### Big Idea/Topic

Heat

### Standards Alignment

**S3P1. Obtain, evaluate, and communicate information about the ways heat energy is transferred and measured.**

a. Ask questions to identify sources of heat energy. (*Clarification statement:* Examples could include sunlight, friction, and burning.)

b. Plan and carry out an investigation to gather data using thermometers to produce tables and charts that illustrate the effect of sunlight on various objects. (*Clarification statement:* The use of both Fahrenheit and Celsius temperature scales is expected.)

c. Use tools and everyday materials to design and construct a device/structure that will increase/decrease the warming effects of sunlight on various materials. (*Clarification statement:* Conduction, convection, and radiation are taught in upper grades.)

Connections to Other Content Standards:

**ELAGSE3R14:** Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 3 topic or subject area.

**ELAGSESL1:** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on others’ ideas and expressing their own clearly.

a. Ask questions to check understanding of information presented, stay on topic, and link their comments to the remarks of others.

b. Explain their own ideas and understanding in light of the discussion.

**MGSE3.MD.1** Tell and write time to the nearest minute and measure elapsed time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes, e.g., by representing the problem on a number line diagram, drawing a pictorial representation on a clock face, etc.

**MGSE3.NBT.2** Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.

**MGSE3.MD.3** Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs. For example, draw a bar graph in which each square in the bar graph might represent 5 pets.

**SS3G3** Describe how physical systems affect human systems.

b. Describe how the early explorers (SS3H2a) adapted, or failed to adapt, to the various physical environments in which they traveled.
Instructional Design

**Teacher Notes:** The focus of this instructional segment is thermal energy and heat transfer. A suggested letter to the parents is included: [Dear Parent](#).

There are many misconceptions about heat:
- Heat is a substance. Heat is not energy.
- Temperature is a property of a particular material or object. (For example, students may believe that metal is naturally cooler than plastic.)
- The temperature of an object depends on its size.
- Heat and cold are different. (Cold is the absence of heat. Heat and cold can be thought of as opposite ends of a continuum.)
- Cold is transferred from one object to another. (Heat is transferred from one object to another. Heat moves from the warmer object to the cooler object.)
- Objects that keep things warm (sweaters, mittens, blankets) are sources of heat. (Objects keep things warm by trapping heat.)
- Some substances (flour, sugar, air) cannot heat up. (All substances heat up, although some gain heat more easily than others.)
- Objects that readily become warm (conductors of heat) do not readily become cold. (Conductors gain (and lose) heat easily.)

Background information:
Heat is the name given to the flow of energy from hotter to cooler objects. Temperature is used to measure the amount of thermal energy. A temperature reading is the average amount of energy movement in a substance. The molecules in cold things move very slowly and the temperature is less than the temperature in warmer things. The molecules in hot things move very quickly, and the temperature rises because hot substances usually expand when heated.

**When a hot substance comes in contact with a cold substance, the thermal energy will flow from hotter to colder until the objects become the same temperature.**

Insulators are materials that block the flow of heat, while conductors are materials that allow heat to flow easily. Sometimes students believe that insulators are really heat sources, because they seem to make things warm, or heat things up. Insulators will stop the heat from flowing, so things that are warm tend to say warm, but they are not a heat source. Good insulators include plastics, air, fabrics that hold air, feathers, or other similar materials.

Listen carefully to student explanations and provide investigations and explanations to address correct science thinking.

The standard expects students to use thermometers. Keep the thermometers disinfected if more than one student is measuring at a time. Unless you have a thermometer for each student, set up a station for individual students and disinfect before the next student works at the station.
Demonstrate thermometer readings by using your phone camera to video the temperature rising in warm water or lowering in ice water. Explain that the liquid increases in volume as it gets warmer so that the liquid inside the thermometer takes up more space.

**Engage**

Phenomenon: Parts of your desk feel warmer or cooler to the touch. Some places in the room are warmer or cooler than others. What is going on?
Have students write questions about what they want to know.

Say: Warm things transfer their warmth to cooler things. As something transfers its heat, it gets cooler. You cannot make something cold. Cold is the absence of heat.

All materials want to be the same temperature so warmer objects use energy to make other objects warmer. Ice doesn’t cool a drink. The drink gives up its heat to warm the ice and the ice melts. See the handout **Ice Pack**.

Handout: **Conductors**

**Plugged/Unplugged:** Provide students with the handout **Conductors** and have them use objects around their homes to answer the questions.

**Explore**

Investigate: **Hands Are Not Thermometers**

Teacher note: Although students without thermometers will need to use hands as a measure of cool, cooler, warm, and warmer, have students collect and analyze data using thermometers whenever possible.

Background information for Teachers: **Reading a Thermometer**
A YouTube introduction from Miacademy Learning Channel: **How to Read a Thermometer**

Introduction: The sun provides heat to the Earth. You can feel a difference if you stand in the bright sunshine or if you stand in the shade. What other things make you feel warmer? Brainstorm a list of things that give off heat. After students name several things such as kitchen appliances, light bulbs, heaters, furnace, fire, candles, etc., ask them to find the warmest place in the room and the coolest place in the room. Provide thermometers so they can measure the differences. Handout **Heat sources**. Have students complete the handout and then discuss answers with the class.

Remind students that their bodies also have warmth. Ask them what they do to warm up if they feel cold. A few jumping jacks, running in place, and quickly rubbing their hands together should give them a chance to release energy as well as warm up.

Explain that we measure the temperature with a thermometer. Have a class scavenger hunt this week to find all of the places that use thermometers or post temperatures. Put a chart on the wall and have students write down where they saw a thermometer or a temperature reading and if it was in Celsius or in Fahrenheit.
Teacher Note: It is necessary that you expect data in a specific thermometer scale: Celsius or Fahrenheit. To alleviate confusion, have students work with one scale at a time until they begin to understand how the number range works. Then you can ask for readings of a specific one. Explain that scientists use the Celsius scale since it is used worldwide, and it uses a scale of 0 to 100. Fahrenheit is only used in the United States and is most recognized by the people who live here.

Student information: Using a Thermometer is a handout to give third graders basic information about thermometers.

