Therem 3: Changing Lifestyles

Unit 7: Impact on Infrastructure

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Introduction

Thank you for using this Raising Educational Achievement through Cultural Heritage Up (REACH Up) unit in your classroom! The lessons are designed to address the Alaska Science Standards and Grade Level Expectations, Alaska Cultural Standards and the Bering Strait School District Scope and Sequence goals. All of the activities focus on infrastructure and related changes from Alaska Native cultural, physical and earth science perspectives. This supplemental unit addresses the place-based question: How is climate change affecting infrastructure in our area and why are these changes important to our community?

The REACH Up Infrastructure unit consists of a total of four activities: Ask an Expert, Infrastructure Vocabulary, and a two-part Water Quality lab activity. Each activity will require its own class period (approximately 45 minutes) and discussion could easily be extended into multiple class periods. You may also want to repeat sections of an activity during subsequent class meetings, such as reviewing the Impact on Infrastructure video or having your students practice the vocabulary card games multiple times. If you are utilizing the entire Infrastructure unit, you should introduce the activities in the order they are presented. However, if time is short, any of the activities could be presented independently.

The accompanying student guide is intended for use with multiple groups of students and you should not allow students to write in them. You can either have students record their work in a science notebook or create copies of the corresponding worksheets that are included in this teacher's guide.

Whole Picture

Climate change is affecting Alaska. Snow is melting earlier in the spring and fall is getting extended. Sea ice starts to form later in the season or does not form at all, causing stronger onshore storms and increased flooding. Rapid erosion due to permafrost thaw is more frequently observed. These environmental changes are affecting infrastructure, including houses and buildings, causing them to collapse.

In the past, Alaska Natives led a nomadic life. This meant that housing was temporary, as people built a shelter and took it down as needed. Today, many people have permanent housings. Having a permanent home allows people to have a shelter all year round and have stability.

Challenges of climate change are multi-fold. Subsistence lifestyles require people to be close to the food source, while coastal erosion and thawing permafrost can make it difficult to have a house in the most ideal locations. There is also a limited time during a year that a house can be built. Buildings also need to withstand storms, extreme cold and wind.

Sod huts in the past provided insulation and at the same time allowed air to escape, keeping air quality inside optimal. Today, with advanced technologies, buildings can have good insulation and retain heat inside. However, houses also need to be designed to allow moisture to escape to prevent mold, which can cause serious health issues.

Developing housing that is energy efficient and can adapt to the changing environment is crucial to create a healthy living environment, reduce fuel costs, and reduce further contribution to the greenhouse effect. Some people in the Arctic have been working toward that goal.

The nonprofit Cold Climate Housing Research Center (CCHRC) in Fairbanks, Alaska, for example, tries to combine practices that have worked in the Arctic for centuries with technology and techniques that can help to build houses more easily and keep building costs down in remote places. Learning from sod huts and skin tents used in the past, they have designed houses with super-insulated walls to imitate sod. They have built composting, waterless toilets that dry out waste so it can be burned for heat. This helps where sewers can cause problems and fuel costs are very high.

CCHRC started a prototype house built on skis in Newtok, the village that experienced erosion firsthand, witnessing the river water getting closer every year, submerging fields where they used to pick berries and hunt moose. CCHRC's idea was to allow the house to be towed across the tundra as the ocean encroaches.

Predicted to need 2,000 homes in the next 10 years, Bethel, Alaska, started a small-scale logging industry, reducing housing costs. It also built a truss plant, creating jobs and houses.

Alaska is warming at a rate two to three times faster than the mainland United States. Environmental changes are increasingly forcing communities to adapt more quickly than expected. Thriving communities in Alaska will benefit from young people who can help adapt to rapid climate change by learning from the past and developing innovating thinking.

Reference

Cold Climate Research Housing Center: *http://www.cchrc.org*

Unit Vocabulary

Science Terms to Define	
climate	the weather conditions prevailing in general or over a long period
heat	the movement of thermal energy from a region of higher temperature to a region of lower temperature by conduction, convection or radiation
insulate	protect something by interposing material that prevents the loss of heat
vent	an opening that allows air, gas or liquid to pass out of or into a confined space

Terms for Incorporating Local Indigenous Language				
English	**Iñupiaq**	**Yup'ik**	**Siberian Yupik**	**Local Translation**
climate	silam simiġvia	ella	eslavut	
heat	uqquq	puqla	puqla	
house	ini	ena	mangteghaq	
insulation	uquqsaun	umcigun	maqaasghaq	
vent	inim	ellvik	iiyaq	
window	igaliq	egaleq	gergesek	

Activity MS.7.1: Ask an Expert

Overview

In this activity, students will interview an elder or cultural knowledge bearer.

Objectives

On successful completion of the lesson, students will be able to:

- demonstrate effective interviewing techniques
- interpret qualitative data from interviews
- describe how different infrastructure was in the past in the local community compared to today
- explain how climate change is affecting infrastructure in the local community

Alaska Standards

Alaska Science Standards / Grade Level Expectations

[6-8] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

[6] SA3.1 The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by gathering data to build a knowledge base that contributes to the development of questions about the local environment (e.g., moose browsing, trail usage, river erosion).

Alaska Cultural Standards

[B] Culturally-knowledgeable students are able to build on the knowledge and skills of the local cultural community as a foundation from which to achieve personal and academic success throughout life. Students who meet this cultural standard are able to:

[B.2] make effective use of the knowledge, skills, and ways of knowing from their own cultural traditions to learn about the larger world in which they live.

[D] Culturally-knowledgeable students are able to engage effectively in learning activities that are based on traditional ways of knowing and learning. Students who meet this cultural standard are able to:

[D.4] gather oral and written history information from the local community and provide an appropriate interpretation of its cultural meaning and significance.

[E] Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them. Students who meet this cultural standard are able to:

[E.4] determine how ideas and concepts from one knowledge system relate to those derived from other knowledge systems.

