unit 11

A Home for a Penguin
Design Challenge:
What do we need to know about the properties of materials to design an artificial penguin habitat?

Section 1
What do we need to know about penguins?
Lesson 1
Where do Adelie penguins live?
Lesson 2
What solids and liquids are in a penguin’s habitat?
Lesson 3
What do we need to know to make a habitat for a penguin in a zoo?
Lesson 4

Section 2
How can we pick the best materials for our penguin habitat?
Lesson 5
How can we describe materials?
Lesson 6
How can we test which materials would keep our penguin cool?
Lesson 7

Section 3
What is the best design for our penguin habitat?
Lesson 8
How should we design our habitat?
Lesson 9
What do we need to redesign?
<table>
<thead>
<tr>
<th>Lesson</th>
<th>Inside MySci kit, you’ll find:</th>
<th>Items you must supply:</th>
<th>Extra prep time needed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesson 2</td>
<td>(2) 9-oz clear plastic cups (1) 9-oz clear plastic dish 6 paper plates 6 bags of assorted rocks 6 hand lenses 1/2 cup salt States of Matter Solids, book States of Matter Liquids, book</td>
<td>Science notebooks &amp; internet access Chart paper Water Ice cubes OPTIONAL EXTEND: Ice cubes, Stick of butter, Handful of chocolate chips or small chocolate bar, 2 crayons, Piece of bread</td>
<td>Copies of Evaluation Worksheet (Appendix i) Time to freeze one of the 9-ounce glasses of water!</td>
</tr>
<tr>
<td>Lesson 3</td>
<td></td>
<td>Science notebooks &amp; internet access</td>
<td>Copies of Venn Diagram (Appendix ii), answer key (Appendix iii)</td>
</tr>
<tr>
<td>Lesson 4</td>
<td></td>
<td>Science notebooks &amp; internet access</td>
<td>Copies of Engineering Design Cycle (Appendix iv)</td>
</tr>
<tr>
<td>Lesson 5</td>
<td>6 swatches of wool 6 swatches of cotton 6 swatches of paper towels Plastic wrap Aluminum foil 6 swatches of Mylar</td>
<td>Science notebooks Scissors Tape</td>
<td>Copies of the Data Sheet for Observing Materials (Appendix v)</td>
</tr>
<tr>
<td>Lesson 6</td>
<td>1 small silver-plated metal tray 1 small plastic tray 2 thermometer strips Penguin ice cube tray</td>
<td>Science notebooks &amp; internet access 8 penguin ice cubes Scissors Tape</td>
<td>Make ice cubes!</td>
</tr>
<tr>
<td>Lesson 7</td>
<td>1 heat lamp, clamp MySci Crate 1 kitchen timer 1 thermometer 3 petri dishes 6 pieces of black paper Aluminum foil (From Lesson 5) 6 Graduated medicine cups Penguin Ice Cube Tray (From Lesson 6) Material Swatches (From Lesson 5)</td>
<td>Science notebooks 8 penguin ice cubes Scissors Tape Electrical outlet</td>
<td>Copies of the Scientific Drawing Rubric (Appendix vi) Make ice cubes!</td>
</tr>
<tr>
<td>Lesson 8</td>
<td>Materials from previous lessons (especially Lesson 6)</td>
<td>Science notebooks Penguin ice cubes (enough for each group plus extras)</td>
<td></td>
</tr>
<tr>
<td>Lesson 9</td>
<td>Materials from previous lessons All About Matter, by Mari Schuh</td>
<td>Science notebooks Penguin ice cubes Chart paper</td>
<td>Make more ice cubes! Copy and administer post-assessment</td>
</tr>
</tbody>
</table>
What do we need to know about penguins?

Lesson 1: Where do Adelie penguins live?

LEARNING TARGETS
Identify the components of a penguin's natural habitat.
Describe how heat can affect a penguin's home.

SUMMARY
Students will hear Where is Home, Little Pip? and watch a video to identify the components of a penguin habitat. Students will also learn how heat can affect a penguin's home.

ENGAGE
Ask the class: What do we know about penguins? Make a KWL (Know, Want to know, and Learn) chart with the class. Use this opportunity to pre-assess the students’ understanding of a penguin’s needs.

