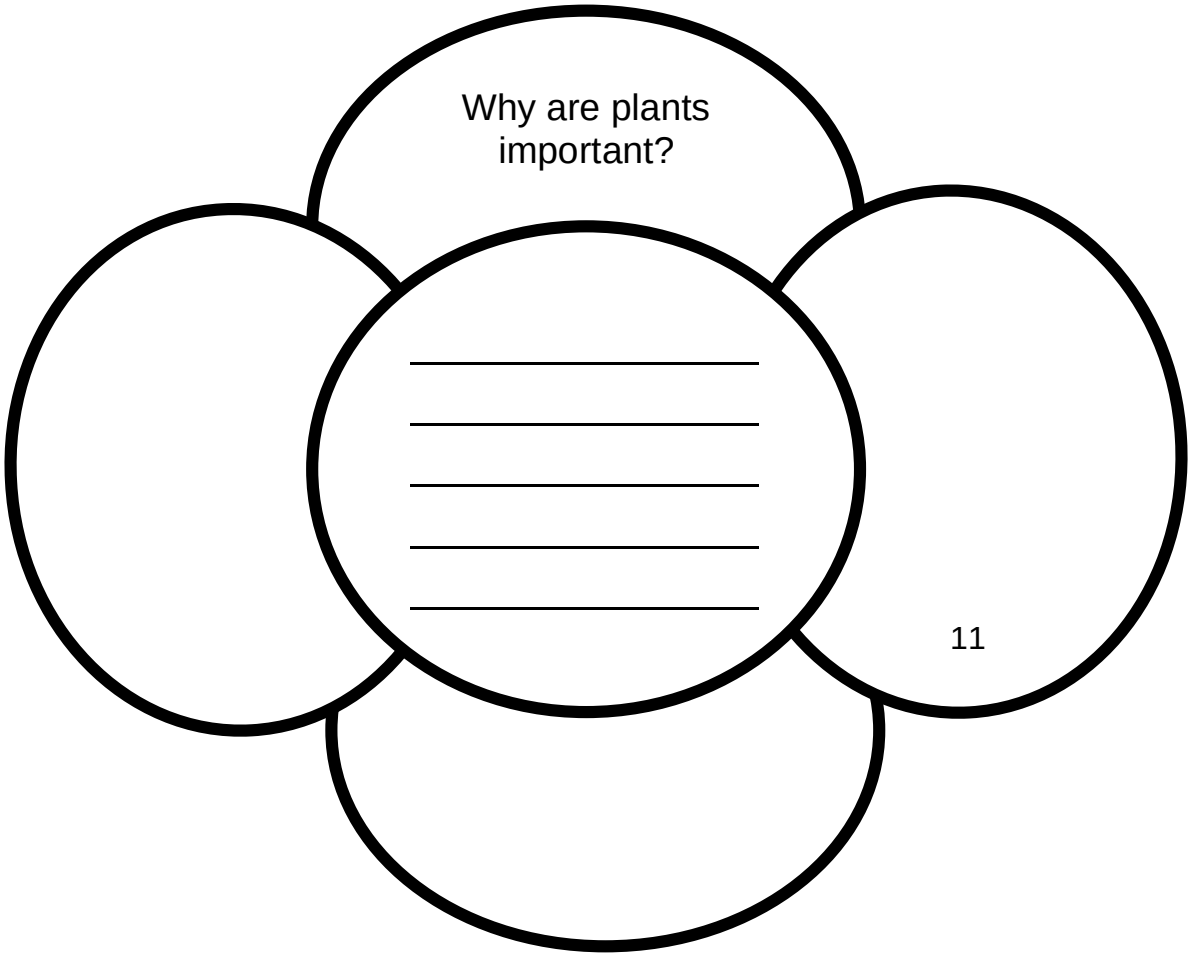

Many plants give us food. Strawberries, tomatoes, potatoes, lettuce and carrots all come from plants.
6


People use the leaves from basil, mint and oregano plants to season foods.
7


Some plants are used to make medicines. People use gel from Aloe plants for cuts and burns.
8


Some plants grow beautiful flowers to give color and more seeds to our Earth.
9


Plants are all around us. They help us live.
10


Why are plants important?
11

Food From Plants

Name _____

Draw and label four foods that come from plants.

Which is your favorite food? Explain why this is your favorite food.