Bering Strait School District Scope & Sequence

6.3A Demonstrate an understanding of how energy can be transformed, transferred, and conserved. (SC3.1)

7.9A Recognizes phase changes (sublimation, condensation, evaporation) and energy transfer. (SD 3.2)

8.2G Recognizes that most substances can exist as solid, liquid or gas depending on temperature (motion of particles). (SB3.1)

8.3B Recognizes that energy can exist in many forms (heat, light, chemical, electrical, mechanical) and can change form. (SB2.1)

Materials

- REACH Up Middle School Student Guide: *Impact on Infrastructure*
- Student Worksheet: *Ask an Expert about Impact on Infrastructure*
- Internet access and projector

Activity Preparations

1. Identify adults within your school who have lived year-round in the community for many years. This might include teachers, administrators, secretaries, teacher aides, lunchroom/kitchen staff, recess duties, maintenance and custodial staff, etc. Ask these local knowledge bearers if they would be willing to speak with a group of your students about how infrastructure in the area has changed, and how those changes have affected the community. Make sure that the volunteers you have identified will be available during the time that your class will be completing this activity.
2. Ask the volunteers if they speak an Alaska Native Language, and if so, which language(s) and dialect(s) they are familiar with. If applicable, have them translate the written words on the student worksheet, so you have an answer key. Also, ask them to teach you the pronunciation of the terms.

Activity Procedure

1. Distribute the REACH Up Middle School Student Guide: Impact on Infrastructure and ask students to work with a partner to read pages 1-3.
2. Show the video, *Impact on Infrastructure*, available at www.k12reach.org/videos.php. Videos are located under the Multimedia tab. Allow time for students to share comments and ask questions.
3. Explain that students will interview a few community members about local infrastructure changes. Separate students into small groups according to how many knowledge bearers are available to share information with your class. Explain if the appointed interviewees speak an Alaska Native Language, so students know whether or not they should pursue that portion of the interview.
4. Review expectations for student behavior while conducting the interview, including introductions and thanking the interviewee at the end of the interview. Discuss suggestions for effective interviewing techniques, such as allowing ample time for the interviewee to answer, and asking follow-up questions.
5. Distribute one Student Worksheet: *Ask an Expert about Impact on Infrastructure* to each group and assign each group one local knowledge bearer to interview. Provide 15-20 minutes for students to locate and interview the knowledge bearer.
6. Reconvene in the classroom and ask groups to share their findings. How has the local infrastructure changed? What impacts might the changes have on local lifestyles? If your students learned local indigenous words for the vocabulary terms, compare their translations with the translations found on page 4.

STUDENT WORKSHEET: ***Ask an Expert about Impact on Infrastructure***

Names of Group Members: _____

Interview a long-term community member to learn more about infrastructure in your area. Take notes about what you learn.

Who did you interview? _____

Ask:

What was infrastructure such as roads and houses like in the past compared to today?

How is climate change affecting infrastructure in your community (roads, houses and buildings, water resources, etc.)?

Have you or someone you know had to make any changes to your living environment (inside/outside of houses/buildings, water supply, roads, etc.)? If so, how?

Other notes:

For Alaska Native Language Speakers:

What language(s) do you speak? _____

What dialect(s)?_____

Could you translate the following words?

Climate: _____

Heat: _____

House: _____

Insulation: _____

Vent: _____

Window: _____

Activity MS.7.2: Infrastructure Vocabulary

What terminology do we need to know to discuss infrastructure?

Overview

In this activity, students will learn key infrastructure terminology in English and their local Alaska Native language by playing vocabulary games with peers.

Objectives

On successful completion of this lesson, students will be able to:

- read and speak indigenous terms related to climate and infrastructure, and
- illustrate and define terms related to infrastructure and changing climate's impact on infrastructure.

Alaska Standards:

Alaska Cultural Standards

[A] Culturally-knowledgeable students are well grounded in the cultural heritage and traditions of their community. Students who meet this cultural standard are able to:

[A.1] Assume responsibilities for their role in relation to the well-being of the cultural community and their lifelong obligations as a community member.

[B] Culturally-knowledgeable students are able to build on the knowledge and skills of the local cultural community as a foundation from which to achieve personal and academic success throughout life. Students who meet this cultural standard are able to:

[B.2] Make effective use of the knowledge, skills, and ways of knowing from their own cultural traditions to learn about the larger world in which they live.

[D] Culturally-knowledgeable students are able to engage effectively in learning activities that are based on traditional ways of knowing and learning. Students who meet this cultural standard are able to:

[D.5] Identify and utilize appropriate sources of cultural knowledge to find solutions to everyday problems.

Bering Strait School District Scope & Sequence:

7.9A Recognize phase changes (sublimation, condensation, evaporation) and energy transfer. (SD3.2)**9.9H**

8.2G Recognize that most substances can exist as solid, liquid or gas depending on temperature (motion of particles). (SB3.1)

8.3B Recognize that energy can exist in many forms (heat, light, chemical, electrical, mechanical) and can change form. (SB2.1)

10.2C Identify the interrelationships and different stages of the water, carbon and nitrogen cycles.

10.5D Describe causes, effects, preventions, and mitigations of human impact on climate.

11.7E Students develop an understanding of the dynamic relationships among scientific, cultural, social and personal perspectives.

Materials

- REACH Up High Middle Student Guide: *Impact on Infrastructure*
- Vocabulary card sets (1 per group of 4-6 students)
- Student Information Sheet: *Word Games Instructions* (1 per group)
- Student Worksheet: *Infrastructure Vocabulary*
- Dry Erase Markers (1 per group)
- Timers (optional)

Activity Preparations

1. If your students completed Activity HS.7.1 Ask an Expert, refer to their completed worksheets for the terms you will have them use for the vocabulary word card games.
2. If your students did not conduct interviews with Native language speakers, consult with a local knowledge bearer or language expert to determine which language/dialect translation provided on page 4 of the Student Guide would be most appropriate for your students to practice. The following chart is provided for reference.