EXPLORE
Read Where is Home, Little Pip. Ask: What can we learn about a penguin’s habitat from this book? Ask the class to identify the pictures that show the weather, the environment, the other animals Pip meets and where they live.

EXPLAIN
Ask the class: What do we need to add to our KWL chart after reading about Pip?
Add more information to the chart. While the book does not reveal the temperature, the pictures and words indicate a very cold environment with wind, snow, pebbles, near water, etc (mentions Antarctica specifically).

ELABORATE
Ask the class: What does a penguin's natural habitat look like? How can heat affect a penguin's home? Can these changes be undone? Discuss together.
Watch a video of a penguin's natural environment:

Could a penguin live in St. Louis? Why or why not? Have you ever seen a real penguin in St. Louis? Have a discussion with the class about these questions. If no student mentions seeing penguins at the zoo, bring it up. There are penguins living in St. Louis, at the zoo! In this unit, we will learn how scientists and engineers worked together to make sure that penguins could live happily in St. Louis. You can use the St. Louis zoo penguin webcam site to show students penguins in St. Louis right now!
http://www.stlzoo.org/visit/thingstoseeanddo/thewild/penguinpuffincoast/web-cam-at-penguin-puffin-coast/

MYSCI MATERIALS:
Where is Home, Little Pip? by Karma Wilson and Jane Chapman

TEACHER PROVIDES:
Science notebooks
Chart paper
Internet access

Teaching Tip:
This icon highlights an opportunity to check for understanding through a formal or informal assessment.

Teaching Tip:
Teachers should look for snow, ice, etc. in the students’ drawings. In their writing, look for information to explain that heat melts ice.
Lesson 1 continued: Where do Adelie penguins live?

EVALUATE

☑ Ask the class: What does an Adelie penguin home look like? Instruct students to draw a picture in their science notebooks of a penguin's natural habitat using what they learned from the book and video.
Lesson 2: What solids and liquids are in a penguin’s habitat?

LEARNING TARGETS
Describe how mixtures are made and how to separate their components.
Identify that different types of matter exist and many can be solid or liquid, depending on temperature.

SUMMARY
The students will observe and explore different liquids and solids; salt water, ice and rocks.

ENGAGE
The teacher holds up the glasses (one filled with water and one filled with ice). Ask the class to describe the differences between what is in each of these glasses. Then pour the glass of water into the plastic dish. Did the water change shape? Why? Do the same with the ice. Did the ice take the shape of the dish? Why/why not?

Ask the class: What is a solid and a liquid? Read pages 4-5 in States of Matter: Solids and pages 4-5 in States of Matter: Liquids.

EXPLORE
What solids and liquids can be found in a penguin’s habitat? (Think back to the book we read in Lesson 1) Brainstorm together as teacher records ideas on chart paper.

Say to the class: Some of you mentioned that there rocks or pebbles in a penguin’s habitat. (If no students mentioned these, bring them up yourself). In your group’s bag, you have several types of rocks. Are these solids or liquids? Are all of the rocks the same, or are some of them different? What are the differences? Take student responses. When you put different kinds of things together, it is called a mixture. How might we sort this mixture of rocks into different groups?

Give the students time to examine the rocks as a group and come up with different ways to sort them. Encourage them to feel the rocks, use the hand lenses, etc. Students might bring up sorting them by color, size or texture.

EXPLAIN
Say to the class: We have talked about solids and liquids in a penguin’s habitat. What solids and liquids can you think of where you live? Remember: liquids can take the shape of a container, solids do not.

ELABORATE
Ask the class: Has anyone ever made kool-aid? What do you have to do to make that? Is kool-aid a solid or a liquid? Explain that kool-aid is a liquid that you make by mixing a solid (powder) into a liquid (water).