Seeds and Plants on Earth

Name _____

1. What is needed for these seeds to germinate on Earth? Illustrate and label.

2. What is needed for this plant to grow on Earth? Illustrate and label.

3. List the items from above that are Earth's natural resources.

_____

_____

Name _____

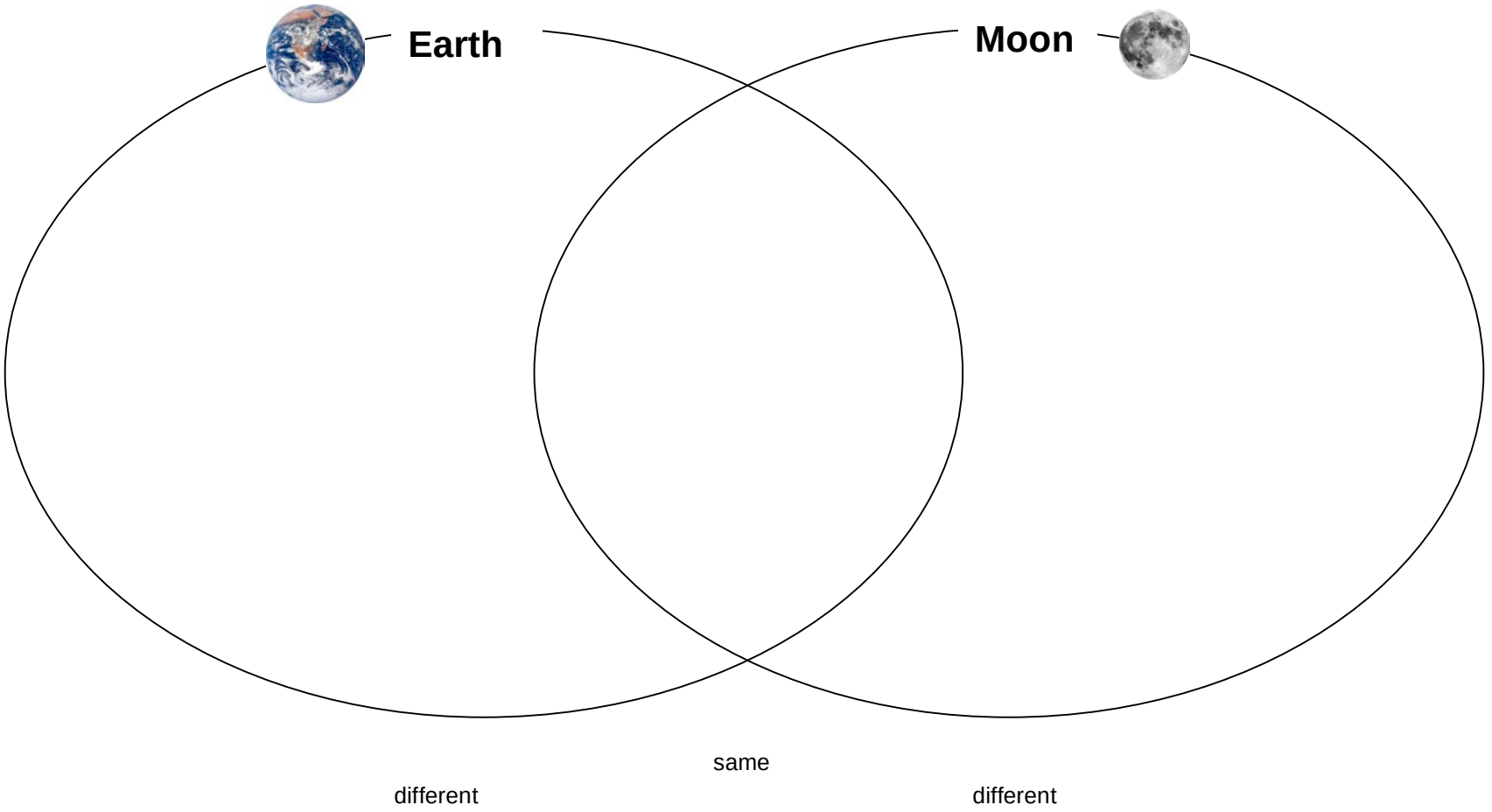
KWL

Moon

Know	Want to Know	Learned
Write at least two things you know about the moon.	Write at least two things you want to know about the moon.	Write at least two things you learned about the moon.

Name _____

Let's compare and contrast the Earth and the moon. List words to describe each one in the correct spaces.



Seeds on the Moon

Name _____

If we planted some seeds on the moon do you think they would grow? Use information from what we have read to explain your answer.

Plant Growth Chamber Engineer

Name _____

What would you put in a lunar plant growth chamber if you were an engineer designing and building one? Explain your answer.

Our Moon

Name _____

Let's blast off and learn about the moon!

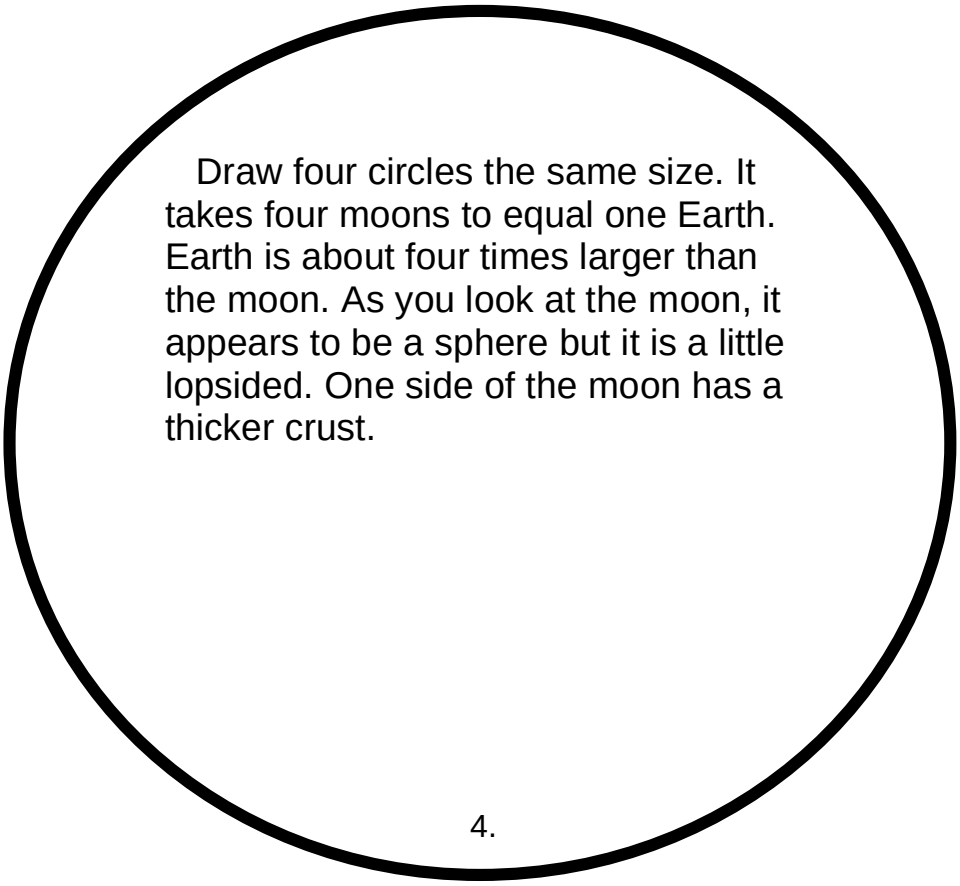
1.

The moon is about 240,000 miles, or about 382,400 kilometers from Earth. It would take two to four days to travel there on a spacecraft.