Have students place cups of sand, water, soil, etc. in the direct sunshine and cups of each in the shade. Leave them in place for an hour. Have students feel the differences of the materials to distinguish between the amount of thermal energy absorbed by each substance. Have them switch the cups that have been in the sun with those that have been in the shade to see that the substances give up their heat as quickly as they gain heat. *(If something warms up quickly, it will cool just as quickly. If something warms up slowly, it will cool just as slowly.)*

Now have students do the same investigation but use thermometers to find out temperature ranges by substance and by location.

Thermometer safety and accuracy:
- Choose the student who will read the thermometer and another student check the reading.
- Body heat can change the temperature reading. Caution students from holding the thermometer while measuring or taking the thermometer out of what they are measuring to look at the reading.
- Have a plan in place if there is an accident and the thermometer breaks. Let students know expectations about broken glass or lab equipment.
- If students are sharing thermometers, have a plan for disinfection before another student handles the thermometer.
- Only immerse thermometers that are safe in liquids.
- Check the temperature range of the thermometer before measuring extremes.

For students with challenges in figuring out how the thermometer scales are different, provide them with more information about number lines and skip counting: Handout Number Lines.

**Investigate:** Put some chocolate ice chips that are about the same size (chocolate chips or butter could be used if available) on different surfaces such as a baking sheet, a piece of foil, a piece of Styrofoam, waxed paper, a white paper plate, a black piece of construction paper, a piece of cardboard, a piece of plastic, etc. Choose four. Place them in the direct sunlight. Put a thermometer on the surfaces to record temperature data. Show students how to use the chart What’s Hot and What’s Not. Have students notice what happens to the chips (chocolate chips or ice chips) depending on the surface of the container. They can use a craft stick or plastic knife to discover how much melting occurred due to the surface temperature.

Have students use their data from What’s Hot and What’s Not to show their temperature readings in bar graph form. Handout: What’s Hot Data Sheet
Say to the students: Here’s the challenge! Now use common household materials to design a structure that will change the amount of melting of the chips or the time it takes to melt the chips. Sketch your design and then build the structure. Try it out. Modify the design until you can see clear results showing that the structure made a difference. Show your evidence by timing when you checked, recording the time before and after, making routine checkpoints, showing the results, and writing your conclusions on the handout.

Teacher note: Depending on the independent level of the class, students can do this in groups, or step by step as a class.
Handout: Next Step Investigation

**Plugged:** The thermometer on the handout Temperature Rising incorporates a “play” and a “pause” button so that students can watch the temperature rise and see how the colors change. Ask: Why do you think thermometer changes color as the temperature rises? Have students pause the thermometer at different stages and read the temperature reading noticing that the Fahrenheit and Celsius numbers are different, but the liquid inside is measuring the same height.

For the Next Step Investigation, they can share pictures or videos of their designs and results.

Many smartphones can use an app for temperature readings. A parent can help their child measure temperature using the app if no other thermometer is available.

**Unplugged:** Students can conduct the investigations at home using the Handout: What’s Hot What’s Not (no thermometer). For the Next Step Investigation, they can share their shelter design and sketches of before and after. Their conclusions will be based on time and degree of melting rather than temperature readings if there is no thermometer available.
Provide students with handouts of different thermometer readings: Thermometer Practice or cut and paste your own using the blank clipart Thermometer. Make sure the thermometers are measured in Fahrenheit and Celsius so that students can see that the temperature is the same, but the number scale is different. Challenge them to figure out the temperatures in degrees of the reading. Provide word problems asking students to calculate differences in temperatures by reminding them that a thermometer is much like a number line. Use thermometers that measure in twos and five’s as well as one-degree increments, if possible.

**Explain**
Explain: When you put on a sweater, coat, jacket, or gloves, you are insulating so your body doesn’t lose heat to the surrounding air as quickly. This is what insulating does. It keeps something from transferring heat. Since heat transfers its energy to warm up things that are cooler, it helps to know how to insulate against the heat or to insulate to hold in the heat. Conductors allow heat to transfer more quickly than insulators.

Teacher note: In Social Studies students learn that explorers and pioneers had to come up with ways to survive the warm and cold conditions as they traveled and determined where to settle. Knowing how to use sources of heat and how to insulate against the cold or heat were important.

Have students collect data by measuring the temperature of common items sitting at room temperature over a period of time and then measuring the temperatures when heat is added. Have
students recognize that sweaters and gloves do not produce heat, but they do insulate to lessen the heat transfer. An optional activity for heat and insulation: The Mitten Problem.

Students can work in small groups to measure the temperatures of cold or warm water in cups of various materials. Handout: Insulators

Provide a class chart for students to brainstorm items that are used as insulators. Examples could include coolers, towels, potholders, pan handles, gloves, coats, hats, etc.

Additional ideas:
Fasten cotton balls or felt to the outside of an empty clean milk container, to the inside of an empty clean milk container, and leave one without an insulator. Record the temperature of a baby jar of ice water or of very warm water. Put it inside of each of the three milk cartons. Have students record the temperatures of each water sample every 5 minutes to provide data on the effectiveness of insulation placement.

They can put thermometers under different colors of paper and lay them in direct sunlight to learn that color can also absorb or reflect heat.

Staple or tape three sides of a piece of black construction paper to a piece of white construction paper to form a pouch. Students can put their hands inside the pouch and feel the difference in temperature according to which side is facing direct sunlight.

Blubber Gloves
Animals living in very cold climates stay warm because they are insulated with body fat or blubber. A search for Blubber Gloves will give websites with an investigation simulating how this works. Students put on a glove and coat it in a solid fat like Crisco shortening. Then a large rubber glove is put on over the coated one. Have students place the blubber insulated hand and the uncoated hand in a bowl of ice water to feel the difference.

Communicating: Handout Interview
Interview older members of your household or family about changes in air conditioning, insulation, and temperature control. How did they keep comfortable on very warm days and very cold days? Write an illustrated booklet or record a video about then, now and the future.