Talk about how penguins live in salt water. Ask the class if salt water is a solid, liquid or a mixture. Tell the class we are going to make a mixture to

MYSCI MATERIALS:
(2) 9-oz clear plastic cups
(1) 9-oz clear plastic dish
6 paper plates
6 bags of assorted rocks
6 hand lenses
1/2 cup salt
States of Matter Solids, book
States of Matter Liquids, book

TEACHER PROVIDES:
Copies of Evaluation Worksheet (Appendix i)
Science notebooks
Chart paper
Water
Internet access
Ice cubes

TEACHER PROVIDES:
Ice cubes
Stick of butter
Handful of chocolate chips or small chocolate bar
2 crayons
Piece of bread

Teaching Tip:
Teacher needs to pour water into one of the glasses to freeze ahead of time.

Teaching Tip:
Some children might ask about the food penguins eat and how that is provided in the house or habitat. This unit is focusing on building a habitat that will hold a steady temperature more than how it would feed the penguins.
Lesson 2 continued: What solids and liquids are in a penguin’s habitat?

show how a solid can be combined with a liquid.

Ask: What do you think will happen to the salt when we add it to the water? Write your prediction in your science notebook.

Then have the class watch as you pour the salt into the glass of water. Make observations about how it looks and see if their predictions were correct. Did the salt disappear or dissolve? Discuss what it means to have something dissolve.

Read pages 12–14 in States of Matter: Solids to learn more. If you have time and would like to explore further, read additional sections of the books in this lesson.

EVALUATE

Pass out and have students complete the Evaluation Worksheet (Appendix i) for Lesson 2.

EXTEND (OPTIONAL)

Show the students the materials that you have brought for testing (ice cubes, stick of butter, chocolate chips (or chocolate bar), 2 crayons, and a piece of bread. Put each object into a small dish. Ask students to describe the objects. Use properties of materials vocab to describe. Ask them: Are these items solids or liquids? (They are all solids.) But, what will happen if we heat these items up? Have students make predictions about what will happen to each item. Record student predictions.

Use the heat lamp in Lesson 7 materials and your MySci crate to set up the experiment. Use the thermometer in Lesson 7 to measure the temperature before you turn the lamp on. Put the items in the crate and turn on the lamp. Every 2 minutes, record the temperature and what is happening to each item. Keep recording and observing until the ice, butter, and chocolate are completely melted. The crayons may get soft but might not melt completely.

What will happen if we let all of these things sit here NOT under the lamp. Will they go back to how they were before? Record predictions.

Check on the items the next day. What did they look like before we heated them? What happened when we heated them? What do they look like now? Read pages 10–11 of States of Matter: Liquids.
Lesson 3: What do we need to know to make a habitat for a penguin in a zoo?

LEARNING TARGETS
Explain the different roles of scientists and engineers.

SUMMARY
Students discuss design factors and materials that are used to keep penguins cool.

ENGAGE
Ask the class: Has anyone been to the penguin exhibit at the zoo? What is it like?
Take different children’s answers. Ask them if it was a hot day when they visited? Were the penguins hot? Why not? How did they stay cool? The following video is of the St. Louis Zoo. Watch: St. Louis Zoo http://www.youtube.com/watch?v=g0FdEvw0b4A

EXPLORE
Ask the class: How do you think people figured out how to build the penguin house at the zoo? What materials were needed to build the penguin house? What kinds of people helped? What jobs did they do?
Make a list on chart paper of the jobs the students know.

EXPLAIN
If no one mentioned scientist or engineer in the above question, add these to the list of jobs.
Watch the video that explains how people work together to make a soda machine. Soda Machine Engineers http://www.youtube.com/watch?v=3KQm-8cHmjt
Hand out copies of Appendix ii and work through the phrase bank with the students. Explain what each phrase means if students are unclear. Have them write the phrases in the Venn Diagram. An answer key is provided for you in Appendix iii.

ELABORATE
Ask the class: How do scientists and engineers work together on a big project like the penguin habitat? What does each one do? Use Appendix ii to guide the discussion. Examples may include:

- Who studies penguins to know what they need? (Scientists)
- Who designs the habitat? (Engineers)
- Who picks the best materials to use in the design? (Engineers)

EVALUATE
Ask students to answer these three questions. Use the answer key in Appendix iii as a guide.

- Describe one thing that both scientists and engineers do.
- Describe one thing that only scientists do.
- Describe one thing that only engineers do.