Alaska Native Languages in the Bering Strait Region				
Language	**Dialect Group**	**Dialect**	**Subdialect**	**Community**
Iñupiaq	Seward Peninsula Inupiaq	Bering Strait		Brevig Mission
			Diomede	Little Diomede
				Shishmaref
			Wales (Kinikmiu)	Wales
		Qawariaq	Teller	Teller
				Unalakleet
				Shaktoolik
			Fish River	Golovin*
				White Mountain
	Northern Alaskan Iñupiaq	Malimiut		Koyuk
Siberian Yupik		St. Lawrence Island Yupik		Gambell
				Savoonga
Yup'ik		Norton Sound (Unaliq-Pastuliq)	Unaliq	Elim
				Golovin*
				St. Michael
		General Central Yup'ik	Nelson Island and Stebbins	Stebbins

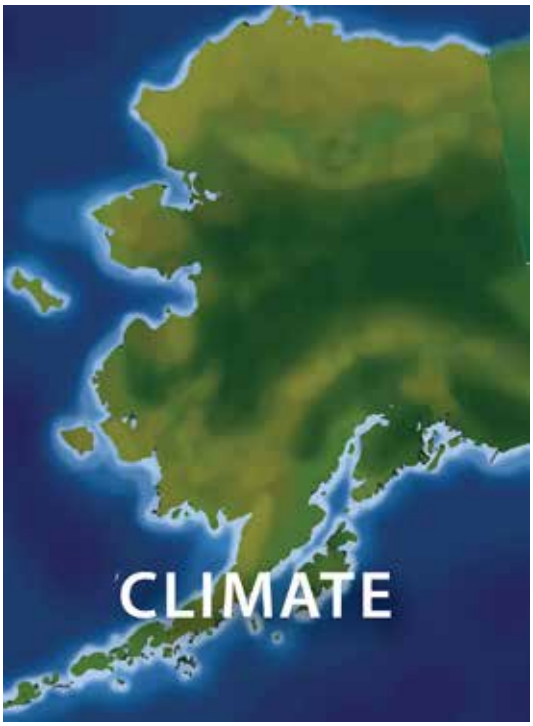
* It is very common for more than one language/dialect, or a combination of dialects, to be spoken in a community. It should also be noted that Inupiaq-Yup'ik bilingualism was common throughout the 1900s in the Norton Sound villages of White Mountain, Golovin, Elim, and Unalakleet. Golovin is listed twice on our chart because specific subdialects were cited in the research found on the Alaska Native Language Center website: http://www.uaf.edu/anlc/languages/.

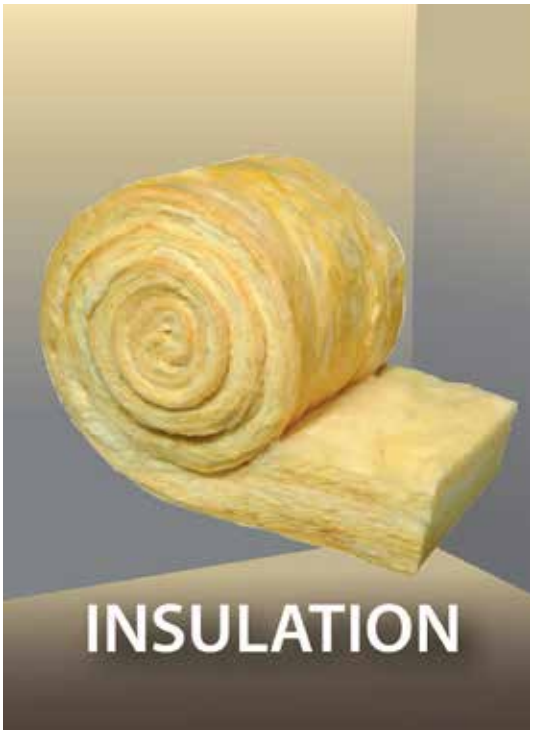
3. Keep in mind that different individuals may translate certain terms differently. It's fine to have different student groups working with various translations, or you can choose a set list of words for your whole class to practice. Highlight the diversity and do not attempt to offer an authoritative translation; the goal is to practice an Alaska Native language while discussing climate change topics.
4. If using the Vocabulary Cards provided by REACH Up, label a sample set of cards with local indigenous words using a dry erase marker. If needed, create your own sets of the vocabulary cards from the template provided.
5. Make copies of the *Word Games Instruction Sheet* (one per group) and the *Impact on Infrastructure Vocabulary* worksheet (one per student).

Activity Procedure

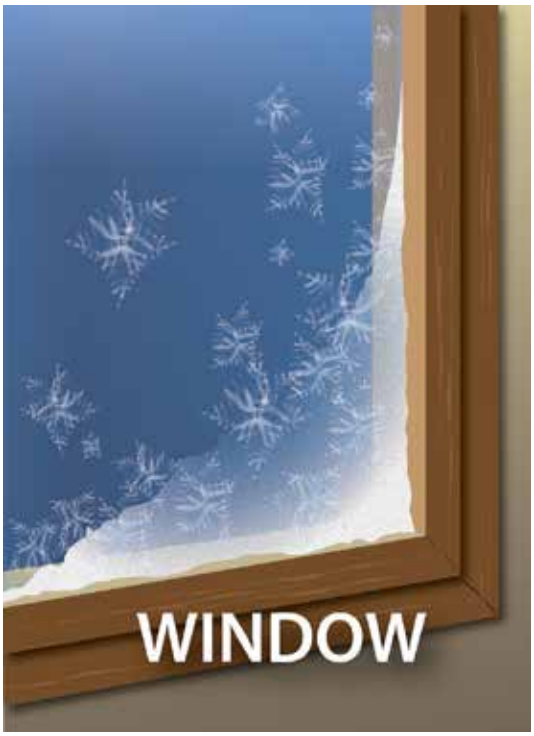
1. Distribute the REACH Up High School Student Guide: *Impact on Infrastructure* and review pages 1-4.
2. Show students the vocabulary cards. Hold up each card. Discuss what each card depicts. How do these terms relate to infrastructure in their region?
3. Say the English and local Alaska Native Language word for the illustration depicted on the card. Ask students to repeat the words. Repeat this once or twice, then ask students to call out the correct words as you hold up each card.
4. Divide the class into four groups.
5. Provide each group with the Word Games Instruction sheet, a set of Vocabulary Cards, dry erase marker, and a timer (optional).
6. Instruct students to label their cards with the local indigenous words. Groups can select one student from the group for this task, or take turns.
7. Direct students' attention to the Word Games Instruction sheet. Students can commit to one game for a period of time or mix and match.
8. Encourage students to play the vocabulary games and practice the vocabulary words during free time throughout the duration of the Impact on Infrastrcture unit. If possible, schedule 10-15 minutes twice per week to practice the vocabulary terms.
9. Write the following terms on the board: clear (water), cloudy (water), flood, lake, pond, river, rain, snow, water. Ask students to share definitions for these terms. Refer back to the REACH Up High School Student Guide: *Impact on Infrastructure* as necessary.
10. Distribute the *Impact on Infrastructure* Vocabulary Worksheet and ask students to complete it.