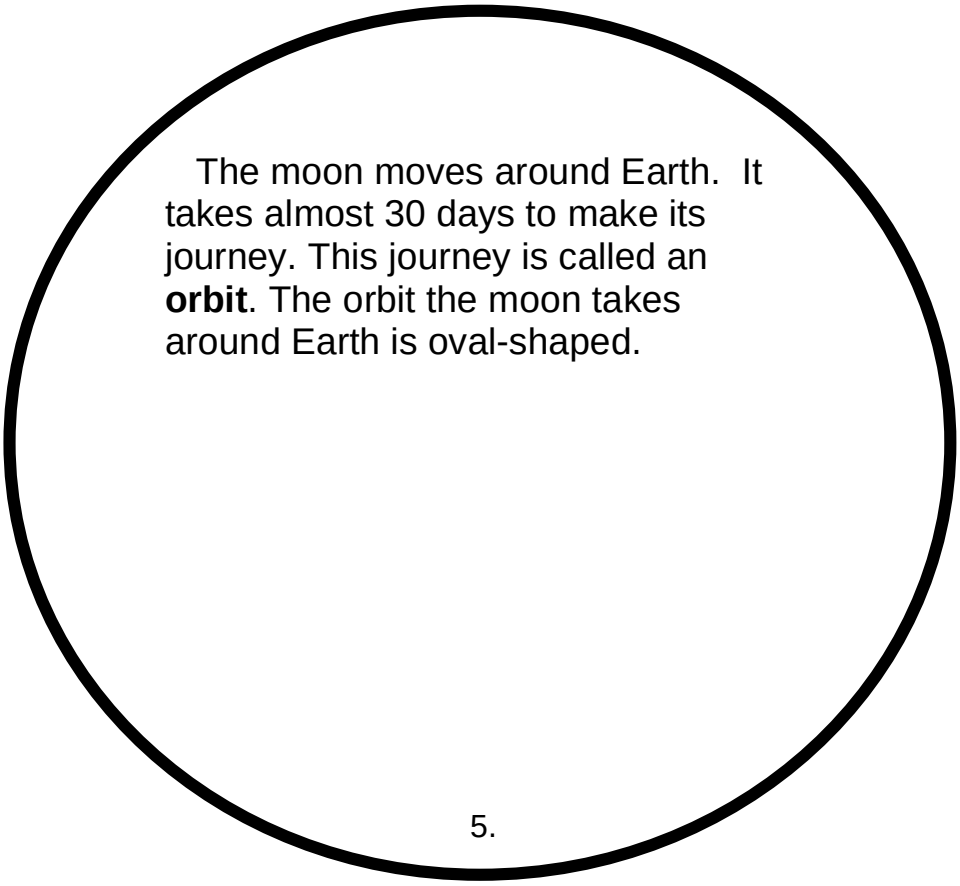
2.

Scientists believe the moon is about 4.6 billion years old.

3.


Draw four circles the same size. It takes four moons to equal one Earth. Earth is about four times larger than the moon. As you look at the moon, it appears to be a sphere but it is a little lopsided. One side of the moon has a thicker crust.

4.


The moon moves around Earth. It takes almost 30 days to make its journey. This journey is called an **orbit**. The orbit the moon takes around Earth is oval-shaped.

5.

As we look at the moon each evening, it appears to change shape. The different shapes you see are called the “**phases** of the moon.”

6.

You can see the moon because of the sun. The light you see on the moon at night is really the reflection of the sun.

7.

When you step on the moon, the surface is like a powder. In some places it is 12 inches, or 30 centimeters, deep. The moon's surface has a lot of rocks. The powder and the rocks are the moon's natural resources.

8.

Look around. You see lots of different landforms: mountains, valleys, wide flat plains and hills. There are many deep holes, which are called **craters**. Rocks and stones fly through space. Sometimes, they hit the moon and make craters.

9.

The moon is very quiet. You do not hear any sounds.

10.

There is no wind or rain on the moon.

11.

The moon can get very hot (about 253 degrees Fahrenheit or 123 degrees Celsius) and very cold (about -387 degrees Fahrenheit or -233 degrees Celsius). Brrrrrrrrrrrrrrrr!

12.

No plants, animals or people live on the moon.

13.

The moon has gravity, but not as much as Earth. If you weigh 60 pounds on Earth, you would only weigh 10 pounds on the moon. Watch out, your steps will be like leaps!

14.

Maybe one day you will take a “leap” on the moon!

15.

Would you like to be an astronaut one day and travel to the moon? Why or why not?

16.

If people were to live on the moon, what would they need to survive?

17.

Engineering Portfolio

Lunar Plant Growth Chamber

Name _____

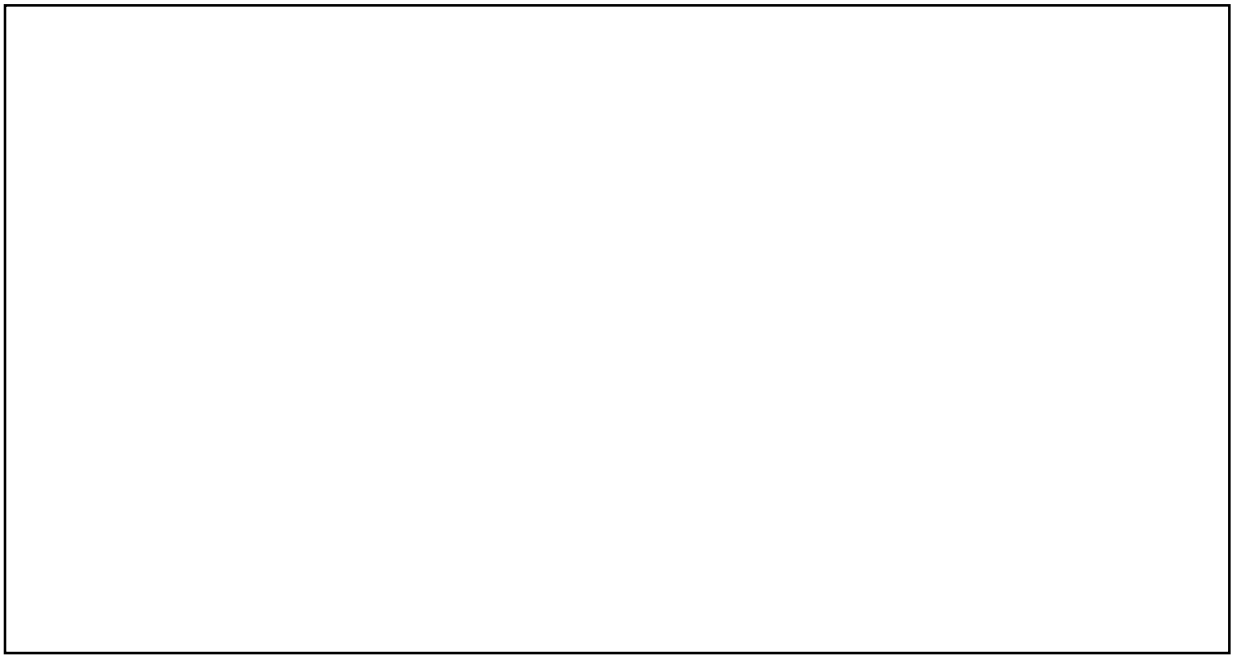
Engineering Worksheet 1

State the Problem:
What do you need to do?