TEACHER PROVIDES:
Copies of Venn Diagram (Appendix ii), answer key (Appendix iii)
Science notebooks
Internet access

Teaching Tip:
Some children might ask about the food penguins eat and how that is provided in the house or habitat. This unit is focusing on building a habitat that will hold a steady temperature more than how it would feed the penguins.
Lesson 4: What is a materials engineer?

LEARNING TARGETS
Identify steps engineers go through to solve problems.

SUMMARY
Students are introduced to the engineering design cycle and hear about what material engineers do.

ENGAGE
Just like there are many different kinds of scientists, there are different kinds of engineers. Who can name a kind of scientist? There are people who study plants, or animals, or rocks. There are scientists that study space, or volcanoes. Take student responses to see how many different kinds of scientists they can name. Just like with scientists, there are different kinds of engineers. Can anyone name a different kind of engineer? Take student responses. There are engineers that build bridges (transportation engineers), make water filters (water engineers), design computers (computer engineers), and many more. Anything that has been built for human use, has been designed by some kind of engineer. The kind of engineers that study what different kinds of fabric or materials can do are called material engineers.

Today we are going to learn about material engineers. Here is a video about one who thinks about what the material should be for space suits for astronauts. What I Do: http://www.careergirls.org/careers/materials-engineer

EXPLORE
Ask the class: What do you think she needed to know to design a good space suit? Have the student work in think-pair-shares.

EXPLAIN
Have students share with the class. Pass out the Engineering Design Cycle (Appendix iv), and allow time for the students to examine it. Review each step:

1. Identify Need/Problem
2. Research & Brainstorm
3. Choose Best Ideas
4. Construct Prototype
5. Test & Evaluate
6. Communicate
7. Redesign

ELABORATE
Guide the class: Using the Engineering Design Cycle, with a partner, can you give an example of each of these steps in making a space suit? Examples might

TEACHER PROVIDES:
Copies of the Engineering Design Cycle (Appendix iv)
Science notebooks
Internet access

Teaching Tip:
Ask the students to remember the steps of what the engineer in the movie had to go through to build the astronaut’s clothing. The following examples are to be used only if the students get “stuck” on a step, and for you to guide their thinking.
Lesson 4 continued: What is a materials engineer?

include:

Identify Need/Problem: Humans need special protection to go into space.

Research & Brainstorm: Engineers study the discoveries of scientists. They also research what others have already tried to do to solve this problem or other problems. For example, they might look at fire suits or scuba suits to learn how to keep people safe from other dangers.

Choose Best Ideas: Engineers consider all of the ideas from brainstorming and researching and choose the best ideas for testing.

Construct Prototype: Engineers and technicians build models of suits.

Test & Evaluate: The spacesuit is tried, maybe in water or a special tank that mimics space.

Communicate: Scientists and engineers get together and discuss what happened, as they examine the data they collected.

Redesign: The group goes back and makes the spacesuit better!

EVALUATE

Ask students to answer these questions: What is the problem that the engineers are trying to solve for the zoo? (Answer: the penguins need a habitat.) Why is this a problem? (It is too warm for penguins to live in St. Louis.)
How can we pick the best materials for our penguin habitat?

Lesson 5: How can we describe materials?

LEARNING TARGETS
Observe and describe properties of several materials.

SUMMARY
Students will observe and describe various materials.

ENGAGE
Ask the students: What are some materials we might use to build a house to keep penguins cool? Record students’ ideas.

EXPLORE
Read the list of the materials the students described. (If you have access to others that they mentioned include those in your observations as well.) We have some materials here we need to observe and record their properties.

Hold up an example of each one of the swatches and say the name of it. Hand out copies and review the Data Sheet for Observing Materials (Appendix v), so the students can match the material to the name on the data sheet.

Ask the class: Which of these materials would help keep penguins cool? As a group, look at each one and record your observations on the Data Sheet.

EXPLAIN
Put students into 6 groups. You can choose to either give each group one sample of every material, OR you can set up the each material in a station and have groups rotate around the stations.

ELABORATE
As a class, share observations about each material. Which material or materials do they think will help keep our penguins cool, and why do they think that?

