Heat

Major Topic and SOL Heat

Science SOL PS.7 a, b, c, and d

Length of Unit **4- 90 minute class periods**

Major Understanding

Students will…

- distinguish between heat and temperature.
- compare and contrast Celsius and Kelvin temperature scales and describe absolute zero.
- illustrate and explain the effect of the addition or subtraction of thermal energy on the motion of molecules.
- analyze a time/temperature graph of a phase change experiment to determine the temperature at which the phase change occurs (freezing point, melting point, or boiling point).
- compare and contrast methods of thermal energy transfer (conduction, convection, and radiation) and provide and explain common examples.
- explain, in simple terms, how the principle of thermal energy transfer applies to heat engines, thermostats, refrigerators, heat pumps, and geothermal systems.
- design an investigation from a testable question related to thermal energy transfer. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis.

Essential Questions

- How can you describe the difference between heat and temperature?
- How can you describe when a phase changes occurs?
- What do you find unique about heat?

Student Objectives

Students will be able to…

- Celsius and Kelvin temperature scales and absolute zero.
- Phase changes, freezing point, melting point, boiling point, vaporization, and condensation.
- Conduction, convection, and radiation.
- Applications of thermal energy transfer.

Lesson Contributed by: Lisa Fain
Funded through 2012 Mathematics and Science Partnership Grant, INSPIRS

Bloom's Taxonomy Skills	**21st Century Learning Skills**
• Creating • Evaluating • Analyzing • Understanding • Remembering • Applying	• Critical Thinking • Problem Solving • Communication • Creativity & Innovation • Collaboration • Contextual Learning

Assessment Evidence

Other Evidence

- Discussion (written or oral)
- Class Participation
- Teacher Observations
- Notebooks
- Writing assignments
- Laboratory assignments/reports
- Group Work
- Rubrics

Technology Computer, Internet Connection, Probeware

Internet Resources

- Convection of Mantle: http://en.wikipedia.org/wiki/Mantle_(geology)#Movement
- Simulations: http://phet.colorado.edu
- Vernier Lab: Boiling Temperature of Water

Supplies/Materials

Lesson 1:

- Copiers of "Measuring Temperature" Lab
- 2 plastic cups (per group)
- Heat Lamp (per group)
- Light Sand
- Dark Sand
- 2 thermometers (per group)
- Copies of "Measuring Temperature of Color" Lab
- 3 plastic cups (per group)
- Heat Lamp (per group)
- 3 different colors of sand

- 3 thermometers (per group)
- Copies of Rubric

Lesson 2:

- Soda Can
- Water
- Salt
- Crushed Ice
- Stirring Stick
- Plastic Spoon
- Copies of States of Matter
- Copies of Boiling Temperature of Water Lab
- For each lab group:
- Vernier interface
- Vernier Temperature Probe
- 250 ml beaker
- ring stand
- utility clamp
- hot plate
- water
- Equipment from Boiling Temperature of Water
- 1 Tablespoon of rock salt
- Copies of Rubric

Lesson 3:

- Dry Erase Boards (per group)
- Dry Erase Marker (per group)
- Heat Lamp
- Piece of Card Stock
- Jar of Hot water
- Beaker of Chicken Noodle Soup
- Hot plate
- Copies of “Heat Activities”
- Copies of “Heat Transfer”
- Copies of Rubric

Lesson 4:

- Rubber Bands
- Copies of “Rubber Band Experiment” Sheet
- Computers
- Vernier Temperature Probes
- Styrofoam cups
- Film canisters
- Yeast
- Hydrogen Peroxide
- Copies of “Taking the Temperature” Lab

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- Copies of Rubric

Lesson 1: How Cold is Cold? (1 – 90 minute class)

Engage:

- Have a class discussion:
  - How hot is hot? How cold is cold? Could your students tell the exact room temperature, or the temperature outside if someone were to ask? The degree of how cold or hot an object is called "temperature". Typically a thermometer is used to measure temperature. A thermometer works by undergoing physical changes. In a typical laboratory thermometer, the liquid – either mercury or alcohol – that is sealed in a glass tube expands or contracts at a uniform rate over a range of temperatures. When a thermometer is exposed to heat, the liquid inside of it expands and rises in the tube. Conversely, when the thermometer is exposed to cold, the liquid will contract and fall in the tube. To measure the change in rise or fall of the liquid, a "scale" is used. The metric system uses the Celsius scale and the symbol °C is placed after the temperature measured.