Literature Links:
- Have students read about arctic animals such as polar bears, walrus, whales, and seals.
- Agatha’s Feather Bed by Carmen Deedy  Agatha spins yarn and weaves cloth like no other, and she’s worked hard to sell enough wares to buy a brand-new feather bed. However, when six angry, naked geese show up to get their feathers back, Agatha must reckon with how precious resources can be.
- Lesson plans based on news article about Pierre the Penguin who is going bald, so scientists are finding ways to insulate Pierre: Pierre the Penguin (This work is licensed under an Attribution-ShareAlike 3.0 Unported Creative Commons license.)
- Tall Tales such as Heat Wave by Helen Ketteman: Handout Tall Tales provides the story of Babe the Blue Ox and Davy Crockett and the Frozen Dawn
**Elaborate**
Teacher Note: Choose a project for students to plan and carry out that shows their understanding of heat, conduction, and insulation. Some ideas are provided:
Now that you know more about heat and how the energy moves from warm to cold, design an investigation.

- Design a structure for an explorer trying to survive a very cold winter or a very hot summer.
- Investigate how insulation can prevent ice melting or water freezing.
- Design a product that will help an animal survive very cold or very hot conditions.
- Build a solar cooker and try roasting a hot dog, popping popcorn, melting marshmallows, making cheese toast, etc.
- Design a map of a room in your house. Add symbols to show doors, windows, heat sources, etc. Use a thermometer to measure the temperatures and color to label the warm and cool spots in the room. Write a paragraph explaining why according to what you know about heat sources, conduction, and insulation there are temperature differences. Devise a plan to lessen the differences in the temperatures between the warm and cool spots.
- Investigate and collect data to determine the best cup for keeping liquids cold or hot.
- Check the temperature of a collection of common household objects. Lay them in the sun and in the shade to note the ones that heat quickly and cool quickly as well as those that heat slowly and cool slowly.

Handout [I Wonder and I Investigate](#)

**Plugged/Unplugged:** Have students provide their findings on the handout.

**Evaluate**
Ask: How does an insulator know whether to keep something warm or to keep something cold? Do you need different insulators for different reasons? Discuss.
Ask: When is it good to use a heat conductor and when is it good to use an insulator?
Teacher note: Listen to student’s reasoning to find out if they understand that heat travels from warmer to cooler so that the temperature is equalized. Pay attention to whether students use science words in their explanations correctly: conduct, insulate, transfer, temperature, thermometer, heat

- Handout [Thermometer Practice](#)
- Items from [Assessment Ideas](#)
- Handout [Performance Task](#)
- Handout [Sample Rubrics](#)

**Handouts**

- [Dear Parent](#)
- [Ice Pack](#)
- [Conductors](#)
- [Hands Are Not Thermometers](#)
- [Reading a Thermometer](#)
- [Heat Sources](#)
- [Using a Thermometer](#)
- [Number Lines](#)
• What’s Hot and What’s Not
• What’s Hot and What’s Not (no thermometer)
• What’s Hot Data Sheet
• Next Step Investigation
• Temperature Rising
• Thermometer Practice
• Thermometer (Clip art)
• Insulators
• Interview
• Tall Tales
• I Wonder I Investigate
• Assessment Ideas
• Performance Task
• Sample Rubrics

Supplies
• Thermometers
• Chart paper or place to post class charts
• Cups: Styrofoam, paper, plastic, etc.
• Access to water: warm and cold
• Ice cubes
• Ice chips or chocolate chips
• Various materials as surfaces and for structure building: cardboard, construction paper, foil, metal, wood, cotton, felt, paper towels, rolls from paper towels or toilet paper, empty clean milk containers, etc.

Evidence of Student Success
• Handout Assessment Ideas includes multiple choice and constructed response items.
• Handout Performance Task
• Rubrics for group and project work are included.
• A sample homework handout Thermometer Practice is provided.

Students will understand
• There are many sources of heat. Heat is produced by mechanical and electrical machines or anytime one thing rubs against something else (friction).
• When warmer things are put with cooler ones, the warm ones lose heat, and the cool ones gain it until they are all the same temperature.
• A warmer object can warm a cooler one by contact or at a distance.
• Sun is the most important source of heat.
• Some materials conduct heat much better than others. (conductors)
• Poor conductors can reduce heat loss. (insulators)
• A thermometer is a tool used to measure heat.
• Thermometers can measure in Celsius or in Fahrenheit. The United States uses the Fahrenheit scale for weather and room temperature. Scientists and other countries use the Celsius scale.
• Heat is transferred in many different ways.
- The state or form of water can be changed by heating or cooling it. (ice, liquid water, steam)
- Different areas of a room have different temperatures due to specific conditions (vents, doors, windows, crowded space, etc.)

Students will be able to
- Read a thermometer using both the Celsius and the Fahrenheit scales.
- Graph temperatures
- Collect and analyze data such as the temperature rising and falling.
- Communicate observations
- Sequence temperatures
- Plan and carry out designs to solve problems

### Student Learning Supports

The goal for science education in the state of Georgia is as follows: All Students, over multiple years of school, actively engage in science and engineering practices and apply crosscutting concepts to deepen their understanding of the core ideas in these fields. The learning experiences provided for students should engage them with fundamental questions about the world and with how scientists have investigated and found answers to those questions. This lesson includes the disciplinary core ideas, science and engineering practices and crosscutting concepts to actively engage students in exploring science concepts with real world topics. As part of the vision, we must support the inclusion of all students in science learning.

Some **general** strategies to include all students in the learning process of science are as follows:
- Provide consistent and positive feedback.
- Keep directions brief and clear.
- Make sure parents and students know schedules, due dates, requirements, expectations, and how assignments/tests are going to be collected.
- Share evaluation results in a timely manner to students and parents.
- Package assignments in a way that students know the sequence, what is required, when it is required, what is available as choice and what is for fun.
- Provide/encourage organizational strategies such as where to work, store work, when and where to turn in assignments, graphic organizers, etc.
- Provide reminders of important dates and requirements.
- Go over notebook and journal ideas and share your entries with students so they can see what you expect.
- Allow dictation and/or text to speech software programs and tools.
- Check in with students by phone or online to answer questions, give reminders, and check progress.
- Provide parents with updates on progress and upcoming assignments. Communicate often.
- Provide resources that students can access offline.
- Allow students to give information orally or in drawings.
- Model expectations and demonstrations in video/online/phone.
- The teacher should have students match letter prior to reading or writing to remind them of the alphabet.
• The teacher can have students identify words that they know in any text that they are reading.
• The teacher can provide students with sentence frames to assist students frames to help students get started writing.
• Provide students with the opportunity to interact with numbers.
• The teacher should provide multiple ways for students to gain and show their knowledge.