Vocabulary Cards





Vocabulary Cards



Vocabulary Cards

_____ Local Indigenous Word	_____ Local Indigenous Word
_____ Local Indigenous Word	_____ Local Indigenous Word

STUDENT INFORMATION SHEET: *Word Games Instructions*

VOCABULARY SWAP:

1. Distribute one card to each person.
2. Practice the word on your card, then find a classmate. Teach them the word on your card and learn the word on their card. Trade cards.
3. Find another classmate and repeat.

FIND THE CARD:

1. Divide into small groups. Each group will need a set of vocabulary cards. Spread the cards in front of you so that everyone in your group can see the pictures.
2. Listen as your teacher says a word aloud from one of the cards.
3. Work with your group to find and hold up the correct card.

VOCABULARY SLAP:

1. Select one student to serve as the "caller" for this game. That student should make a list of the vocabulary words on a separate sheet of paper. The words can be found on the back of the cards.
2. Place the cards in a circle, picture-side-up, in the middle of the playing area.
3. The caller should call out a word from their list. Everyone else should quickly place their hand on the picture that they believe represents that word.
4. Turn over the card or cards that students selected to see who chose correctly. Each student who placed his or her hand on the correct card earns a point.
5. Put the card(s) back in the circle and play again.
6. Play for a designated period of time. At the end of the time, the person with the most points wins.

TEAMWORK:

1. Divide your group into two teams. Each team will need a pencil and paper.
2. Shuffle the vocabulary cards and stack them picture-side up in the middle of the table.
3. Work with your team to write down the local Alaska Native Language terms for the picture on the card.
4. After both teams have written answers for the top card, turn the card over to check. Teams get 1 point for the correct Alaska Native Language word.
5. Repeat until all cards are gone. The team with the most points wins.

STUDENT WORKSHEET: ***Impact on Infrastructure Vocabulary***

Name: _____

1. Draw a line connecting each definition to the term that it represents.

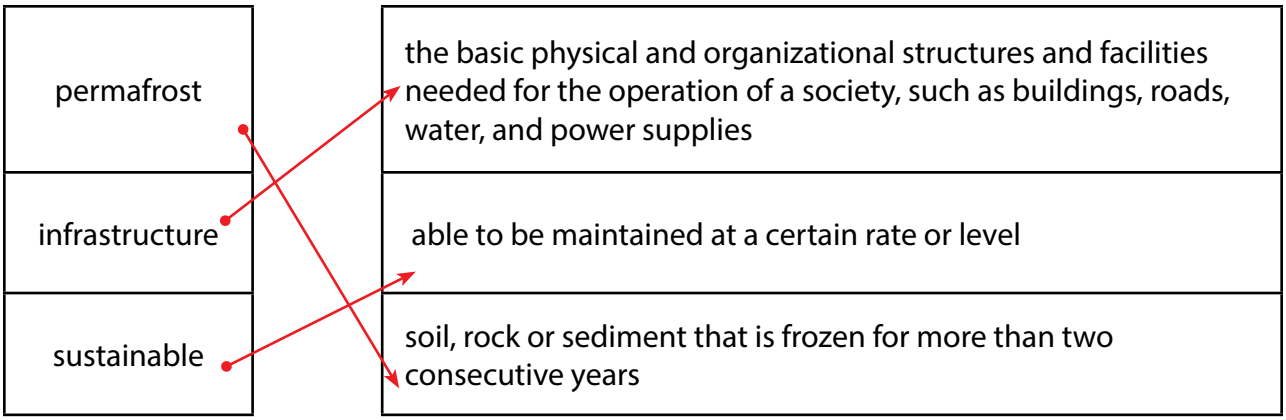
infrastructure	the basic physical and organizational structures and facilities needed for the operation of a society, such as buildings, roads, water and power supplies
permafrost	able to be maintained at a certain rate or level
sustainable	soil, rock or sediment that is frozen for more than two consecutive years

2. Complete the chart by writing the local Alaska Native Language terminology and illustrating the missing terms.

My Community: _____		
English Word	Local Alaska Native Language Word	Illustration
Climate		
Heat		
Insulation		
House		
Vent		
Window		

Answer Key: *Impact on Infrastructure Vocabulary*

1. Draw a line connecting each definition to the term that it represents.



2. Complete the chart by writing the local Alaska Native Language terminology and illustrating the missing terms.

My Community: _____

English Word	Local Alaska Native Language Word	Illustration
climate	Answers will vary depending on language and dialect spoken in this community.	Sketch should illustrate word at left.
heat	Answers will vary depending on language and dialect spoken in this community.	Sketch should illustrate word at left.
house	Answers will vary depending on language and dialect spoken in this community.	Sketch should illustrate word at left.
insulation	Answers will vary depending on language and dialect spoken in this community.	Sketch should illustrate word at left.
vent	Answers will vary depending on language and dialect spoken in this community.	Sketch should illustrate word at left.
window	Answers will vary depending on language and dialect spoken in this community.	Sketch should illustrate word at left.

Activity MS.7.3: Building an Energy Efficient House

Overview

In this lesson students will learn about energy transfer and insulation.

Objectives

On successful completion of this lesson, students will be able to:

- describe potential impacts of climate change on buildings/houses
- describe factors that affect insulation of a building
- describe how energy transfer is related to how different house designs affect the temperature inside of a building
- consider the conditions of their houses and come up with ways to improve them, if necessary, from a scientific, cultural and personal perspectives

Next Generation Science Standards

Standards by Disciplinary Core Ideas: Energy

Standards by Topic: Energy

Performance Expectations

The activity is just one step toward reaching the performance expectations listed below:

MS-PS3-3: Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

MS-PS3-4: Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

Dimention:

Science & Engineering Practices

Constructing Explanations and Designing Solutions
Connections to Nature of Science: Science Knowledge Is Based on Empirical Evidence

Disciplinary Core Ideas

PS3.B: Conservation of Energy and Energy Transfer

- Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3)
- The amount of energy transfer needed to change the temperature of a matter

sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4)

Crosscutting Concepts
Energy and Matter

Alaska Standards

Alaska Science Standards and Grade Level Expectations

SA1: The student demonstrates an understanding of the processes of science by

[6-8] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring and communicating

[6] SA 1.2 collaborating to design and conduct simple repeatable investigations

[7] SA 1.2 collaborating to design and conduct simple repeatable investigations, in order to record, analyze (i.e., range, mean, median, mode), interpret data, and present findings.