Explore:

- Have your students complete the "Measuring Temperature" Lab (attached).

Explain:

- Discuss with students why the dark sand had a higher temperature after 10 minutes.
- Ask the class: Why do people wear light – colored clothes in the summer and dark – colored clothes in the winter? In what ways is color related to heat absorption?

Elaborate:

- Have students complete "Measuring Temperature of Color" Lab (attached) using their choice of sand color and have the class compare the different results.

Evaluate:

- Discuss with the students their findings in the lab and look for understanding of absorption of heat and radiation of heat.
- Follow weighted rubric for this lesson(attached)

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Lesson 2: What's the Matter? (1-90 minute class)

Engage:

- Set the stage by show the class the soda can.
- Explain to the students that you will mixing ice and salt inside the can to see what happens.
- Set up Demo:
    - 1. Put 5 tbsp. of salt into the can.
    - 2. Add crushed ice to fill the can up half way.
    - 3. Stir the salt and ice mixture with the stir stick.
    - 4. Observe what happens.
- While you are setting up the demo say to the class "I am going to try to make water that is in the air change state. Right now around us it is a gas – water vapor. What other states can it turn into?"
- Brainstorm some ways that students have seen water change states. Identify how water has changed states.
- Once the brainstorming session is over take a look at the can. Frost will have formed on the bottom half of the can that contains the salt and ice. Water vapor changes directly to solid ice.
- Ask: Why did we see this happen?
- Explain what happen: Frost forms because the ice and salt mixture is very cold, and cools the can enough so that the water vapor that is in contact with the can freezes without ever going through the liquid state of water. Notice no frost forms on the upper part of the can.

Explore:

- Give each student a copy of "States of Matter" (attached). Have them follow the procedure and allow them explore the "States of Matter" simulation on http://phet.colorado.edu (directions on handout).

Explain:

- Have students complete the Boiling Temperature of Water from Vernier Physical Science lab (attached).
- Make sure that students complete the questions and print a copy of their graphed data.

Elaborate:

- Have students complete the same procedure for the Boiling Temperature of Water, however, they need to add one tablespoon of rock salt to their beaker of water and determine it's boiling temperature in the same manner that they did for the water.

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- Make sure that they print off a copy of their graphed data.

Evaluate:

- Follow weighted rubric for this lesson (attached).
- Discuss with students their finding to the different labs that they complete.
- Look for student understanding of phase change diagrams and the reasoning for the leveling off of the temperature vs. time graph during the phase changes.

Lesson 3: Ms. Sunshine (1- 90 minute class)

Engage:

- **Skit:** Narrator; Main Character (Ms. Sunlight). Select 1 student to be in the skit and act out the role of Ms. Sunlight as the teacher reads the Narrator's part.
- Tell the student they are going to be doing a skit. Watch for situations where heat is being transferred.
  - *NARRATOR: It is summer, and look, there's Ms. Sunlight all kicked back in her lounge chair, enjoying her vacation, complete with her sunglasses and summer wear. Oh, how she is enjoying those sun rays. Hours go by, and she is feeling so hot, so thirsty for a cool drink. As she goes to find something to quench her thirst – ouch, it seems that the sand has burned her tender little feet! Oh, poor Ms. Sunlight. Once her feet are feeling better, she gets a cold drink. She sets her drink in the hot sand. As she sips her drink, the drink is cold on top and warm on the bottom – but then it starts feeling warm on top.*

  ****End of Skit****

  - *NARRATOR: We've just demonstrated, through our skit, the three types of heat transfer. We'd like for you and a partner to discuss where you saw examples of heat transfer, describing at least one heat transfer on your whiteboard.*
- Have students show their boards. Have one set of students share one description of heat transfer, then ask:
  - *Who else saw that one?*
  - *Someone share a different example of heat transfer; raise your hand if you have that one, etc.*

Note: Students will learn the proper terms of the three types of heat transfers in this lesson. Avoid telling them the answer at this time. Consider using the skit again at the end of the lesson to assess students' understanding and their use of proper terminology.