Draw a picture of yourself.

Engineering Worksheet 2

Draw an electrical circuit. Label each part.



Explain the steps you will follow to make sure your electrical circuit works.

Engineering Worksheet 2 (continued)

Engineering Worksheet 3

Draw your watering system. Label each part.

Explain the steps you will follow to make sure your watering system works.

Engineering Worksheet 3 (continued)

Engineering Worksheet 4

Draw your lunar plant growth chamber model.
Did you include:

- the chamber
- the electrical circuit
- the watering system

Label each part.

Engineering Worksheet 5

Draw your lunar plant growth chamber model.
Label each part.

Explain the steps you took to build your lunar plant growth chamber.

Engineering Worksheet 5 (continued)

Engineering Worksheet 5 (continued)

Engineering Worksheet 6

Evaluate your lunar plant growth chamber.

What is the size of your lunar plant growth chamber?

Length: _____

Width: _____

Height: _____

Does your lunar plant growth chamber meet the size requirements? Explain your answer.

_____

_____

_____

_____

_____

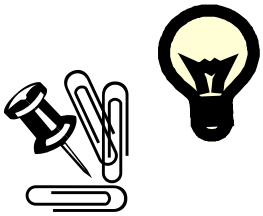
_____

Engineering Worksheet 6 (continued)

Does your electrical circuit work? How do you know?

Does your watering system work? How do you know?

Price List for Materials



Item	Price
battery	85¢
battery holder	63¢
cardboard	4¢
coffee stirrer	3¢
construction paper	8¢
electrical tape	6¢
glue stick	28¢
light bulb	96¢
paper clip	10¢
paper triangles	1¢
plastic	32¢
plastic tray	45¢
popsicle stick	11¢
push pin	12¢
sandpaper	1¢
screw	7¢
socket	76¢
straw	5¢
Styrofoam®	62¢
syringe	14¢
tape	2¢
tubing	6¢ an inch
wire	2¢ an inch
wood	15¢
wooden beams	4¢ an inch

Store Supplies

Graph each item you purchase from the store.

Items in the Store

battery															
battery holder															
cardboard															
coffee stirrer															
construction paper															
electrical tape															
glue stick															
light bulb															
paper clip															
paper triangles															
plastic															
plastic tray															
popsicle stick															
push pin															
sandpaper															
screw															
socket															
straw															
Styrofoam®															
syringe															
tape															
tubing															
wire															
wood															
wooden beams															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Number of Items Bought

Lunar Plant Growth Chamber Requirements

Length – The chamber must be between 4 inches and 6 inches long.

Width – The chamber must be between 4 inches and 6 inches wide.

Height – The chamber must be between 5 inches and 11 inches high.

You must include:

- an electrical circuit
- a watering system
- a chamber
- a compartment to hold your electrical circuit

Lunar Plant Growth Chamber Journal

Name _____

Date _____

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			K-2	3-5	Exploring Technology	Invention & Innovation	Systems	Foundations	Impacts	Issues	Technological Design	Advanced Design Applications	Advanced Technological Applications	Engineering Design
The Nature of Technology														
STL-1	**Understanding the characteristics and scope of technology**	**8**	**12**	**12**	**16**	**7**	**10**	**8**	**12**	**10**	**9**	**10**	**11**	
A	The natural world and human-made world are different.	4												
B	All people use tools and techniques to help them do things.	4												
C	Things that are found in nature differ from things that are human-made in how they are produced and used.		4											
D	Tools, materials, and skills are used to make things and carry out tasks.		4											
E	Creative thinking and economic and cultural influences shape technological development.		4											
F	New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology.			4	4	4								
G	The development of technology is a human activity and is the result of individual or collective needs and the ability to be creative.			3	4									
H	Technology is closely linked to creativity, which has resulted in innovation.			3	4									
I	Corporations can often create demand for a product by bringing it onto the market and advertising it.			2	4	3								
J	The nature and development of technological knowledge and processes are functions of the setting.						4	2	2	4	3	4	4	
K	The rate of technological development and diffusion is increasing rapidly.						2	4	3					
L	Inventions and innovations are the results of specific, goal-oriented research.						2	2	3	3	4	4	4	
M	Most development of technologies these days is driven by the profit motive and the market.						2		4	3	2	2	3	

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			K-2	3-5	Exploring Technology	Invention & Innovation	Systems	Foundations	Impacts	Issues	Technological Design	Advanced Design Applications	Advanced Technological Applications	Engineering Design
The Nature of Technology														
STL-2	**Understanding the core concepts of technology**	**20**	**28**	**21**	**10**	**33**	**114**	**0**	**0**	**33**	**33**	**33**	**36**	
A	Some systems are found in nature, and some are made by humans.	4												
B	Systems have parts or components that work together to accomplish a goal.	4												
C	Tools are simple objects that help humans complete tasks.	4												
D	Different materials are used in making things.	4												
E	People plan in order to get things done.	4												
F	A subsystem is a system that operates as a part of another system.		4											
G	When parts of a system are missing, it may not work as planned.		4											
H	Resources are the things needed to get a job done, such as tools and machines, materials, information, energy, people, capital, and time.		4											
I	Tools are used to design, make, use, and assess technology.		4											
J	Materials have many different properties.		4											
K	Tools and machines extend human capabilities, such as holding, lifting, carrying, fastening, separating, and computing.		4											
L	Materials have many different properties.		4											
M	Technological systems include input, processes, output, and, at times, feedback.			4		3								
N	Systems thinking involves considering how every part relates to others			4		3								
O	An open-loop system has no feedback path and requires human intervention, while a closed-loop system uses feedback.					4								
P	Technological systems can be connected to one another.			3		4								
Q	Malfunctions of any part of a system may affect the function and quality of the system.				3	4								
R	Requirements are the parameters placed on the development of a product or system.				3	4								
S	Trade-off is a decision process recognizing the need for careful compromises among competing factors.				4									
T	Trade-off is a decision process recognizing the need for careful compromises among competing factors.			4		3								
U	Different technologies involve different sets of processes.			3		4								