[8] SA 1.2 collaborating to design and conduct repeatable investigations, in order to record, analyze (i.e., range, mean, median, mode), interpret data, and present findings.

SA3: The student demonstrates an understanding that the interactions with the environment provide an opportunity for understanding scientific concepts by

[6] SA 3.1 gathering data to build a knowledge base that contributes to the development of questions about the local environment (e.g., moose browsing, trail usage, river erosion)

[7] SA 3.1 designing and conducting a simple investigation about the local environment

[8] SA 3.1 conducting research to learn how the local environment is used by a variety of competing interests (e.g., competition for habitat/resources, tourism, oil and mining companies, hunting groups)

SB2: The student demonstrates an understanding of how energy can be transformed, transferred, and conserved by

[6] SB 2.1 recognizing that energy can exist in many forms (i.e., heat, light, chemical, electrical, mechanical)

[7] SB 2.1 explaining that energy (i.e., heat, light, chemical, electrical, mechanical) can change form

SF: The student develops an understanding of the dynamic relationships among scientific, cultural, social and personal perspectives.

Bering Strait School District Scope and Sequence

6.3A Demonstrate an understanding of how energy can be transformed, transferred, and conserved. (SC3.1)

7.9A Recognizes phase changes (sublimation, condensation, evaporation) and energy transfer. (SD 3.2)

8.2G Recognizes that most substances can exist as solid, liquid or gas depending on temperature (motion of particles). (SB3.1)

8.3B Recognizes that energy can exist in many forms (heat, light, chemical, electrical, mechanical) and can change form. (SB2.1)

Materials for Activity

Part 1

- REACH Up Middle School Student Guide: *Impact on Infrastructure*
- Student Worksheet: *Building an Energy Efficient House—Part 1*
- 1 Uninsulated water bottle with an uninsulated lid per group
- 1 Insulated water bottle with an insulated lid per group (the bottle should hold the same amount of water as the uninsulated bottle)
- 1 LabQuest 2 per group
- 1 Temperature sensor per group
- Ice cold water (1000ml per group)
- 1 500ml measuring cup per group

Part 2

- REACH Up Middle School Student Guide: *Impact on Infrastructure*
- Student Worksheet: Building an Energy Efficient House—Part 2
- 1 Insulated water bottle with an insulated lid per group
- 1 Insulated water bottle without a lid per group
- Plastic wrap
- Rubber band
- 1 LabQuest 2 per group
- 1 Temperature sensor per group
- Very warm water (1000ml per group)
- 1 500ml measuring cup per group

Activity Preparations

Part 1

1. Make copies of the Student Worksheet: *Building an Energy Efficient House—Part 1*.
2. Check the LabQuest 2 to see if they are fully charged. If not, recharge them.
3. Prepare ice cold water. Each group will need 1000ml (1L).

Part 2

1. Make copies of the Student Worksheet: *Building an Energy Efficient House—Part 2*.
2. Check the LabQuest 2 to see if they are fully charged. If not, recharge them.
3. Prepare very warm water. It does not need to be boiling hot but it should be hot to the touch. Each group will need 1000ml (1L).

Activity Procedure

Part 1

1. Review pages 1-2 in the REACH Up Middle School Student Guide: *Impact on Infrastructure.*
2. Next, read and discuss pages 5 together as a class.
3. Read and discuss the "Predict" section of page 6 as a class.
4. Distribute the Student Worksheet *(Building an Energy Efficient House—Part 1*) and go over the experiment procedures.
5. Divide your class into groups, ideally with each group having three to four students and have them do the experiment by following the steps below:
   a. Connect a temperature sensor to a LabQuest 2.
   b. Pour 500ml of ice cold water into each of the insulated and uninsulated water bottles (or fill the bottles about 2/3 full).
   c. Feel the water with your hands and record how cold it feels in the chart on the Student Worksheet.
   d. Using the temperature sensor, measure the water temperature. Record the temperature in the chart.
   e. Place lids on the water bottles and leave them in the room for 15 minutes.
   f. Observe the outside of the water bottles and record any changes you find.
   g. Measure the temperature of the water again and record it in the chart.

(Between Steps **e** and **f**, you may wish to have your students discuss what may happen to the temperature of the water and why. You may also want to engage them in other activities to fill 15 minutes of waiting time.)

6. Using the "Discuss" section of page 6, discuss the result as a class:
   a. Share your results with your classmates.
   b. Which type of water bottle kept the water temperature closer to its original temperature? Why?
   c. How is energy transfer related to how different house designs affect the inside temperature of the house?
   d. Did you find any changes on the outside of the water bottles? If so, explain what you observed.

Part 2

1. Read and discuss the "Predict" section of page 7 as a class.
2. Distribute the Student Worksheet (*Building an Energy Efficient House—Part 2*) and go over the experiment procedures.
3. Divide your class into groups, ideally with each group having three to four students and have them do the experiment by following the steps below
   a. Connect a temperature sensor to a LabQuest 2.
   b. Pour 500ml of hot water into each of the water bottles (or fill the bottles about 2/3 full).
   c. Using the temperature sensor, measure the water temperature. Record the temperature in the chart of the Student Worksheet.
   d. Place a lid on one of the water bottles. Place plastic wrap on the other water bottle and secure it with a rubber band. Leave them in the room for 20 minutes.
   e. Measure the temperature of the water again and record it in the chart.

(Between Steps **d** and **e**, you may wish to have your students discuss what may happen to the temperature of the water and why. You may also want to engage them in other activities to fill 20 minutes of waiting time.)

4. Using the "Discuss" section of page 7, discuss the result as a class:
   a. Share your results with your classmates.
   b. Did the water bottle with the "window" maintain the original temperature of the water? Why or why not?
   c. How is energy transfer related to how windows affect the inside temperature of a house?