Explore:

- Students will be exploring three stations showing different ways heat is transferred from one object to another. Explain the stations:

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- **Station #1** – Heat lamp: hold your hands about 6 inches from the lamp. Have a partner hold a card stock over one of your hands for the count of 10 and then remove the card stock. Think about how the heat was getting to your hand.
- **Station #2** – Jar of hot war: Put your hand on the jar. Think about how the heat from the jar is getting to your hand.
- **Station #3** – Beaker of Chicken Noodle soup on hot plate: Observe what happens to the bits in the soup. You will draw and label what you see. Think about what is causing the bits of soup to go up and down.

- Distribute "Heat Activities" (attached) to students. Assign students to stations.
- Rotate through stations (you will have about 8 minutes per station) and on the "Heat Activities" sheet, answer for each station up to "Definition" and "Examples." We will answer these together. Once students have complete all three stations discuss with them:

  - Station #1- How does the heat get to your hand?
  - Station #1 is an example of radiation. On your definition line write the following (and write on the board for students to copy): Radiation is the transfer of heat through space between objects that are not touching. What are some examples of radiation?
  - Station #2 – How is the heat from the jar getting to your hand?
  - Station #2 is an example of conduction. Conduction is heat transferring through direct contact of a warmer object to a cooler one.
  - What are some examples of conduction?
  - Station #3 – What did you notice that the noodles in the soup were doing?
  - Station #3 is an example of convection. Convection is heat transfer through a liquid creating a current as cold, denser matter displaces warm less dense matter.
  - What are some examples of convection?

Explain:

- Distribute the assessment: "Heat Transfer" (attached)
- Ask students to write which type of heat transfer is being shown in the picture.
- Once everyone has completed identifying the pictures, ask students to talk with a partner and take turns to explain each type of heat transfer.
- Discuss or do the skit again and ask students to name the type of heat transfer.

Elaborate:

- Have students answer the question on the bottom of the student sheet, "Heat Transfer." Allow them to use their textbook or other resources.

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- Expand on convection in the mantle. For technical information for the teacher go to: http://en.wikipedia.org/wiki/Mantle_(geology)#Movement

Evaluate: Follow weighted rubric for this lesson (attached).

Lesson 4: Can You Feel the Heat? (1 -90 minute class)

Engage:

- Discuss with students the word "energy". Discuss how it is related to heat. Look around the room, what kinds of energy are in the room?
- Discuss how energy can change from on form to another form.

Explore:

- Have the students do the Rubber Band Experiment:
    1. Give each student a rubber band and the worksheet (attached) for the rubber band experiment. Have them hook it around their thumbs and hold it so it is taut, but not stretched.
    2. Have the student touch the rubber band to their forehead and pay attention to its temperature.
    3. Have student stretch the rubber band out about 20-cm or so and then immediately touch it to their forehead. Ask the students if the rubber band feels colder or warmer? Have them record their answer in Chart A.
    4. Have the students return the rubber band to its normal size.
    5. Have each student do this 3 times and record their results. As a group they should discuss their findings.

Explain:

- As a class discuss the findings of the groups:
    - Did the rubber band feel warmer or colder?
    - Why would it have changed temperature to begin with?
    - How does this pertain to the materials that make-up the rubber band?

Elaborate:

- Have students complete "Taking the Temperature" experiment (attached).

Evaluate:

- Follow weighted rubric for this lesson (attached).