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			K-2	3-5	Exploring Technology	Invention & Innovation	Systems	Foundations	Impacts	Issues	Technological Design	Advanced Design Applications	Advanced Technological Applications	Engineering Design
STL-2	**Understanding the core concepts of technology (continued)**		**20**	**28**	**21**	**10**	**33**	**14**	**0**	**0**	**33**	**33**	**33**	**36**
V	Controls are mechanisms or particular steps that people perform using information about the system that causes systems to change.				3		4							
W	Systems thinking applies logic and creativity with appropriate compromises in complex real-life problems.										4	4	4	4
X	Systems, which are the building blocks of technology, are embedded within larger technological, social, and environmental systems.							4				3	4	
Y	The stability of a technological system is influenced by all of the components in the system, especially those in the feedback loop.							3			4	4	3	4
Z	Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste.							3			4	2	2	4
AA	Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development.										4	4	4	4
BB	Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints.										3	4	3	4
CC	New technologies create new processes.							4			4	3	4	4
DD	Quality control is a planned process to ensure that a product, service, or system meets established criteria.										3	3	2	4
EE	Management is the process of planning, organizing, and controlling work.										3	2	3	4
FF	Complex systems have many layers of controls and feedback loops to provide information.										4	4	4	4

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			K-2	3-5	Exploring Technology	Invention & Innovation	Systems	Foundations	Impacts	Issues	Technological Design	Advanced Design Applications	Advanced Technological Applications	Engineering Design
STL-3	**Understanding the relationships among technologies and connections with other fields of study**	**4**	**8**	**6**	**5**	**12**	**11**	**5**	**7**	**12**	**10**	**10**	**12**
A	The study of technology uses many of the same ideas and skills as other subjects.	4											
B	Technologies are often combined.		4										
C	Various relationships exist between technology and other fields of study.		4										
D	Technological systems often interact with one another.			3	2	4							
E	A product, system, or environment developed for one setting may be applied to another setting.				3	4							
F	Knowledge gained from other fields of study has a direct effect on the development of technological products and systems.			3		4							
G	Technology transfer occurs when a new user applies an existing innovation developed for one purpose in a different function.						3	2		4	4	3	4
H	Technological innovation often results when ideas, knowledge, or skills are shared within a technology, among						3			4	3	4	4
I	Technological ideas are sometimes protected through the process of patenting.						2		3	4			4
J	Technological progress promotes the advancement of science and mathematics.						3	3	4		3	3	
Technology and Society													
STL-4	**Understanding the cultural, social, economic and political effects of technology**	**4**	**8**	**14**	**11**	**3**	**2**	**13**	**10**	**6**	**7**	**8**	**4**
A	The use of tools and machines can be helpful or harmful.	4											
B	When using technology, results can be good or bad.		4										
C	The use of technology can have unintended consequences.		4										
D	The use of technology affects humans in various ways, including their safety, comfort, choices, and attitudes about technology's development and use.			4									
E	Technology, by itself, is neither good nor bad, but decisions about the use of products and systems can result in desirable or undesirable consequences.			4	3	3							
F	The development and use of technology poses ethical issues.			3	4								
G	Economic, political, and cultural issues are influenced by the development and use of technology.			3	4								
H	Changes caused by the use of technology can range from gradual to rapid and from subtle to obvious.							4		2	3	4	
I	Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.						2	3	4				
J	Ethical considerations are important in the development, selection, and use of technologies.							3	2	4	4	4	4
I	The transfer of a technology from one society to another can cause cultural, social, economic, and political changes affecting both societies to varying degrees.							3	4				

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			K-2	3-5	Exploring Technology	Invention & Innovation	Systems	Foundations	Impacts	Issues	Technological Design	Advanced Design Applications	Advanced Technological Applications	Engineering Design
STL-5	**Understanding the effects of technology on the environment**	**4**	**8**	**8**	**6**	**9**	**3**	**18**	**6**	**11**	**13**	**13**	**11**
A	Some materials can be reused and/or recycled.	4											
B	Waste must be appropriately recycled or disposed of to prevent unnecessary harm to the environment.		4										
C	The use of technology affects the environment in good and bad ways.		4										
D	The management of waste produced by technological systems is an important societal issue.			4		3							
E	Technologies can be used to repair damage caused by natural disasters and to break down waste from the use of various products and systems.				3	4							
F	Decisions to develop and use technologies often put environmental and economic concerns in direct competition with one another.			4	3	2							
G	Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing and recycling.								4	3	2	2	3
H	When new technologies are developed to reduce the use of resources, considerations of trade-offs are important.							3		4	2	3	4
I	With the aid of technology, various aspects of the environment can be monitored to provide information for decisionmaking.							4			2		
J	The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment.							4				2	
K	Humans devise technologies to reduce the negative consequences of other technologies. 3 4 3 3 4							3		4	3	3	4
L	Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment.							3	4	2		4	3	
STL-6	**Understanding the role of society in the development and use of technology**	**4**	**8**	**13**	**12**	**2**	**4**	**10**	**2**	**4**	**3**	**3**	**4**
A	Products are made to meet individual needs and wants.	4											
B	Because people's needs and wants change, new technologies are developed, and old ones are improved to meet those changes.		4										
C	Individual, family, community, and economic concerns may expand or limit the development of technologies.		4										
D	Throughout history, new technologies have resulted from the demands, values, and interests of individuals, businesses, industries, and societies.			4									
E	The use of inventions and innovations has led to changes in society and the creation of new needs and wants.			3	4								
F	Social and cultural priorities and values are reflected in technological devices.			3	4								
G	Meeting societal expectations is the driving force behind the acceptance and use of products and systems.			3	4	2							
H	Different cultures develop their own technologies to satisfy their individual and shared needs, wants, and values.							4					
I	The decision whether to develop a technology is influenced by societal opinions and demands, in addition to corporate cultures.							3	2	4			4
J	A number of different factors, such as advertising, the strength of the economy, the goals of a company, and the latest fads contribute to shaping the design of and demand for various technologies.						4	3			3	3	