EVALUATE
Ask students to choose two of the materials that they looked at today. They should compare and contrast the two materials. How are they the same? How are they different? They can use their work on Appendix v to answer the question.

MYSCI MATERIALS:
- 6 swatches of wool
- 6 swatches of cotton
- 6 swatches of paper towels
- Plastic wrap
- Aluminum foil
- 6 swatches of Mylar

TEACHER PROVIDES:
- Science notebooks
- Scissors
- Tape
- Copies of Data Sheet for Observing Materials (Appendix v)

Teaching Tip:
Remind students they can use their eyes, ears, nose and hands to explore each material, but no tasting!
Lesson 6: How can we test which materials would keep our penguin cool?

LEARNING TARGETS
Define the properties of a material as to the usefulness for a specific task.

SUMMARY
Students will observe differences between metal and plastic trays as to how they feel.

ENGAGE
Ask the class: What do scientists and engineers do when they want to see which material is best for what they are trying to do? Take a few ideas. Ideally, someone will say conduct an experiment, or test it. Refer back to Appendix iv, about the steps engineers go through to design things.

EXPLORE
Pass around the 2 trays to the students. Ask them to feel each tray and decide which one is “colder.” Tally their responses on chart paper.

Tell the students that we are going to test the two trays. Ask the class: What tool could be used to show that the temperature starts off the same for both trays? If no one suggests a thermometer, bring it up. Demonstrate how the thermometer strips work and let the groups test them out by holding them, and then laying them on the different trays. Now ask on which tray they think the ice cube will melt first. Record their predictions. Put one ice cube on each tray and have the students observe.

EXPLAIN
Ask the class: What happened? Was your prediction right? There should be much discussion on what happened, depending on the previous knowledge of the students.

ELABORATE
Ask students: How could we use the materials we studied in Lesson 5 to make the ice cube melt even more slowly? Which material do you think would work the best? Why? Show students the samples of the materials. Take student responses.

Then, take one sample of each kind of material, wrap up an ice cube in the material, and observe. NOTE: If you want the process to go more quickly, use the heat lamp from Lesson 7. After 5 minutes, 10 minutes, and 15 minutes, unwrap each one and see how much has melted. Which materials are working best to insulate the ice cubes? How did your prediction match what really happened?

EVALUATE
Now it is time for you to be the engineer. Which material or materials will you use to design your penguin habitat, and why? (Answer: students should choose one or two of the materials that allowed the ice cube to melt the slowest.)

MYSCI MATERIALS:
1 small silver-plated metal tray
1 plastic tray
2 thermometer strips
Penguin ice cube tray

TEACHER PROVIDES:
8 penguin ice cubes (make beforehand)
Science notebooks
Scissors
Tape
Internet access

Teaching Tip:
It is common for students to think that because something “feels” colder, it will keep matter colder. This is a phenomenon that needs to observed many times before it is understood that metal conducts, or draws away heat while plastic insulates or holds heat or cold.

Teaching Tip:
There is the possibility that some unrest will occur in your students’ thinking at this point. It is to be expected as they are undergoing a shift in their thinking.
Lesson 7: How should we design our habitat?

LEARNING TARGETS
Design a structure to insulate the penguin habitat.

SUMMARY
Students will look at the testing site in which they will design their penguin habitat and begin work.

ENGAGE
Today we are going to design our habitats for penguins. When scientists or engineers begin their design, they use smaller models called prototypes first to observe the results. Here are the constraints about our penguin habitat. Constraints is a term used by engineers to define what kinds of materials, sizes or costs something might have. The penguin ice cube will be put in the medicine cup. Then you will build the habitat with any of the 6 materials around the medicine cup that will fit in the petri dish.

Explain to the class: To make the testing fair, you may only use the 6 materials we have here. Engineers often have constraints! But you can use any or all of them in any way. You need to leave a space for your penguin. Here is a model of the penguin house where the habitats you make will be tested. (Show them the plastic box with aluminum foil, the black construction paper, and the heat lamp.) Let the students read the temperature on the thermometer. It should be near 100 degrees. Show them the black squares where their penguin houses will be placed.