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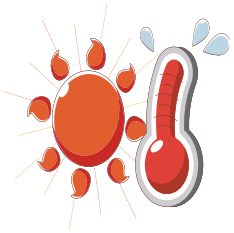


Name_____

Date_____

Heat Unit

Lesson 1

Measuring Temperature Lab

Materials

- 2 plastic cups
- Heat Lamp
- Light Sand
- Dark Sand
- 2 thermometers

Process

1. Obtain two plastic cups and label one “light sand” and the other “dark sand”.
2. Pour 4 cm of light sand into the cup. Use a ruler to assist in this measurement.
3. Do the same for the dark sand.
4. Place a thermometer into the center of each cup and halfway down into the sand. Record the initial temperature reading of each cup of sand.
5. Place a heat lamp 20 cm over the top of the cups.
6. Turn on the lamps and record the temperature of the sand every 2 minutes for 10 minutes (using a stop watch).
7. After 10 minutes, turn off the lamp and remove it. Allow the cups to sit for 5 minutes and record the temperature of each cup.

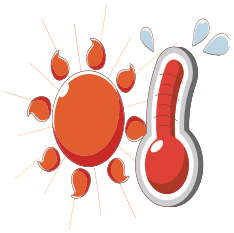
Data Table

	Temperature (°C)	
Time (minutes)	Cup #1 – Light Sand	Cup #2 – Dark Sand
Start		
2		
4		
6		
8		
10		
5 minutes after light is turned off.		

Challenge Question:

1. Which cup got hotter?

2. Did one cup lose more heat than the other cup?



Name_____

Date_____

Heat Unit

Lesson 1

Measuring the Temperature of Color Lab

Materials

- 3 plastic cups
- Heat Lamp
- 3 thermometers
- 3 different color of sand

Process

1. Obtain three plastic cups and label one “red sand”, one “yellow sand”, and the other “blue sand”.
2. Pour 4 cm of sand into the correct cup. Use a ruler to assist in this measurement.
3. Place a thermometer into the center of each cup and halfway down into the sand. Record the initial temperature reading of each cup of sand.
4. Place a heat lamp 20 cm over the top of the cups.
5. Turn on the lamps and record the temperature of the sand every 2 minutes for 10 minutes (using a stop watch).
6. After 10 minutes, turn off the lamp and remove it. Allow the cups to sit for 5 minutes and record the temperature of each cup.

Data Table

	Temperature (°C)		
Time (minutes)	Cup #1 – Red Sand	Cup #2 – Yellow Sand	Cup #3 – Blue Sand
Start			
2			
4			
6			
8			
10			
5 minutes after light is turned off.			

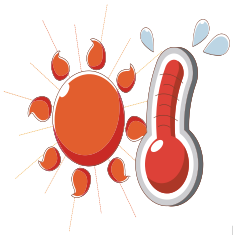
Challenge Question:

1. Which color got hotter?

2. Did one cup lose more heat than the other cups?

3. Why do people were light-colored clothes in the summer and dark-colored clothes in the winter?

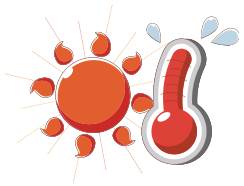
4. In what way is color related to heat absorption?



Name_____

Measuring Temperature Lesson 1 Rubric

	Beginning 1	**Developing 2**	**Accomplished 3**	**Exemplary 4**	**Score**
Participation in Brainstorming Activity 10% of grade for the Lesson	Contributes very little the brainstorming session and is not respectful of others when they are speaking.	Contributes some to the class discussion and is respectful of others when they speak.	Contributes to the class discussion and is respectful of others when they speak.	Contributes a great deal to the discussion and is very respectful of others when they are speaking.	
"Measuring Temperature Lab" 40 % of grade for the Lesson	Follows lab procedure and records observations. No questions have been answered.	Follows lab procedure and records observations. Questions have been answered, however, answers are not reasonable.	Follows lab procedure and records observations. Questions have been answered in complete sentences and answers are mostly reasonable.	Follows lab procedure and records observations. Questions have been answered in complete sentences and all answers are reasonable.	
"Measuring Temperature or Color Lab" 40% of grade for the Lesson	Follows lab procedure and records observations. No questions have been answered.	Follows lab procedure and records observations. Questions have been answered, however, answers are not reasonable.	Follows lab procedure and records observations. Questions have been answered in complete sentences and answers are mostly reasonable.	Follows lab procedure and records observations. Questions have been answered in complete sentences and all answers are reasonable.	
Participation in class discussion of labs 10% of grade for the Lesson	Contributes very little the brainstorming session and is not respectful of others when they are speaking.	Contributes some to the class discussion and is respectful of others when they speak.	Contributes to the class discussion and is respectful of others when they speak.	Contributes a great deal to the discussion and is very respectful of others when they are speaking.	
Total / Grade					