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			K-2	3-5	Exploring Technology	Invention & Innovation	Systems	Foundations	Impacts	Issues	Technological Design	Advanced Design Applications	Advanced Technological Applications	Engineering Design
The Nature of Technology														
STL-7 Understanding the influence of technology on history		**4**	**4**	**6**	**12**	**4**	**28**	**22**	**9**	**0**	**3**	**3**	**0**
A	The way people live and work has changed throughout history because of technology.		**4**										
B	People have made tools to provide food, to make clothing, and to protect themselves.			**4**									
C	Many inventions and innovations have evolved by using slow and methodical processes of tests and refinements.				**3**	**4**							
D	The specialization of function has been at the heart of many technological improvements.				**3**	**4**							
E	The design and construction of structures for service or convenience have evolved from the development of techniques for measurement, controlling systems, and the understanding of spatial relationships.						**4**						
F	In the past, an invention or innovation was not usually developed with the knowledge of science.					**4**							
G	Most technological development has been evolutionary, the result of a series of refinements to a basic invention..								**4**				
H	The evolution of civilization has been directly affected by, and has in turn affected, the development and use of tools and materials.									**3**	**4**			
I	Throughout history, technology has been a powerful force in reshaping the social, cultural, political, and economic landscape.									**4**	**3**			
J	Early in the history of technology, the development of many tools and machines was based not on scientific knowledge but on technological know-how.								**4**					
K	The Iron Age was defined by the use of iron and steel as the primary materials for tools.								**4**	**3**				
L	The Middle Ages saw the development of many technological devices that produced long-lasting effects on technology and society								**4**	**3**				
M	The Renaissance, a time of rebirth of the arts and humanities, was also an important development in the history of technology.								**4**	**3**				
N	The Industrial Revolution saw the development of continuous manufacturing, sophisticated transportation and communication systems, advanced construction practices, and improved education and leisure time.								**4**	**3**				
O	The Information Age places emphasis on the processing and exchange of information.								**4**	**3**	**2**		**3**	**3**

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Design														
STL-8	**Understanding the attributes of design**		**8**	**8**	**11**	**10**	**3**	**13**	**2**	**0**	**15**	**16**	**15**	**15**
A	Everyone can design solutions to a problem.		4											
B	Design is a creative process.		4											
C	The design process is a purposeful method of planning practical solutions to problems.			4										
D	Requirements for a design include such factors as the desired elements and features of a product or system or the limits that are placed on the design.			4										
E	Design is a creative planning process that leads to useful products and systems.				3	4	3							
F	There is no perfect design.				4	3								
G	Requirements for a design are made up of criteria and constraints.				4	3								
H	The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype.							4			3	4	4	3
I	Design problems are seldom presented in a clearly defined form.							3			4	4	3	4
J	The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.							3			4	4	4	4
K	Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.							3	2		4	4	4	4

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STL-9	**Understanding engineering design**		**8**	**12**	**11**	**10**	**0**	**13**	**2**	**0**	**14**	**10**	**10**	**15**
A	The engineering design process includes identifying a problem, looking for ideas, developing solutions, and sharing solutions with others.		4											
B	Expressing ideas to others verbally and through sketches and models is an important part of the design process.		4											
C	The engineering design process involves defining a problem, generating ideas, selecting a solution, testing the solution(s), making the item, evaluating it, and presenting the results.			4										
D	When designing an object, it is important to be creative and consider all ideas.			4										
E	Models are used to communicate and test design ideas and processes.			4										
F	Design involves a set of steps, which can be performed in different sequences and repeated as needed.				4	3								
G	Brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum.				3	4								
H	Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.				4	3								
I	Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.							4			3	4	3	3
J	Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.							3			4	3	3	4
K	A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.							3			4	3	4	4
L	The process of engineering design takes into account a number of factors.							3	2		3			4

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STL-10	**Understanding the role of troubleshooting, R&D, etc. in problem-solving**		**8**	**12**	**9**	**10**	**6**	**4**	**7**	**11**	**3**	**14**	**14**	**3**
A	Asking questions and making observations helps a person to figure out how things work. .		4											
B	All products and systems are subject to failure. Many products and systems, however, can be fixed.		4											
C	Troubleshooting is a way of finding out why something does not work so that it can be fixed.			4										
D	Invention and innovation are creative ways to turn ideas into real things.			4										
E	The process of experimentation, which is common in science, can also be used to solve technological problems.			4										
F	Troubleshooting is a problem-solving method used to identify the cause of a malfunction in a technological system.				3	2	4							
G	Invention is a process of turning ideas and imagination into devices and systems. Innovation is the process of modifying an existing product or system to improve it.				3	4	2							
H	Some technological problems are best solved through experimentation.				3	4								
I	Research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace.							4			3	3	3	3
J	Technological problems must be researched before they can be solved.								4	3		4	4	
K	Not all problems are technological, and not every problem can be solved using technology.									4		4	3	
L	Many technological problems require a multidisciplinary approach.								3	4		3	4	

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Abilities for a Technological World														
STL-11	**Abilities to apply the design process**	**12**	**16**	**10**	**19**	**3**	**18**	**3**	**4**	**16**	**18**	**18**	**17**	
A	Brainstorm people's needs and wants and pick some problems that can be solved through the design process.	4												
B	Build or construct an object using the design process.	4												
C	Investigate how things are made and how they can be improved.	4												
D	Identify and collect information about everyday problems that can be solved by technology, and generate ideas and requirements for solving a problem.		4											
E	The process of designing involves presenting some possible solutions in visual form and then selecting the best solution(s) from many.		4											
F	Test and evaluate the solutions for the design problem.		4											
G	Improve the design solutions.		4											
H	Apply a design process to solve problems in and beyond the laboratory-classroom.			3	4									
I	Specify criteria and constraints for the design.			3	4									
J	Make two-dimensional and three-dimensional representations of the designed solution.				4									
K	Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed.				4									
L	Make a product or system and document the solution.			4	3	3								
M	Identify the design problem to solve and decide whether or not to address it.							3	4					
N	Identify criteria and constraints and determine how these will affect the design process.						4			3	4	3	3	
O	Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.						4			3	4	4	3	
P	Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design						3			3	3	4	4	
Q	Develop and produce a product or system using a design process.						3			4	4	4	4	
R	Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.						4			3	3	3	3	

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STL-12	**Abilities to use and maintain technological products and systems**		**12**	**16**	**8**	**3**	**13**	**20**	**0**	**0**	**0**	**11**	**11**	**0**
A	Discover how things work.		4											
B	Use hand tools correctly and safely and be able to name them correctly.		4											
C	Recognize and use everyday symbols.		4											
D	Follow step-by-step directions to assemble a product.			4										
E	Select and safely use tools, products, and systems for specific tasks.			4										
F	Use computers to access and organize information.			4										
G	Use common symbols, such as numbers and words, to communicate key ideas.			4										
H	Use information provided in manuals, protocols, or by experienced people to see and understand how things work.				4		3							
I	Use tools, materials, and machines safely to diagnose, adjust, and repair systems.						4							
J	Use computers and calculators in various applications.				4	3	2							
K	Operate and maintain systems in order to achieve a given purpose.						4							
L	Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.							4				3	3	
M	Diagnose a system that is malfunctioning and use tools, materials, machines, and knowledge to repair it.							4				4	4	
N	Troubleshoot, analyze, and maintain systems to ensure safe and proper function and precision.							4						
O	Operate systems so that they function in the way they were designed.							4						
P	Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.							4				4	4	