Some strategies specific to this lesson are as follows:
• The teacher should keep a list of student observations about the temperature of their desks and other items around the room. This will allow students to come back to their observations later in the lesson.
• The teacher may want to provide students with sentence starters or question stems to get them started writing questions.
• The teacher may want to create a list of student questions and then help students identify the questions that are already in a format that can be answered using the obtain, evaluate, and communicate process.
• Teachers can, also, help student alter their questions to be in a format that can be answered using the obtain, evaluate, and communicate process. The focus should be on the question not being just yes or no questions.
• If the students can safely go outside, then have students go outside and stand in the sun then stand in the shade. Then have students make observations about their experience.
• The teacher may need to provide repeat directions on how to use a thermometer as the lesson progresses.
• The teacher should consider asking students what they know about body heat and have them give examples of body heat.
• The teacher should consider asking students how we measure the temperature of humans. The connection here is the thermometer and heat. This will help students see a real-world application of this science tool.
• The teacher may want to have students chart the temperature data on a number line so that they can more easily compare the two temperature scales.
• The teacher should consider giving students the choice of what to explore. It may be beneficial to provide students with a list of things that they could design an investigation about.
• The teacher may want to provide students a graphic organizer that will help them organize their thoughts to help plan the investigation.
• The teacher should consider providing students with a list of household materials that they can use to build their device. Some students may prefer a written list, and some may prefer images.
• The teacher should provide students with ample time to design their device, test and modify as need.
• The teacher may want to consider providing students with options of how to show their knowledge of heat at the end of the lesson. These options could include making a video, writing a paragraph, altering their device or explaining what would make their device better.
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<th>Engaging Families</th>
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<tr>
<td>• Identify additional support materials or resources that can be used at home to support student understanding of the big idea.</td>
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<td>• Connect to <a href="#">Georgia Home Classroom</a> resources</td>
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<td>• Dear Parent/Caregiver letter</td>
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Dear Parent/Caregiver:

The focus of this segment in science will help your child understand the concept of heat as an energy. It will help to have your child look around the house to locate items that give off heat including people and pets. It will help your child to recognize that clothing, quilts and blankets do not give off heat, but they do insulate to hold in body heat.

If you have a thermometer in your home, help your child practice reading it. Have them notice places where the temperature is posted or noted, such as on the weather report, on a sign in front of a building, a person checking forehead temperatures, etc. Remind your child to look at the temperature unit to see if the temperature is Celsius or Fahrenheit.

Your child will learn more about materials that conduct heat and those that insulate. Let them see the difference in pans and pots in the kitchen. Explain why sometimes the handle of the pan is not metal, why you use a potholder, and why you sometimes choose to use a wooden spoon when cooking.

Share stories about how heating and cooling has changed. Talk with your child about how you stayed warm during very cold times and how you stayed cool during very hot times. Answer questions about home insulation and ways to control the temperature.

Investigations for this segment will help your child recognize that not all things heat or cool at the same rate of speed. When an object heats quickly, it will also cool quickly. An investigation of observing how ice or chocolate chips melt and ways to slow down the process will help your child understand the concept of insulation. A challenge is to build a structure out of common household materials that will insulate the chips to slow the melting process.

You child will design an investigation. A handout is provided to let them write the supplies used, a place to collect data, and conclusions. Here are some ideas:

- Design a structure for an explorer trying to survive a very cold winter or a very hot summer.
- Investigate how insulation can prevent ice melting or water freezing.
- Design a product that will help an animal survive very cold or very hot conditions.
- Build a solar cooker and try roasting a hot dog, popping popcorn, melting marshmallows, making cheese toast, etc. Use caution to avoid burns.
- Design a map of a room in your house. Add symbols to show doors, windows, heat sources, etc. Use a thermometer to measure the temperatures and color to label the warm and cool spots in the room. Write a paragraph explaining why according to what you know about heat sources, conduction, and insulation there are temperature differences. Devise a plan to lessen the differences in the temperatures between the warm and cool spots.
- Investigate and collect data to determine the best cup for keeping liquids cold or hot.
- Check the temperature of a collection of common household objects. Lay them in the sun and in the shade to note the ones that heat quickly and cool quickly as well as those that heat slowly and cool slowly.
Ciao is a greeting in Italy. It can mean hello or goodbye. It is pronounced “chow.”

Warm things transfer their heat (energy) to make the temperature equal. When they do this, they get cooler. When you put an ice cube in a glass of water, the ice cube melts because the water is trying to make it the same temperature and the water gets cooler because it is losing its heat.

Does the sentence on the ice pack explain why ice packs and ice cubes melt? Explain why or why not.
Conductors Name

When warmer things are put with cooler ones, the warm ones lose heat, and the cool ones gain it until they are all at the same temperature. A warmer object can warm a cooler one by contact or at a distance. Some materials conduct heat much better than others. Poor conductors are called insulators and can reduce heat loss.

A good conducting material at room temperature feels cooler than a poor conducting material at room temperature. For example, if you touch a wooden surface in a room like a wooden tabletop and then touch a metal surface in the same room, like a metal chair leg, those objects feel like they are at different temperatures.

Touch various other materials in the room. Which ones feel cool to the touch? They are conducting heat from your hand. Which ones don’t feel as cool to the touch? They are insulating the heat so that those objects don’t transfer heat from your hand.

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<th>Not Cool to the Touch</th>
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How are the ‘cool to the touch’ objects alike?

How are the ‘not cool to the touch’ objects alike?
Hands Are Not Thermometers

3 Containers

Room temperature water

Warm water (For safety reasons test the water before allowing students to immerse their hands in it.)