Name _____

Period _____

States of Matter

Learning Goal:

Students will be able to describe the particulate model of matter for a solid liquid and gas. Students will understand the arrangement, motion, and energy of the particles in each phase.

- How the molecules in a solid, liquid and gas compare to each other.
- How temperature relates to the kinetic energy of molecules.

Procedure:

- Open the internet browser and enter the address: http://phet.colorado.edu
- Click on "Play with Sims" and select "Chemistry" from the menu on the left.
- Open the "States of Matter" Simulation and select "Run Now"

Investigation:

1. Predict what the molecules of a solid, liquid and gas look like. Illustrate your prediction with a drawing.

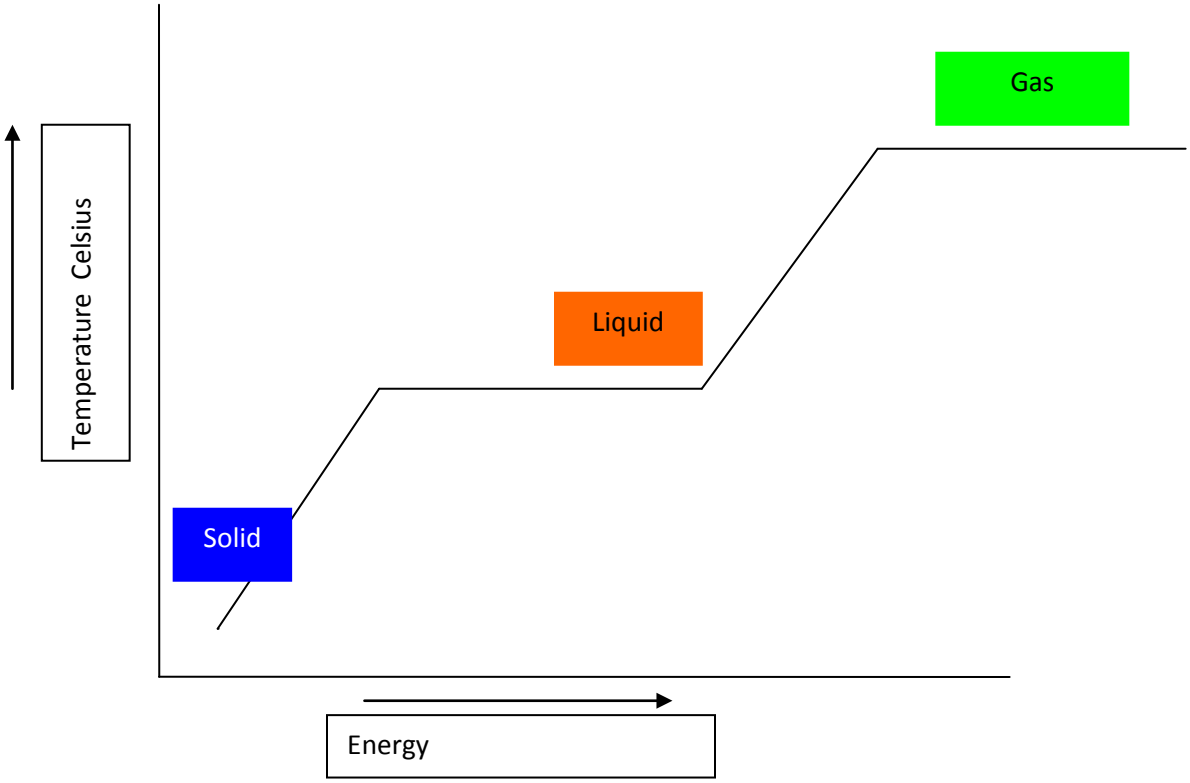
Solid Liquid Gas

1a. Predict how a change in temperature (heat or cold) will effect each phase change.