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STL-13 Abilities to assess the impact of products and systems			**8**	**12**	**9**	**3**	**16**	**4**	**15**	**11**	**1**	**9**	**9**	**1**
A	Collect information about everyday products and systems by asking questions.		4											
B	Determine if the human use of a product or system creates positive or negative results.		4											
C	Compare, contrast, and classify collected information in order to identify patterns.			4										
D	Investigate and assess the influence of a specific technology on the individual, family, community, and environment.			4										
E	Examine the trade-offs of using a product or system and decide when it could be used.			4										
F	Design and use instruments to gather data.				3		4							
G	Use data collected to analyze and interpret trends in order to identify the positive or negative effects of a technology.					3								
H	Identify trends and monitor potential consequences of technological development.				3		4							
I	Interpret and evaluate the accuracy of the information obtained and determine if it is useful.				3		4							
J	Collect information and evaluate its quality.							4	3	2	1	2	2	1
K	Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and environment.								4	3		3	3	
L	Use assessment techniques, such as trend analysis and experimentation to make decisions about the future development of technology.								4	3		4		
M	Design forecasting techniques to evaluate the results of altering natural systems.								4	3			4	

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The Designed World														
STL-14	**Understanding of and abilities to select and use medical technologies**	**12**	**12**	**14**	**0**	**8**	**4**	**4**	**4**	**0**	**0**	**12**	**0**
A	Vaccinations protect people from getting certain diseases.	**4**											
B	Medicine helps people who are sick to get better.	**4**											
C	There are many products designed specifically to help people take care of themselves.	**4**											
D	Vaccines are designed to prevent diseases from developing and spreading; medicines are designed to relieve symptoms and stop diseases from developing.		**4**										
E	Technological advances have made it possible to create new devices, to repair or replace certain parts of the body, and to provide a means for mobility.		**4**										
F	Many tools and devices have been designed to help provide clues about health and to provide a safe environment.		**4**										
G	Advances and innovations in medical technologies are used to improve healthcare.			**4**									
H	Sanitation processes used in the disposal of medical products help to protect people from harmful organisms and disease, and shape the ethics of medical safety.			**4**									
I	The vaccines developed for use in immunization require specialized technologies to support environments in which a sufficient amount of vaccines are produced.			**3**		**4**							
J	Genetic engineering involves modifying the structure of DNA to produce novel genetic make-ups.			**3**		**4**							
K	Medical technologies include prevention and rehabilitation, vaccines and pharmaceuticals, medical and surgical procedures, genetic engineering, and the systems within which health is protected and maintained.							**4**				**4**	
L	Telemedicine reflects the convergence of technological advances in a number of fields, including medicine, telecommunications, virtual presence, computer engineering, informatics, artificial intelligence, robotics, materials science, and perceptual psycho						**4**					**4**	
M	The sciences of biochemistry and molecular biology have made it possible to manipulate the genetic information found in living creatures.								**4**			**4**	

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STL-15 Understanding of and abilities to select and use agricultural and biotechnologies			**8**	**12**	**12**	**4**	**4**	**4**	**4**	**7**	**4**	**0**	**16**	**4**
A	The use of technologies in agriculture makes it possible for food to be available year round and to conserve resources.		**4**											
B	There are many different tools necessary to control and make up the parts of an ecosystem.		**4**											
C	Artificial ecosystems are human-made environments that are designed to function as a unit and are comprised of humans, plants, and animals.			**4**										
D	Most agricultural waste can be recycled.			**4**										
E	Many processes used in agriculture require different procedures, products, or systems.			**4**										
F	Technological advances in agriculture directly affect the time and number of people required to produce food for a large population.				**4**									
G	A wide range of specialized equipment and practices is used to improve the production of food, fiber, fuel, and other useful products and in the care of animals.						**4**							
H	Biotechnology applies the principles of biology to create commercial products or processes.					**4**								
I	Artificial ecosystems are human-made complexes that replicate some aspects of the natural environment.				**4**									
J	The development of refrigeration, freezing, dehydration, preservation, and irradiation provide long-term storage of food and reduce the health risks caused by tainted food.				**4**									
K	Agriculture includes a combination of businesses that use a wide array of products and systems to produce, process, and distribute food, fiber, fuel, chemical, and other useful products.							**4**					**4**	
L	Biotechnology has applications in such areas as agriculture, pharmaceuticals, food and beverages, medicine, energy, the environment, and genetic engineering.								**4**	**3**			**4**	
M	Conservation is the process of controlling soil erosion, reducing sediment in waterways, conserving water, and improving water quality.									**4**			**4**	
N	The engineering design and management of agricultural systems require knowledge of artificial ecosystems and the effects of technological development on flora and fauna.										**4**		**4**	**4**

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STL-16 Understanding of and abilities to select and use energy and power technologies			**8**	**8**	**12**	**0**	**8**	**12**	**6**	**3**	**17**	**20**	**0**	**17**
A	Energy comes in many forms.		4											
B	Energy should not be wasted.		4											
C	Energy comes in different forms.			4										
D	Tools, machines, products, and systems use energy in order to do work.			4										
E	Energy is the capacity to do work.				4									
F	Energy can be used to do work, using many processes.						4							
G	Power is the rate at which energy is converted from one form to another or transferred from one place to another, or the rate at which work is done.				4									
H	Power systems are used to drive and provide propulsion to other technological products and systems.						4							
I	Much of the energy used in our environment is not used efficiently.				4									
J	Energy cannot be created nor destroyed; however, it can be converted from one form to another.							4			3	4		3
K	Energy can be grouped into major forms: thermal, radiant, electrical, mechanical, chemical, nuclear, and others.							4			3	4		3
L	It is impossible to build an engine to perform work that does not exhaust thermal energy to the surroundings.								4		3	4		3
M	Energy resources can be renewable or nonrenewable.							1	2	3	4	4		4
N	Power systems must have a source of energy, a process, and loads.							3			4	4		4