Cold water

Thermometer

Have a student put one hand in the cold water, the other hand in the warm water for two minutes. Then have them put both hands in the room temperature water.

The hand that was in the cold water will feel warm and the hand that was in the warm water will feel cooler.

Explain: The skin senses hot and cold and reacts to it. The blood vessels will change size to protect the body temperature. For this reason, hands will change temperature according to different conditions. Some people have cold hands and others have warm hands naturally.

Discuss with students why a thermometer is a better tool for measuring temperature than a hand.
Reading a Thermometer

Thermometers measure temperature. They tell us if things are hot, warm, cool, or cold. There are many different designs and purposes for thermometers.

- Health
- Cooking
- Weather
- Science Lab

Thermometer Clip Art
Background for Teachers

Thermometers use a number scale. Many people use the Fahrenheit scale, but many countries and scientists use the Celsius scale. The two number scales measure the same thing but use different ranges of numbers. This is because the men who invented the device and scale measured different things to determine the numbers they used.

Celsius used water as the focus of his number scale. His scale marked the temperature that liquid water turns to ice as zero. The Celsius scale measured the temperature of water turning to steam (boiling) as 100 degrees. Remember that when you see a weather forecast on TV, in a newspaper or on the radio, that any Celsius temperature from 20 degrees upwards is going to be warm, above 25 degrees is hot, above 30 degrees is very hot.

Fahrenheit used alcohol as the focus of his number scale. His scale measured the temperature that liquid water turns to ice as 32 degrees. The temperature of water turning to steam on Fahrenheit’s scale is 212 degrees.

Both thermometers measure the same thing, but they use different numbers. Always remember to tell which scale you are using when reporting the temperature. Add the letter C after the temperature if using the Celsius scale and the letter F after the temperature if using the Fahrenheit scale.

Thermometers with liquid inside work because the liquid expands as the liquid is heated and contracts as it cools. This liquid is measured by a number scale. This scale is tailored to the size of the thermometer and can measure individual degrees, by twos, or even by fives. Make sure students practice figuring out the number scale used to calculate the reading. With practice students can determine the degree on the scale even if the scale is counting by twos or fives.

Adhesive aquarium thermal strips are inexpensive, can be purchased in bulk, and give a wide range of temperature readings. Forehead thermometers are limited to the range of a human’s body temperature and do not work well for measuring water temperature.

The standard expects students to use thermometers. Keep the thermometers disinfected if more than one student is measuring at a time. Unless you have a thermometer for each student, set up a station for individual students and disinfect before the next student works at the station.

Demonstrate thermometer readings by using your phone camera to video the temperature rising in warm water or lowering in ice water. Explain that the liquid increases in volume as it gets warmer so that the liquid inside takes up more space. There are apps available for measuring temperature.
Heat Sources

We know that going outside on a sunny day can make us warmer. The sun is a heat source. When we check our temperatures, we notice that we are also heat sources. Put your hand on your forehead, under your arm, or on your neck. You can feel that you are also producing heat.

Rubbing your hands together quickly will produce more heat. This action causes friction. Friction makes heat.

Walk around where you live and find places or objects that get warm. If something plugs into an electrical outlet, it will probably warm up. Electricity can transfer energy into heat.

Heat sources

<table>
<thead>
<tr>
<th>Gives off heat</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubbing my hands together quickly</td>
<td>Friction</td>
</tr>
<tr>
<td>Light bulb when I turn on the lamp</td>
<td>Electricity</td>
</tr>
</tbody>
</table>

|                                |            |
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|                                |            |
|                                |            |
|                                |            |
|                                |            |
|                                |            |
|                                |            |
|                                |            |

Georgia Department of Education
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Using a Thermometer

The F stands for Fahrenheit. The C stands for Celsius. We use Fahrenheit in the United States, but most countries and scientists use Celsius.

When there is an increase in heat, the liquid in the hollow tube will expand and push up in the tube. So, when the temperature gets hotter, the liquid will go higher. When there is a decrease in heat, the liquid in the hollow tube in contract and will go down in the tube.

To read the thermometer, you look at the top of the liquid and match it to the number on the scale. Always check to see if the scale is measuring in F or in C.

Temperature is measured in degrees. Instead of writing the word, we can use the symbol °. If the temperature is 30 degrees Celsius, you would write 30° C.

Looking at this thermometer, I can see that it measures 10° F.
Number Lines

Thermometers are like tubes with number lines on them or beside them.

Not all number lines are alike. Some have lines for each number, but some only have lines for twos or fives.

When you are reading the number line on a thermometer, you must figure out the scale.

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10| 11| 12| 13| 14| 15| 16| 17| 18| 19| 20|

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0 |   |   |   |   |   |   |   |   |   | 10|   |   |   |   |   |   |   |   |   |

Even without the numbers you can count to see that the number line is counting each line.

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0 | 2 | 4 | 6 | 8 | 10| 12| 14| 16| 18| 20|

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0 |   |   |   |   |   |   |   |   |   | 10|   |   |   |   |   |   |   |   |   |

If the number line is counting by two’s, you can still figure out where the other numbers would be. 3 is in between 2 and 4 even if the line is not there.

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5 | 10| 15| 20|

If the number line is counting by five’s, you can still figure out where the other numbers are even if they are not printed on the line.

A thermometer has a number line that is much greater than 20! It will save space by counting by 2’s or 5’s and not putting every number at a line.

When reading a thermometer, look closely to find out how it is counting so you can get a better reading.
What’s Hot and What’s Not

Challenge: Choose four surfaces to test how much heat is transferred from the sun to the surface. Ideas include different colors of paper, foil, metal pot or pan, wood, grass, soil, etc. Write the surface names you choose on the chart below.

You will use the sun as your source of heat for this. Before you take the surfaces out to the sunlight, put the palm of your hand on each and describe them as cool, warm, or hot. Put them in direct sun for 10 minutes. Touch each of them again with the palm of your hand. Describe them as cool, warm, or hot. What did you observe?