EXPLORE
Put the students into 6 groups. Explain to the class that their group will have ten minutes to discuss, plan, and draw their penguin house. Make sure they understand the materials they are allowed to choose from.

Once students have made a drawing of their plans, give them the materials that are shown on their drawing and allow them to start building their habitat. Explain the Scientific Drawing Rubric (Appendix vi) the students will be evaluated on.

EXPLAIN
Have each group show the class its design drawing and discuss the materials it chose.

MYSCI MATERIALS:
MySci red crate
1 heat lamp, clamp
1 kitchen timer
1 thermometer
3 petri dishes (take apart to use for 6 bottoms to hold the ice penguins)
6 pieces of black paper
Aluminum foil (From Lesson 5)
6 graduated medicine cups
Material swatches (From Lesson 5)
Penguin Ice Cube Tray (From Lesson 6)

TEACHER PROVIDES:
Copies of the Scientific Drawing Rubric (Appendix vi)
Science notebooks
8 penguin ice cubes (make beforehand)
Scissors
Tape
Electrical outlet

Teaching Tip:
Set up the “Zoo habitat” by lining the crate with foil, putting the black paper down on the bottom and then attaching the heat lamp. Plug in and turn on the heat lamp before testing to warm up the “penguin house”. Place the thermometer in the bottom. Turn on the heat lamp and heat the box until the temperature reads about 100 degrees, according to a thermometer placed on the bottom of the box.
Lesson 4 continued: How should we design our habitat?

ELABORATE
We are using ice cubes because they change from ice to water when they melt. Why is it harder to measure water when it is frozen? What is special about water? (It can be a liquid, solid or gas.) What changes the ice to water or the water to ice? (The temperature). Have the students write in their science notebooks other examples of things that change form with heating or cooling and whether they can change back like ice can. (Examples of things that change, but can not change back could include cooking eggs, making pancakes, etc.) Examples that can change back and forth include butter, metals or candle wax.)

EVALUATE

☑ Have the students write down the steps their group went through to plan and build the penguin habitat in their science notebook. Put their penguin habitats in a safe place for future testing.
Lesson 8: How can we test our habitat?

LEARNING TARGETS
Conduct an experiment.
Collect and compare data.

SUMMARY
The students will observe the results of their prototype tests.

EXPERIMENT PROTOCOL
Review the experiment: We will test our prototype’s insulation ability by seeing how much of the penguin ice cube melted using the medicine cups. We are going to put one penguin ice cube in each of prototypes that the groups made and then quickly transfer it to the big penguin house. We will set the timer for 10 minutes. Afterwards, we will remove the prototypes, and check for signs of melting. We will remove the ice cube and measure the amount of water left in the cup. Have each group report how much water is left in their medicine cup and compare the numbers.

Lesson 9: What do we need to redesign?

REDESIGN
Read All About Matter, by Mari Schuh. Discuss the concepts in the book, solids, liquid, gases, how materials are specifically picked for certain jobs by their properties.

Have each group go back and discuss what students think worked and didn’t work and what they want to change. Have the groups redesign and rebuild the habitat as needed. Run the test again and collect the data. Compare the results with yesterday.

Next have a discussion as to which material was used the most and why. Ask the students to write in their science notebook which material (or group of materials) is best for insulating.
Key to Understanding the NGSS Codes

**NGSS codes begin with the grade level, then the “Disciplinary Core Idea code”, then a standard number. The Disciplinary Core Ideas are:**

**Physical Sciences**
PS1: Matter and its interactions  
PS2: Motion and stability: Forces and interactions  
PS3: Energy  
PS4: Waves and their applications in technologies for information transfer

**Life Sciences**
LS1: From molecules to organisms: Structures and processes  
LS2: Ecosystems: Interactions, energy, and dynamics  
LS3: Heredity: Inheritance and variation of traits  
LS4: Biological evolution: Unity and diversity

**Earth and Space Sciences**
ESS1: Earth’s place in the universe  
ESS2: Earth’s systems  
ESS3: Earth and human activity

**Engineering, Technology, and Applications of Science**
ETS1: Engineering design  
ETS2: Links among engineering, technology, science, and society