STUDENT WORKSHEET: ***Building an Energy Efficient House—Part 1***

Name: _____

Predict

1. Which type of house keeps more heat inside, a house with thin roof and thin walls or a house with a roof and walls with added materials? Why?

Experiment

1. Pour 500ml of ice cold water into each of the insulated and uninsulated water bottles (or fill the bottles about 2/3 full).
2. Feel the water bottles with your hands and record how cold each feels in the chart below.
3. Connect a temperature sensor to a LabQuest 2. Using the temperature sensor, measure the water temperature. Record the temperature in the chart below.
4. Place lids on the water bottles and leave them in the room for 15 minutes.
5. Observe the outside of the water bottles and record any changes you find.
6. Measure the temperatures of the water again and record your results in the chart below.

	Uninsulated water bottle	**Insulated water bottle**
Is the bottle warm or cold to the touch?		
Initial temperature		
Observation of the outside of the bottle		
Final temperature		

Discuss

- Share your results with your classmates.
- Which type of water bottle kept the water temperature closer to its original temperature? Why?
- How is energy transfer related to how different house designs affect the inside temperature of the house?
- Did you find any changes on the outside of the water bottles? If so, explain what you observed.

ANSWER KEY: *Building an Energy Efficient House — Part 1*

Name _____

Predict

1. Which type of house keeps more heat inside, a house with thin roof and thin walls or a house with a roof and walls with added materials? Why? Answers will vary.

Experiment

1. Pour 500ml of ice cold water into each of the insulated and uninsulated water bottles (or fill the bottles about 2/3 full).
2. Feel the water bottles with your hands and record how cold each feels in the chart below.
3. Connect a temperature sensor to a LabQuest 2. Using the temperature sensor, measure the water temperature. Record the temperature in the chart below.
4. Place lids on the water bottles and leave them in the room for 15 minutes.
5. Observe the outside of the water bottles and record any changes you find.
6. Measure the temperatures of the water again and record your results in the chart below.

	Uninsulated water bottle	**Insulated water bottle**
Is the bottle warm or cold to the touch?	Cold	Room temperature
Initial temperature	Answers will vary but the initial temperature of both bottles will most likely be about the same	Answers will vary but the initial temperature of both bottles will most likely be about the same
Observation of the outside of the bottle	Water droplets form	No change
Final temperature	Answers will vary but the final temperature will most likely higher than that of the insulated bottle	Answers will vary but the final temperature will most likely lower than that of the uninsulated bottle

STUDENT WORKSHEET: ***Building an Energy Efficient House — Part 2***

Name: _____

Predict

Which type of house keeps more heat inside, a house with big windows or small windows? Does a window work as a good insulator for the house? Why?

Experiment

1. Pour 500ml of hot water into each of the water bottles (or fill the bottles about 2/3 full).
2. Connect a temperature sensor to a LabQuest 2. Using the temperature sensor, measure the water temperature. Record the temperature in the chart below.
3. Place a lid on one of the water bottles. Place plastic wrap on the other water bottle and secure it with a rubber band. Leave the water bottles in the room for 20 minutes.
4. Measure the temperature of the water again and record it below.

	Insulated water bottle with an insulated lid	Insulated water bottle with a plastic wrap
Initial Temperature		
Final Temperature		

Discuss

- Share your results with your classmates.
- Did the water bottle with the "window" maintain the original temperature of the water? Why or why not?
- How is energy transfer related to how windows affect the inside temperature of a house?

ANSWER KEY: *Building an Energy Efficient House — Part 2*

Name: _____

Predict

Which type of house keeps more heat inside, a house with big windows or small windows? Does a window work as a good insulator for the house? Why?

Experiment

1. Pour 500ml of hot water into each of the water bottles (or fill the bottles about 2/3 full).
2. Connect a temperature sensor to a LabQuest 2. Using the temperature sensor, measure the water temperature. Record the temperature in the chart below.
3. Place a lid on one of the water bottles. Place plastic wrap on the other water bottle and secure it with a rubber band. Leave the water bottles in the room for 20 minutes.
4. Measure the temperature of the water again and record it below.

	Insulated water bottle with an insulated lid	Insulated water bottle with a plastic wrap
Initial Temperature	Answers will vary but the initial temperature of both bottles will most likely be about the same	Answers will vary but the initial temperature of both bottles will most likely be about the same
Final Temperature	Answers will vary but the final temperature will most likely be higher than that of the bottle with a plastic wrap	Answers will vary but the final temperature will most likely be lower than that of the bottle with an insulated lid

Discuss

Answers will vary.

- Share your results with your classmates.
- Did the water bottle with the "window" maintain the original temperature of the water? Why or why not?
- How is energy transfer related to how windows affect the inside temperature of a house?

Activity MS.7.4: Moisture Inside of a House

Overview

In this lesson students will learn about factors that affect mold growth and how to keep inside of a building healthy.

Objectives

- On successful completion of this lesson, students will be able to:
- describe potential impacts of climate change on buildings/houses
- describe factors that affect mold growth in a building
- describe potential health problems mold inside a building can cause
- consider how different building designs affect the humidity level and temperature inside a building
- consider the conditions of their houses and come up with ways to improve them, if necessary, from a scientific, cultural and personal perspectives

Next Generation Science Standards

Standards by Disciplinary Core Ideas:
From Molecules to Organisms: Structures and Processes

Standards by Topic: Growth, Development, and Reproduction of Organisms

Performance Expectations

The activity is just one step toward reaching the performance expectations listed below:
MS-LS1-5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

Dimention:

Science & Engineering Practices
Constructing Explanations and Designing Solutions

Disciplinary Core Ideas
ELS1.B: Growth and Development of Organisms

- Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5) *
  [Note to teachers: Mold is an organism but not a plant.]

Crosscutting Concepts
Cause and Effect

Alaska Standards:

Alaska Science Standards and Grade Level Expectations

SA1: The student demonstrates an understanding of the processes of science by

[6-8] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring and communicating

[6] SA 1.2 collaborating to design and conduct simple repeatable investigations

[7] SA 1.2 collaborating to design and conduct simple repeatable investigations, in order to record, analyze (i.e., range, mean, median, mode), interpret data, and present findings.