<table>
<thead>
<tr>
<th>Surface</th>
<th>Beginning</th>
<th>After 10 minutes</th>
<th>What you observed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Rank the surfaces in order from warmest to coolest after 10 minutes.

<table>
<thead>
<tr>
<th>Surface</th>
<th>Warmest</th>
<th>Warm</th>
<th>Cool</th>
<th>Coolest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.</td>
<td>2.</td>
<td>3.</td>
<td>4.</td>
</tr>
</tbody>
</table>

You will place chips on each surface still in the sun. Try to keep the amount of chips equal on each surface for a fair test. Allow them to sit in the sunlight for 10 minutes. What did you observe?

<table>
<thead>
<tr>
<th>Surface</th>
<th>Warmest</th>
<th>Warm</th>
<th>Cool</th>
<th>Coolest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notes or sketch what you found out.</td>
<td>1.</td>
<td>2.</td>
<td>3.</td>
<td>4.</td>
</tr>
</tbody>
</table>
What’s Hot and What’s Not

Challenge: Choose four surfaces to test how much heat is transferred from the sun to the surface. Ideas include different colors of paper, foil, metal pot or pan, wood, grass, soil, etc. Write the surface names you choose on the chart below.

Put the thermometer on the surface, do not touch for one minute, and record the temperature at the beginning. Do this for each surface.

After 10 minutes, put the thermometer back on each surface in the same place, do not touch for one minute, and record the temperature.

<table>
<thead>
<tr>
<th>Surface</th>
<th>Beginning Temperature Fahrenheit degrees</th>
<th>Beginning Temperature Celsius degrees</th>
<th>Fahrenheit Temperature after 10 minutes</th>
<th>Celsius Temperature after 10 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What did you observe about the surface temperatures?

Rank the surfaces in order from warmest to coolest after 10 minutes.

<table>
<thead>
<tr>
<th>Surface</th>
<th>Warmest</th>
<th>Warm</th>
<th>Cool</th>
<th>Coolest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.</td>
<td>2.</td>
<td>3.</td>
<td>4.</td>
</tr>
<tr>
<td>Temperature (F, C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

You will place chips on each surface. Try to keep the amount of chips equal on each surface for a fair test. Allow them to sit in the sunlight for 10 minutes. What did you observe?

<table>
<thead>
<tr>
<th>Surface</th>
<th>Warmest</th>
<th>Warm</th>
<th>Cool</th>
<th>Coolest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes
What’s Hot and What’s Not Data

Remember to include the important details of a bar graph:

Title

Headings across the top

Temperature readings down the sides

Fahrenheit and Celsius with degree symbol: °

<table>
<thead>
<tr>
<th>Surface</th>
<th>Beginning Temperature F.</th>
<th>Temperature after 30 minutes F.</th>
<th>Beginning Temperature C.</th>
<th>Temperature after 30 minutes C.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Choose the data set from the warmest and the coolest surface. Graph data from the table using Fahrenheit or Celsius.

Title

<table>
<thead>
<tr>
<th>Temp.</th>
<th>Start</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td></td>
<td></td>
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<tr>
<td>75</td>
<td></td>
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<tr>
<td>70</td>
<td></td>
<td></td>
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<tr>
<td>65</td>
<td></td>
<td></td>
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<tr>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55</td>
<td></td>
<td></td>
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<tr>
<td>50</td>
<td></td>
<td></td>
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<tr>
<td>45</td>
<td></td>
<td></td>
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<tr>
<td>40</td>
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<tr>
<td>35</td>
<td></td>
<td></td>
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<tr>
<td>30</td>
<td></td>
<td></td>
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<tr>
<td>25</td>
<td></td>
<td></td>
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<tr>
<td>20</td>
<td></td>
<td></td>
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<tr>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Next Step Investigation

Name ____________________________
Here’s the challenge! Now use common household materials to design a structure that will change the amount of melting of the chips or the time it takes to melt the chips. List the materials you could use in your structure. Ideas include foil, cardboard, pots/pans, Styrofoam or paper cups, glass or plastic bowls, a frame with towels over it, etc.

1. I will use these materials:

2. Sketch your design on the back of this handout and then build the structure.

3. Try it out: I will put the chips inside the structure for ____ minutes. I will draw or take a picture of the chips before and after.

4. Modify the design until you can see clear results showing that the structure made a difference. Show changes on the drawing that you made on the back of this handout.

This is how I will know that my changes made a difference:

5. Show your evidence by timing when you checked, recording the time before and after, making routine checkpoints, showing the results, etc.

<table>
<thead>
<tr>
<th>Shelter</th>
<th>Before</th>
<th>After</th>
<th>What I found out</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. Writing your conclusion. What worked? What didn’t work as well?

Future ideas: What else would you like to try?
1. Use the number scales on the thermometers to find the matching temperatures. Fill in the blanks.

   \[20^\circ C = \underline{\phantom{0}}^\circ F\]  \[50^\circ F = \underline{\phantom{0}}^\circ C\]  \[30^\circ C = \underline{\phantom{0}}^\circ F\]

2. Color in the thermometers above to show the readings listed.
3. What is the temperature outside today? Give the readings in °C and °F.
4. Is today’s temperature hot, warm, cool, or cold?
5. Does the temperature stay the same all day? Why or why not?
6. Color in the thermometer to show your favorite temperature.
7. What is the temperature reading?
8. Why is this your favorite temperature?
Some materials do not conduct heat. They are used to keep heat in or to keep heat out. Let’s find out more about insulators.

We found out that some objects feel cool to the touch even though they are the same temperature in the room as other objects that didn’t feel as cool to the touch. Those materials that did not feel as cool to the touch do not conduct heat well. We call them insulators.

Use cups of different materials, such as Styrofoam, paper, ceramic, plastic, etc. Use the same amount of water (such as ½ cup of water) that is the same temperature (such as ice water or warm water) for a fair test. We are investigating how well a cup material insulates or conducts heat.

If the cup allows the water to change temperature quickly, it is not a good insulator.

Measure the temperature of the water. Pour ½ cup of the water into each cup. Let the cups sit in the same place for minutes. Measure the temperature of the water every 5 minutes. Sequence the cups to show the best to the worst insulators.