2. Complete the table below by exploring the "Solid, Liquid, Gas" tab in the simulation. **Test** your predictions and record your observations by recording the temperature and illustrations of each substance in the three states of matter.

Substances	**Observations**		
	Solid	**Liquid**	**Gas**
Neon	Temperature: Illustration:	Temperature: Illustration:	Temperature: Illustration:
Argon	Temperature: Illustration:	Temperature: Illustration:	Temperature: Illustration:
Oxygen	Temperature: Illustration:	Temperature: Illustration:	Temperature: Illustration:
Water	Temperature: Illustration:	Temperature: Illustration:	Temperature: Illustration:

3. Interpret the graph of Kinetic Energy vs. Temperature.
Using the graph describe the relationship between Kinetic Energy and Temperature.



4. Write a conclusion, using the simulation and graph.
Use what you have learned in this activity to support the following two statements.

- How the molecules in a solid, liquid and gas compare to each other.
- How temperature relates to the kinetic energy of molecules.

Boiling Temperature of Water

The physical properties of a pure substance can be used to identify the substance and distinguish it from other pure substances. Boiling temperature is one such physical property. Boiling is characterized by the formation of vapor bubbles within the liquid phase as a substance changes from a liquid to a gas. In this experiment, you will study the boiling of water.

OBJECTIVES

In this experiment, you will

- Observe the boiling of water.
- Use a computer to make measurements.
- Analyze the data.
- Graph the data.
- Use the graph to make conclusions about boiling.
- Determine the boiling temperature of water.
- Apply the concepts studied in a new situation.

MATERIALS

computer
Vernier computer interface
Logger*Pro*
Vernier Temperature Probe
250 mL beaker
ring stand
utility clamp
hot plate
water
*1 tablespoon of rock salt for extension