[8] SA 1.2 collaborating to design and conduct repeatable investigations, in order to record, analyze (i.e., range, mean, median, mode), interpret data, and present findings.

SA3: The student demonstrates an understanding that the interactions with the environment provide an opportunity for understanding scientific concepts by

[6] SA 3.1 gathering data to build a knowledge base that contributes to the development of questions about the local environment (e.g., moose browsing, trail usage, river erosion)

[7] SA 3.1 designing and conducting a simple investigation about the local environment

[8] SA 3.1 conducting research to learn how the local environment is used by a variety of competing interests (e.g., competition for habitat/resources, tourism, oil and mining companies, hunting groups)

SB2: The student demonstrates an understanding of how energy can be transformed, transferred, and conserved by

[6] SB 2.1 recognizing that energy can exist in many forms (i.e., heat, light, chemical, electrical, mechanical)

[7] SB 2.1 explaining that energy (i.e., heat, light, chemical, electrical, mechanical) can change form

SF: The student develops an understanding of the dynamic relationships among scientific, cultural, social and personal perspectives.

Bering Strait School District Scope and Sequence

6.6B Understand the feature of adaptation that helps an organism to survive in its surroundings. (SC1.2)

6.7D Survey the major groups of non-animal, non-plant organisms: viruses, bacteria, protists and fungi. (SC2.2)

7.9A Recognizes phase changes (sublimation, condensation, evaporation) and energy transfer. (SD 3.2)

8.2G Recognizes that most substances can exist as solid, liquid or gas depending on temperature (motion of particles). (SB3.1)

8.3B Recognizes that energy can exist in many forms (heat, light, chemical, electrical, mechanical) and can change form. (SB2.)

Materials for Activity

Part 1

- REACH Up Middle School Student Guide: Impact on Infrastructure
- Student Worksheet: Moisture Inside of a House—Part 1
- 1 LabQuest 2 per group
- 1 Relative Humidity sensor per group
- 1 Temperature sensor per group
- Tape
- Labeling marker
- 2 Chambers per group
- 1 Piece of cloth per group
- Rubber stoppers for the chamber lids
- Very warm water (does not need to be boiling hot but should be hot to the touch)

Part 2

- REACH Up Middle School Student Guide: *Impact on Infrastructure*
- Student Worksheet: *Moisture Inside of a House—Part 2*
- 1 LabQuest 2 per group
- 1 Relative Humidity sensor per group
- 1 Temperature sensor per group
- Tape
- Labeling marker
- 2 Chambers per group
- 2 Pieces of cloth per group
- Rubber stoppers for the chamber lids
- Very warm water (hot to the touch)

Activity Preparations

Part 1

1. Make copies of the Student Worksheet: *Moisture Inside of a House—Part 1*.
2. Check the LabQuest 2 to see if they are fully charged. If not, recharge them.
3. Prepare very warm water. It does not need to be boiling hot but it should be hot to the touch. Each group will need enough to damp the piece of cloth.

Part 2

1. Make copies of the Student Worksheet: *Moisture Inside of a House—Part 2*.
2. Check the LabQuest 2 to see if they are fully charged. If not, recharge them.
3. Prepare very warm water. It does not need to be boiling hot but it should be hot to the touch. Each group will need enough to damp the pieces of cloth.

Activity Procedure

Part 1

1. Review pages 1-2 in the REACH Up Middle School Student Guide: *Impact on Infrastructure*.
2. Next, read and discuss pages 8 together as a class.
   If you find it appropriate, mention the following and lead discussions:
   Some non-toxic molds can cause minor allergic symptoms. Toxins produced by some species of mold such as toxic black mold can cause symptoms such as headaches, memory loss, skin inflammation, nausea and dizziness. In extreme cases, toxic black mold can even lead to death. A large amount of moisture in your home could create a mold problem.
3. Distribute the Student Worksheet (Moisture Inside of a House—Part 1) and go over the experiment procedures.
4. Divide your class into groups, ideally with each group having three to four students and have them do the experiment by following the steps below:
   a. Connect a relative humidity sensor and a temperature sensor to a LabQuest 2.
   b. Label one chamber "A" and the other "B," using the tape and labeling marker.
   c. Close the openings of the chamber lids with rubber stoppers.
   d. Soak the piece of cloth in very warm water. Place it inside Chamber B and close the lid tightly. Leave it for 10 minutes.
   e. Observe the inside walls of the chambers and record your observations in the chart on the Student Worksheet.
   f. Measure the humidity levels and temperatures inside the chambers, using the

relative humidity and temperature sensors, respectively. Important: the sensors should NOT touch the cloth. Record the humidity levels and temperatures in the chart.

(Between Steps **e** and **f**, you may wish to have your students discuss what may happen to the humidity levels and temperatures of the chambers as well as the inside walls of the chambers, and why.)

5. Using the "Discuss" section of page 9, discuss the result as a class:
   a. Share your results with your classmates.
   b. Did you find any change in the humidity level after the damp cloth was placed? Why or why not?
   c. How about the temperature?
   d. Did you see any difference in the inside walls of the chambers? Why or why not?

Part 2

1. Distribute the Student Worksheet (Moisture Inside of a House—Part 2) and go over the experiment procedures.
2. Divide your class into groups, ideally with each group having three to four students and have them do the experiment by following the steps below:
   a. Connect a relative humidity sensor and a temperature sensor to a LabQuest 2.
   b. Label one chamber "A" and the other "B," using the tape and labeling marker.
   c. Observe the inside walls of the Chambers A and B and record your observations.
   d. Close the openings of the chamber A lid with rubber stoppers. Do not close the openings of Chamber B.
   e. Measure the humidity levels and temperatures inside the chambers, using the relative humidity sensor and temperature sensor, respectively. Important: the sensors should NOT touch the bottom of the chambers. Record the humidity levels and temperatures in the chart on the Student Worksheet.
   f. Soak the pieces of cloth in very warm water (hot to the touch) and place a piece inside each of the chambers. Close the lids and leave them for 10 minutes.
   g. Observe the inside walls of the chambers. Measure the humidity level and temperature inside the chambers again, using the relative humidity sensor and temperature sensor, respectively. Important: the sensors should NOT touch the cloth. Record your observations in the chart on the Student Worksheet.