<table>
<thead>
<tr>
<th>Cup material</th>
<th>Beginning Temperature of water</th>
<th>Temperature after 5 minutes</th>
<th>Temperature after 10 minutes</th>
<th>Temperature after 15 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Write the cup material in order from best insulator to worst insulator.

<table>
<thead>
<tr>
<th>Best</th>
<th></th>
<th></th>
<th></th>
<th>Worst</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Interview

Choose who you want to chat with about temperature control in the past. You will use these ideas to put together an illustrated booklet, a video, or presentation on how the use of insulators and conductors have changed over the years.

I chose _______________________________________________________

Past:

1. How did the house you grew up in control the temperature?

2. How did you stay warm on very cold days? On very cold nights?

3. How did you stay cool on very hot days? On very hot nights?

Now:

Tell about what you do to stay comfortable on hot and cold days.

Future:

Imagine how scientists will invent things to control temperatures.
Davy Crockett and the Frozen Dawn

A Tennessee Tall Tale

retold by

S.E. Schlosser

One winter, it was so cold that the dawn froze solid. The sun got caught between two ice blocks, and the earth iced up so much that it couldn't turn. The first rays of sunlight froze halfway over the mountain tops. They looked like yellow icicles dripping towards the ground.

Now Davy Crockett was headed home after a successful night hunting when the dawn froze up so solid. Being a smart man, he knew he had to do something quick or the earth was a goner. He had a freshly killed bear on his back, so he whipped it off, climbed right up on those rays of sunlight and began beating the hot bear carcass against the ice blocks which were squashing the sun. Soon a gush of hot oil burst out of the bear and it melted the ice. Davy gave the sun a good hard kick to get it started, and the sun's heat unfroze the earth and started it spinning again. So, Davy lit his pipe on the sun, shouldered the bear, slid himself down the sun rays before they melted and took a bit of sunrise home in his pocket.

Babe the Blue Ox

Minnesota Tall Tales

retold by

S. E. Schlosser

Well now, one winter it was so cold that all the geese flew backward, and all the fish moved south and even the snow turned blue. Late at night, it got so frigid that all spoken words froze solid afore they could be heard. People had to wait until sunup to find out what folks were talking about the night before.

Paul Bunyan went out walking in the woods one day during that Winter of the Blue Snow. He was knee-deep in blue snow when he heard a funny sound between a bleat and a snort. Looking down, he saw a teeny-tiny baby blue ox jest a hopping about in the snow and snorting with rage on account of he was too short to see over the drifts.

Paul Bunyan laughed when he saw the spunky little critter and took the little blue mite home with him. He warmed the little ox up by the fire and the little fellow fluffed up and dried out, but he remained as blue as the snow that had stained him in the first place. So, Paul named him Babe the Blue Ox.
I Wonder and I Investigate

What do you want to know about keeping an ice cube from melting or keeping water from freezing?

I wonder if

1. Plan how you could find out the answer.

2. Materials I will use

3. What I will do

4. What I will measure

5. What happened
   a. Good
   b. Not so good

6. What I found out

7. What I would change
Assessment Ideas

1. Franklin noticed that the cooking pans had handles that were not metal. He wanted to know why. What is one way he could investigate safely?
   a. Use a stopwatch to measure how long it takes for water to boil.
   b. Put the cooking pan out in the sun and check the temperatures of the handle and the pan.
   c. Put the cooking pan in the refrigerator and check the temperatures of the handle and the pan.
   d. Answers b and c

2. Jerald's hot chocolate is too hot to drink, so he puts an ice cube in it. Why does the drink get cooler?
   a. Heat from the ice is transferred to the drink
   b. Heat from the drink is transferred to the ice,
   c. The ice gives the drink a larger volume.
   d. The ice gives the drink a pale color.

3. A fire is burning in the fireplace. You can use it to warm your hands because fire is an example of
   a. Solar energy
   b. Nuclear energy
   c. Electrical energy
   d. Heat energy

4. Use the chart to answer the question.

   Average Temperature in Pine River Pond

<table>
<thead>
<tr>
<th>Depth of Pond (meters)</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Temperature (°C)</td>
<td>17</td>
<td>14</td>
<td>10</td>
<td>?</td>
<td>4</td>
</tr>
</tbody>
</table>

   The average temperature at 8 meters would be about
   a. 12° C.
   b. 10° C.
   c. 7° C.
   d. 3° C.

5. Leo learned that electric current makes heat. What question did he ask to find this out?
   a. Why does water freeze into ice?
   b. Why does my bed feel warmer with a blanket?
   c. Why do toasters get hot?
   d. Why do I wear a jacket when it is cool outside?

6. Which tools should you use to find out how long it takes a tray of ice to melt and reach a temperature of 10° C?
   a. Telescope and beaker
   b. Watch and centimeter ruler
   c. Scale and thermometer
   d. Watch and thermometer
7. Ken put a thermometer in a glass filled with hot water. Why does the liquid inside the thermometer rise?
   a. Gravity pushes it up.
   b. Air bubbles are released.
   c. Heat from the water makes it expand.
   d. Air pressure above the water pulls it up.

8. The group of students collected an aluminum pan, a paper plate, a wooden bowl, and a can of soup. They laid the items on the sidewalk in the bright sunlight with a thermometer on top of each. What were they investigating?
   a. They wanted to find out if the items made different sized shadows.
   b. They wanted to find out if the items would float or sink in water.
   c. They wanted to find out if the items get warmer at different rates.
   d. They wanted to find out if the items would cool at different rates.

9. The teacher put the following items on a table in the classroom and left them all afternoon: a wool sweater, a washcloth, a cooking pan, and a notebook. She put a thermometer under each item. What happened to the temperatures of under each item?
   a. The temperature under the wool sweater was warmer than the others.
   b. The temperature under the cooking pan was warmer than the others.
   c. The temperature under the notebook was cooler than the others.
   d. All of the items were the same temperature.

10. Jo’s hot chocolate is too hot to drink, so she puts an ice cube in it. The temperature of the drink decreases as the heat loses energy by melting the ice. What question matches this concept?
    a. Why does the hot chocolate change color?
    b. Why does the hot chocolate get cooler?
    c. Why does the hot chocolate taste different?
    d. Why was the hot chocolate too hot?