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STL-17 Understanding of and abilities to select and use information and communication technologies			**12**	**16**	**13**	**4**	**8**	**16**	**8**	**8**	**7**	**0**	**24**	**7**
A	Information is data that has been organized.		4											
B	Technology enables people to communicate by sending and receiving information over a distance.		4											
C	People use symbols when they communicate by technology.		4											
D	The processing of information through the use of technology can be used to help humans make decisions and solve problems.			4										
E	Information can be acquired and sent through a variety of technological sources, including print and electronic media.			4										
F	Communication technology is the transfer of messages among people and/or machines over distances through the use of technology.			4										
G	Letters, characters, icons, and signs are symbols that represent ideas, quantities, elements, and operations.			4										
H	Information and communication systems allow information to be transferred from human to human, human to machine, and machine to human.				3		4							
I	Communication systems are made up of a source, encoder, transmitter, receiver, decoder, and destination.				3		4							
J	The design of a message is influenced by such factors as the intended audience, medium, purpose, and nature of the message.				4									
K	The use of symbols, measurements, and drawings promotes clear communication by providing a common language to express ideas.				3	4								
L	Information and communication technologies include the inputs, processes, and outputs associated with sending and receiving information.							4					4	
M	Information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine.							4					4	
N	Information and communication systems can be used to inform, persuade, entertain, control, manage, and educate.							1	4	4			4	
O	Communication systems are made up of source, encoder, transmitter, receiver, decoder, storage, retrieval, and destination.							4					4	
P	There are many ways to communicate information, such as graphic and electronic means.								4	4	4		4	3
Q	Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.							3			4		4	4

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STL-18 Understanding of and abilities to select and use transportation technologies			**12**	**8**	**4**	**4**	**11**	**4**	**8**	**0**	**4**	**16**	**0**	**4**
A	A transportation system has many parts that work together to help people travel.		4											
B	Vehicles move people or goods from one place to another in water, air, or space and on land.		4											
C	Transportation vehicles need to be cared for to prolong their use.		4											
D	The use of transportation allows people and goods to be moved from place to place.			4										
E	A transportation system may lose efficiency or fail if one part is missing or malfunctioning or if a subsystem is not working.			4										
F	Transporting people and goods involves a combination of individuals and vehicles.				4		3							
G	Transportation vehicles are made up of subsystems, such as structural, propulsion, suspension, guidance, control, and support, that must function together for a system to work effectively.						4							
H	Governmental regulations often influence the design and operation of transportation systems.					4								
I	Processes, such as receiving, holding, storing, loading, moving, unloading, delivering, evaluating, marketing, managing, communicating, and using conventions are necessary for the entire transportation system to operate efficiently.						4							
J	Transportation plays a vital role in the operation of other technologies, such as manufacturing, construction, communication, health and safety, and agriculture.							4				4		
K	Intermodalism is the use of different modes of transportation, such as highways, railways, and waterways as part of an interconnected system that can move people and goods easily from one mode to another.								4			4		
L	Transportation services and methods have led to a population that is regularly on the move.								4			4		
M	The design of intelligent and non-intelligent transportation systems depends on many processes and innovative techniques										4	4		4

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4 = Benchmark must be covered in detail, lessons and assessments cover this content
3 = Benchmark is covered, but topics and lessons do not center on them
2 = Topics and lessons refer to previous knowledge and integrate content covered
1 = Topics and lessons refer to previous knowledge

		Course Total	172	232	212	147	166	202	154	97	182	236	209	187
			K-2	3-5	Exploring Technology	Invention & Innovation	Systems	Foundations	Impacts	Issues	Technological Design	Advanced Design Applications	Advanced Technological Applications	Engineering Design
STL-19 Understanding of and abilities to select and use manufacturing technologies			**8**	**12**	**12**	**8**	**4**	**10**	**15**	**3**	**14**	**24**	**0**	**15**
A	Manufacturing systems produce products in quantity.		4											
B	Manufactured products are designed.		4											
C	Processing systems convert natural materials into products.			4										
D	Manufacturing processes include designing products, gathering resources, and using tools to separate, form, and combine materials in order to produce products.			4										
E	Manufacturing enterprises exist because of a consumption of goods.			4										
F	Manufacturing systems use mechanical processes that change the form of materials through the processes of separating, forming, combining, and conditioning them.				4									
G	Manufactured goods may be classified as durable and non-durable.				4									
H	The manufacturing process includes the designing, development, making, and servicing of products and systems.						4							
I	Chemical technologies are used to modify or alter chemical substances.					4								
J	Materials must first be located before they can be extracted from the earth through such processes as harvesting, drilling, and mining.				4									
K	Marketing a product involves informing the public about it well as assisting in selling and distributing it.					4								
L	Servicing keeps products in good operating condition.								4					
M	Materials have different qualities and may be classified as natural, synthetic, or mixed.							4	3		3	4		3
N	Durable goods are designed to operate for a long period of time, while non-durable goods are designed to operate for a short period of time.										4	4		4
O	Manufacturing systems may be classified into types, such as customized production, batch production, and continuous production.							3			3	4		4
P	The interchangeability of parts increases the effectiveness of manufacturing processes.							3			4	4		4
Q	Chemical technologies provide a means for humans to alter or modify materials and to produce chemical products.								4			4		
R	Marketing involves establishing a product's identity, conducting research on its potential, advertising it, distributing it, and selling it.								4	3		4		

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			K-2	3-5	Exploring Technology	Invention & Innovation	Systems	Foundations	Impacts	Issues	Technological Design	Advanced Design Applications	Advanced Technological Applications	Engineering Design
STL-20 Understanding of and abilities to select and use construction technologies			**8**	**12**	**7**	**0**	**12**	**8**	**4**	**0**	**11**	**20**	**0**	**11**
A	People live, work, and go to school in buildings, which are of different types: houses, apartments, office buildings, and schools.		4											
B	The type of structure determines how the parts are put together.		4											
C	Modern communities are usually planned according to guidelines.			4										
D	Structures need to be maintained.			4										
E	Many systems are used in buildings.			4										
F	The selection of designs for structures is based on factors such as building laws and codes, style, convenience, cost, climate, and function.				4									
G	Structures rest on a foundation.				3		4							
H	Some structures are temporary, while others are permanent.						4							
I	Buildings generally contain a variety of subsystems.						4							
J	Infrastructure is the underlying base or basic framework of a system.							4				4		
K	Structures are constructed using a variety of processes and procedures.							4				4		
L	The design of structures includes a number of requirements.										4	4		4
M	Structures require maintenance, alteration, or renovation periodically to improve them or to alter their intended use.										3	4		3
N	Structures can include prefabricated materials										4	4		4

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