For more information, visit [http://www.nextgenscience.org/next-generation-science-standards](http://www.nextgenscience.org/next-generation-science-standards)
### SCIENCE AND ENGINEERING PRACTICES

#### Concepts

<table>
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<tr>
<th>Asking Questions and Defining Problems</th>
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<tbody>
<tr>
<td>• Ask questions based on observations to find more information about the natural and/or designed world(s).</td>
</tr>
<tr>
<td>• Ask and/or identify questions that can be answered by an investigation.</td>
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<tr>
<td>• Define a simple problem that can be solved through the development of a new or improved object or tool.</td>
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<tr>
<th>Developing and Using Models</th>
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<tbody>
<tr>
<td>• Distinguish between a model and the actual object, process, and/or events the model represents.</td>
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<tr>
<td>• Develop a simple model based on evidence to represent a proposed object or tool.</td>
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<tr>
<th>Planning and Carrying Out Investigations</th>
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</thead>
<tbody>
<tr>
<td>• With guidance, plan and conduct an investigation in collaboration with peers (for K).</td>
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<tr>
<td>• Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.</td>
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<td>• Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons.</td>
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<tr>
<td>• Make observations (firsthand or from media) and/or measurements of a proposed object or tool to determine if it solves a problem or meets a goal.</td>
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<tr>
<td>• Make predictions based on prior experiences.</td>
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<tr>
<th>Analyzing and Interpreting Data</th>
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<tr>
<td>• Record information (observations, thoughts, and ideas).</td>
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<tr>
<td>• Use and share pictures, drawings, and/or writings of observations.</td>
</tr>
<tr>
<td>• Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.</td>
</tr>
<tr>
<td>• Compare predictions (based on prior experiences) to what occurred (observable events).</td>
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<tr>
<td>• Analyze data from tests of an object or tool to determine if it works as intended.</td>
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#### Using Mathematics and Computational Thinking

| • Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs. |
| • Use quantitative data to compare two alternative solutions to a problem. |

#### Constructing Explanations and Designing Solutions

| • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. |
| • Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem. |
| • Generate and/or compare multiple solutions to a problem |

#### Engaging in Argument from Evidence

| • Identify arguments that are supported by evidence. |
| • Distinguish between explanations that account for all gathered evidence and those that do not. |
| • Distinguish between opinions and evidence in one’s own explanations. |
| • Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument. |
| • Construct an argument with evidence to support a claim. |
| • Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence. |

#### Obtaining, Evaluating and Communication Information

| • Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim. |
| • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas. |

### DISCIPLINARY CORE IDEAS

#### Concepts

<table>
<thead>
<tr>
<th>Structure and Properties of Matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties. (2-PS1-1)</td>
</tr>
<tr>
<td>Different properties are suited to different purposes. (2-PS1-2),(2-PS1-3)</td>
</tr>
<tr>
<td>PS1.B: Chemical Reactions</td>
</tr>
<tr>
<td>Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. (2-PS1-4)</td>
</tr>
</tbody>
</table>

### CROSSCUTTING CONCEPTS

#### Patterns

- Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

#### Cause and Effect: Mechanism and Prediction

- Events have causes that generate observable patterns.
- Simple tests can be designed to gather evidence to support or refute student ideas about causes.

#### Scale, Proportion, and Quantity

- Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; hotter and colder; faster and slower).
- Standard units are used to measure length.

#### Systems and System Models

- Objects and organisms can be described in terms of their parts.
- Systems in the natural and designed world have parts that work together.

#### Energy and Matter: Flows, Cycles, and Conservation

- Objects may break into smaller pieces, be put together into larger pieces, or change shapes.

#### Structure and Function

- The shape and stability of structures of natural and designed objects are related to their function(s).

#### Stability and Change

- Some things stay the same while other things change.
- Things may change slowly or rapidly.
Key to Understanding the GLE Codes

GLE codes are a mixture of numbers and letters, in this order: Strand, Big Idea, Concept, Grade Level and GLE Code.