11. Mitch used a watch and a thermometer to collect information. What question was Mitch trying to answer?
    a. How much water will the container hold?
    b. How long will it take the water to reach 10° C. in the freezer?
    c. Where do I put the container of water in the freezer?
    d. Where do I put the thermometer in the container?

12. Metal pans for cooking often have handles that are not metal. What question matches the reason?
    a. Why does metal heat more slowly than wood?
    b. Do metal pans for cooking change weight when they are heated?
    c. Why is the handle different from the metal pan?
    d. What materials are better conductors of heat?

13. What happens when a hot rock is put in cold water?
    a. The water gets warmer and the rock cools down.
    b. The water cools down and the rock gets warmer.
    c. The water and the rock both get warmer.
    d. The water and the rock both get cooler.
14. On a sunny day, which takes longest to get warm?
   a. The rocks
   b. The sand
   c. The lake
   d. The sidewalk

15. Bill’s science class is doing an experiment with solar heating using milk cartons and water to see what happens when the carton is placed in the sun for two hours. What tools will Bill need to gather information from his experiment?
   a. Measuring cup and thermometer
   b. Telescope and thermometer
   c. Magnifying glass and thermometer
   d. Watch and centimeter ruler

16. Why does a scientist use a thermometer instead of a hand to measure temperature?

17. Why is it important to know the temperature?

18. Why is it important to know the difference between a material that conducts and a material that insulates? Give an example of each.

19. What are two things you could do to melt an ice cube faster?
   a. Put it in water
   b. Chop it into smaller pieces
   c. Put it in the refrigerator
   d. Insulate it

20. Memara took a thermometer to the playground to measure the temperature of different locations on a sunny day. Where was the temperature the warmest?
   a. The metal pipes of the swing set
   b. The grass around the swing set
   c. The surface of the soil under the swings
   d. The wooden seat of the swing

21. Juan wanted to use the thermometer to measure a container of water. What would you tell him?
   a. Hold the thermometer with your hand when you measure.
   b. Put the thermometer in place and take it out of the container to read the temperature.
   c. Hold the container with your hand as you measure so that it won’t spill.
   d. Move your head close to the thermometer instead of touching the thermometer or container.

22. Alyssia and Roberto were searching for heat sources. Roberto said that his hands got warmer when he rubbed them together very quickly. What heat source was Roberto explaining?
   a. Electrical
   b. Solar
   c. Nuclear
   d. Friction

23. Ken put a thermometer in a glass filled with hot water. Why does the liquid inside the thermometer rise?
   a. Gravity pushes it up.
   b. Air bubbles are released.
c.  Heat from the water makes it expand.
d.  Air pressure above the water pulls it up.

Other items

24.  Why do we use a thermometer?
25.  When is it important to know the temperature?
26.  What could you do to make an ice cube melt faster?
27.  Why do parts of your desk feel like they are different temperatures?
28.  What is insulation and why do we use it?
29.  Name five heat sources.
30.  Name four objects that are good conductors of heat.
Performance Task
You are packing a picnic lunch for your family before you leave for your trip to the park. Your family will eat the lunch hours later when you arrive.
You must make sure that the lunch is packed safely so that your family does not get sick. Cold things need to be the right temperature.

- How can you make the ice last?
- How can you keep things cold?
- What are good ways to insulate?

1. You will participate in a race to figure out how to keep an ice cube from melting longer than someone else.

2. Write a plan to explain how to keep the ice cube from melting. Use what you have learned about insulators and conductors from your past data and investigations.

3. Explain how you will collect data to see what insulator worked best. What will you measure?

4. What did you find out? Use your data to explain your reasoning.
## Sample Rubric

<table>
<thead>
<tr>
<th></th>
<th>1 Poor</th>
<th>2 Fair</th>
<th>3 Good</th>
<th>4 Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation</td>
<td>Refused/did not join in task</td>
<td>Watched others work on task</td>
<td>Worked on task part of the time</td>
<td>Stayed on task until completion</td>
</tr>
<tr>
<td>Cooperation</td>
<td>Would not share with or listen to others (caused a disturbance)</td>
<td>Did not participate in discussions</td>
<td>Shared/listened part of the time</td>
<td>Listened and shared with others</td>
</tr>
<tr>
<td>Science knowledge</td>
<td>Did not show any concept of understanding</td>
<td>Tried but did not show correct understanding</td>
<td>Showed partial understanding of concept</td>
<td>Demonstrated an understanding of the concept</td>
</tr>
<tr>
<td>Science language</td>
<td>Did not use any science vocabulary</td>
<td>Used vocabulary incorrectly</td>
<td>Used some of the vocabulary correctly</td>
<td>Demonstrated an understanding of the vocabulary</td>
</tr>
<tr>
<td>Productivity</td>
<td>Did not accomplish goal</td>
<td>Barely accomplished task</td>
<td>Just did what was required</td>
<td>Was highly productive</td>
</tr>
<tr>
<td>Effective Use of Time</td>
<td>Time without purpose</td>
<td>Got off track frequently</td>
<td>Did well once ideas were clear</td>
<td>No wasted effort—stayed on target</td>
</tr>
</tbody>
</table>

## Sample Rubric for Projects

<table>
<thead>
<tr>
<th></th>
<th>1 Poor</th>
<th>2 Fair</th>
<th>3 Good</th>
<th>4 Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science knowledge</td>
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</tr>
<tr>
<td>Level of completion</td>
<td>Did not complete assignment</td>
<td>Partial completion of assignment</td>
<td>Met the basic requirements of the assignment</td>
<td>Exceeded the requirements</td>
</tr>
<tr>
<td>Communication of results</td>
<td>Did not give any conclusions or reasoning</td>
<td>Showed some work, but did not fully explain or conclude</td>
<td>Answered the questions asked</td>
<td>Provided written reasoning, conclusion and showed data in chart/table/graph format</td>
</tr>
</tbody>
</table>

Georgia Department of Education
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