(Between Steps **f** and **g**, you may wish to have your students discuss what may happen to the humidity levels and temperatures of the chambers as well as the inside walls of the chambers, and why.)

3. Using the "Discuss" section of page 10, discuss the result as a class:
   a. Share your results with your classmates.
   b. Did you observe a difference between Chamber A and Chamber B after the damp clothes were added? Explain.
   c. Did you measure a different percentage of relative humidity between Chamber A and Chamber B after the damp clothes were added? Explain.
   d. How about temperatures?

Extension Activities

- Have students observe the conditions inside their own houses. Have them write a paragraph on the question: Based on your observation, what should be done, if anything, to improve the moisture level of your house?
- Take students on a field trip of a house being built, if possible. Have students write what they have learned.

Assessments:

- Evaluate the responses to the questions and quality of writing.

STUDENT WORKSHEET: ***Moisture Inside of a House—Part 1***

Name: _____

Experiment

1. Label one chamber "A" and the other "B," using the tape and labeling maker.
2. Close the openings of the chamber lids with rubber stoppers.
3. Place the lid on top of Chamber A and close it tightly.
4. Soak the piece of cloth in very warm water. Place it inside Chamber B and close the lid tightly. Leave it for 10 minutes.
5. Observe the inside walls of the chambers and record your observations in the chart below.
6. Measure the humidity levels and temperatures inside the chambers, using the relative humidity sensor and temperature sensor. Important: The sensors should NOT touch the cloth. Record the humidity levels and temperatures below.

	Chamber A	**Chamber B**
Inside wall of the chamber		
Humidity level		
Temperature		

Discuss

- Share your results with your classmates.
- Did you find any change in the humidity level after the damp cloth was placed? Why or why not?
- How about the temperature?
- Did you see any difference in the inside walls of the chambers? Why or why not?

ANSWER KEY: *Moisture Inside of a House—Part 1*

Name: _____

Experiment

1. Label one chamber "A" and the other "B," using the tape and labeling maker.
2. Close the openings of the chamber lids with rubber stoppers.
3. Place the lid on top of Chamber A and close it tightly.
4. Soak the piece of cloth in very warm water. Place it inside Chamber B and close the lid tightly. Leave it for 10 minutes.
5. Observe the inside walls of the chambers and record your observations in the chart below.
6. Measure the humidity levels and temperatures inside the chambers, using the relative humidity sensor and temperature sensor, respectively. Important: The sensors should **NOT touch the cloth**. Record the humidity levels and temperatures below.

	Chamber A	**Chamber B**
Inside wall of the chamber	Dry	Foggy
Humidity level	Answers will vary but the humidity level will most likely be lower than that of Chamber B	Answers will vary but the humidity level will most likely be higher than that of Chamber A
Temperature	Answers will vary but the temperature will most likely be lower than that of Chamber B	Answers will vary but the temperature will most likely be higher than that of Chamber A

Discuss Answers will vary.

- Share your results with your classmates.
- Did you find any change in the humidity level after the damp cloth was placed? Why or why not?
- How about the temperature?
- Did you see any difference in the inside walls of the chambers? Why or why not?

STUDENT WORKSHEET: ***Moisture Inside of a House—Part 2***

Name: _____

Experiment

1. Label one chamber "A" and the other "B," using the tape and labeling maker.
2. Observe the inside walls of the Chambers A and B and record your observations in the chart below.
3. Close the openings of Chamber A lid with rubber stoppers. Do not close the openings of the other chamber (Chamber B).
4. Measure the humidity levels and temperatures inside the chambers, using the relative humidity sensor and temperature sensor, respectively. Record the results.
5. Soak the pieces of cloth in very warm water (hot to the touch) and place a piece inside each of the chambers. Close the lids and leave them for 10 minutes.
6. Observe the inside walls of the chambers. Measure the humidity level and temperature inside the chambers again, using the relative humidity sensor and temperature sensor, respectively. Important: The sensors should NOT touch the cloth. Record the results.

	Chamber A	**Chamber B**
Inside wall of the chamber		
Initial Humidity level		
Initial Temperature		
Inside wall of the chamber		
Final Humidity level		
Final Temperature		

Discuss

- Share your results with your classmates.
- Did you observe a difference between Chamber A and Chamber B after the damp clothes were added? Explain.
- Did you measure a different percentage of relative humidity between Chamber A and Chamber B after the damp clothes were added? Explain.
- How about temperature?

ANSWER KEY: *Moisture Inside of a House—Part 2*

Name: _____

Experiment

1. Label one chamber "A" and the other "B," using the tape and labeling maker.
2. Observe the inside walls of the Chambers A and B and record your observations in the chart below.
3. Close the openings of Chamber A lid with rubber stoppers. Do not close the openings of the other chamber (Chamber B).
4. Measure the humidity levels and temperatures inside the chambers, using the relative humidity sensor and temperature sensor, respectively. Record the results.
5. Soak the pieces of cloth in very warm water (hot to the touch) and place a piece inside each of the chambers. Close the lids and leave them for 10 minutes.
6. Observe the inside walls of the chambers. Measure the humidity level and temperature inside the chambers again, using the relative humidity sensor and temperature sensor, respectively. Important: The sensors should NOT touch the cloth. Record the results.

	Chamber A	**Chamber B**
Inside wall of the chamber	Dry	Dry
Initial Humidity level	Answers will vary but the humidity levels of both chambers will most likely be about the same	Answers will vary but the humidity levels of both chambers will most likely be about the same
Initial Temperature	Answers will vary but the temperatures of both chambers will most likely be about the same	Answers will vary but the temperatures of both chambers will most likely be about the same
Inside wall of the chamber	Foggy	Less foggy
Final Humidity level	Answers will vary but the humidity level will most likely be higher than that of Chamber B	Answers will vary but the humidity will most likely be lower than that of Chamber A
Final Temperature	Answers will vary but the temperature will most likely be higher than that of Chamber B	Answers will vary but the temperature will most likely be lower than that of Chamber A

Discuss

Answers will vary.

- Share your results with your classmates.
- Did you observe a difference between Chamber A and Chamber B after the damp clothes were added? Explain.
- Did you measure a different percentage of relative humidity between Chamber A and Chamber B after the damp clothes were added? Explain.
- How about temperature?