The most important is the strand. The strands are:

1. **ME**: Properties and Principles of Matter and Energy
2. **FM**: Properties and Principles of Force and Motion
3. **LO**: Characteristics and Interactions of Living Organisms
4. **EC**: Changes in Ecosystems and Interactions of Organisms with their Environments
5. **ES**: Processes and Interactions of the Earth’s Systems (Geosphere, Atmosphere and Hydrosphere)
6. **UN**: Composition and Structure of the Universe and the Motion of the Objects Within It
7. **IN**: Scientific Inquiry
8. **ST**: Impact of Science, Technology and Human Activity

For more information, visit [http://dese.mo.gov/college-career-readiness/curriculum/science](http://dese.mo.gov/college-career-readiness/curriculum/science)
Evaluation Worksheet

Section 1, Lesson 2

QUESTIONS
What are two different ways you sorted the rocks during the lesson?

What do we call it when we combine two kinds of solids? Give an example.

A liquid flows and takes the shape of a container. A solid cannot change shape. Sort the items below into solids and liquids. Write the word under the correct column.

<table>
<thead>
<tr>
<th>SOLIDS</th>
<th>LIQUIDS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- WATER
- APPLE
- COFFEE
- ROCK
- KETCHUP
- ICE CUBE
Venn Diagram Comparison

Section 1, Lesson 3

DIRECTIONS
Fill in the phrases from the word bank to show what kinds of things scientists and engineers do.

WORD BANK
- collects data
- learns what others have done to solve the problem
- makes an hypothesis (a guess)
- builds, tests, rebuilds prototype
- compares result with hypothesis
- asks questions

SCIENTIST
- observes nature
- communicates results
- records results of experiment
- designs new things
- defines the problem
- redoes experiment 3 times
- brainstorms many ways to solve the problem

ENGINEER
- defines criteria and constraints (dos & dont's)
- follows the experimental process
- does background research

BOTH
Venn Diagram Comparison Answer Key

Section 1, Lesson 3

<table>
<thead>
<tr>
<th>SCIENTIST</th>
<th>ENGINEER</th>
<th>BOTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>observes nature</td>
<td>designs new things</td>
<td>asks questions</td>
</tr>
<tr>
<td>makes an hypothesis (a guess)</td>
<td>defines the problem</td>
<td>does background research</td>
</tr>
<tr>
<td>follows the experimental process</td>
<td>learns what others have done to solve the problem</td>
<td>collects data</td>
</tr>
<tr>
<td>records results of experiment</td>
<td>defines criteria and constraints (dos &amp; dont’s)</td>
<td>communicates results</td>
</tr>
<tr>
<td>compares result with hypothesis</td>
<td>brainstorm many ways to solve the problem</td>
<td></td>
</tr>
<tr>
<td>redoes experiment 3 times</td>
<td>builds, tests, rebuilds prototype</td>
<td></td>
</tr>
</tbody>
</table>
Engineering Design Cycle

Section 1, Lesson 4

1. Identify Need/Problem
2. Research & Brainstorm
3. Choose Best Ideas
4. Construct Prototype
5. Test & Evaluate
6. Communicate
7. Redesign
## Data Sheet for Observing Materials

### Section 2, Lesson 5

<table>
<thead>
<tr>
<th>SMOOTH OR ROUGH</th>
<th>CAN FOLD IT</th>
<th>SHINY OR DULL</th>
<th>COLOR?</th>
<th>OTHER?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wool</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper Towel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plastic Wrap</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminum Foil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mylar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Scientific Drawing Rubric

**Section 3, Lesson 7**

<table>
<thead>
<tr>
<th></th>
<th>NO</th>
<th>SOMEWHAT</th>
<th>YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did I draw everything I saw?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did I label the parts of my drawing?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did I give my drawing a title?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is my drawing big enough and clear enough to see everything?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is my drawing realistic?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Vocabulary Words

All Sections and Lessons

RECOMMENDATION

We recommend that students participate in investigations as they learn vocabulary, that it is introduced as they come across the concept. MySci students work collaboratively and interact with others about science content also increasing vocabulary. The hands-on activities offer students written, oral, graphic, and kinesthetic opportunities to use scientific vocabulary and should not be taught in isolation.

penguin

habitat

environment

engineer

materials

temperature

design

prototype

insulation

observation

data

prediction

experiment

property

solid

liquid

mixture

separate

freeze

melt

insulate