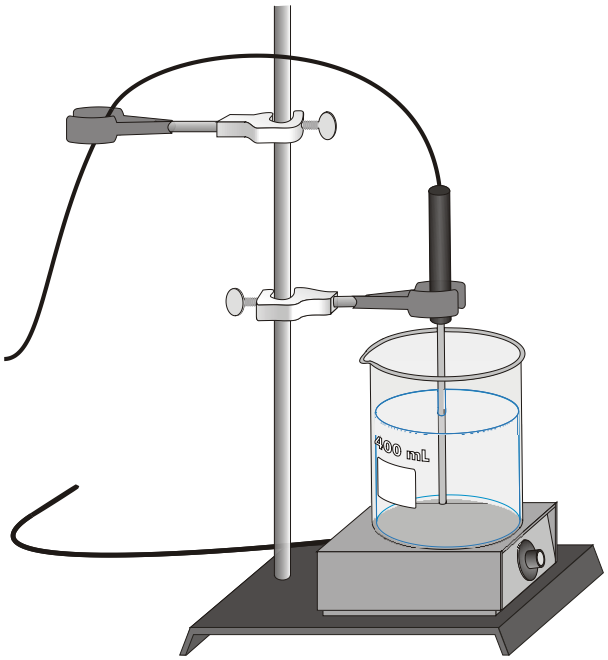


Figure 1

PROCEDURE

1. Obtain and wear goggles. **CAUTION:** Handle hot water and hot equipment with care throughout the experiment.
2. Prepare the water sample.
   a. Arrange a hot plate next to the base of a ring stand.
   b. Fill a 250 mL beaker 2/3 full with hot tap water.
   c. Place the 250 mL beaker on the hot plate. Turn the hot plate to the temperature setting suggested by your teacher.
   d. Use a utility clamp to suspend a Temperature Probe on the ring stand as shown in Figure 1. The tip of the probe should be 1-2 cm above the bottom of the beaker. **CAUTION:** *Do not burn yourself or melt a probe wire with the hot plate*!
3. Connect the Temperature Probe to the computer interface. Prepare the computer for data collection by opening the file "02 Boiling Temperature" from the *Physical Science w Vernier* folder.
4. Click ▶ Collect to begin data collection.
5. Record your observations as the water is heated to its boiling temperature and boils. When the water begins to boil, turn the hot plate setting down to a setting just high enough to maintain boiling.
6. When the water has boiled with noticeable bubbling for six minutes, click ■ Stop to end data collection. Turn off the hot plate and remove the Temperature Probe from the boiling water. Allow the beaker, water, and hot plate to cool before handling them.
7. On the displayed graph, analyze the flat part of the curve to determine the boiling temperature of water:
   a. Move the mouse pointer to the beginning of the graph's flat part. Press the mouse button and hold it down as you drag across the flat part to *select* it.
   b. Click on the Statistics button, . The mean temperature value for the selected data is listed in the statistics box on the graph. Record this value as the boiling temperature in your data table.
8. Print copies of the graph as directed by your teacher.

OBSERVATIONS

DATA

Boiling temperature of water _____ °C

PROCESSING THE DATA

1. Describe your temperature *vs.* time graph.

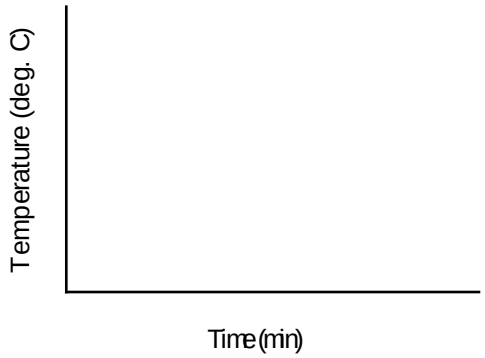
2. What happened to the temperature of the water as it was heated prior to boiling?

3. What happened to the temperature of the water as it boiled?

4. According to your data, what is the boiling temperature of water?

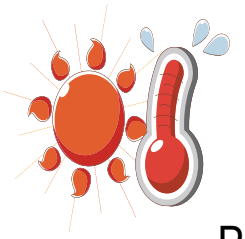
5. Your water sample experienced a wide range of temperatures during this experiment, yet we can correctly speak of its boiling "temperature." Explain.

6. The normal boiling temperature of isopropyl alcohol is 82°C. In the space to the right, sketch and label a graph for the boiling of isopropyl alcohol. Use a starting temperature of 20°C. Identify the boiling temperature on the graph.



EXTENSION

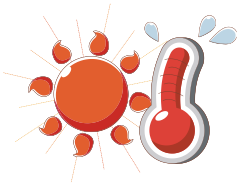
1. Determine the boiling temperature of water with 1 tablespoon of rock salt.



Name_____

Phase Changes of Matter Lesson 2 Rubric

	Beginning 1	**Developing 2**	**Accomplished 3**	**Exemplary 4**	**Score**
Participation in Brainstorming Activity 10% of grade for the Lesson	Contributes very little the brainstorming session and is not respectful of others when they are speaking.	Contributes some to the class discussion and is respectful of others when they speak.	Contributes to the class discussion and is respectful of others when they speak.	Contributes a great deal to the discussion and is very respectful of others when they are speaking.	
"States of Matter" activity 25 % of grade for the Lesson	Answers are not in completes sentences and are not reasonable. All observations are not clearly recorded.	Answers are in complete sentences but are not reasonable. All observations are recorded.	Answers are in complete sentence and are mostly reasonable. All observations are recorded.	Answers are in complete sentences and are reasonable. All observations are recorded.	
Boiling Temperature of Water 40% of grade for the Lesson	Follows lab procedure and records observations. Processing the data is not in complete sentences and no hand drawn graph for question #6. No printed graph of data.	Follows lab procedure and records observations. Processing the data is in complete sentences, but answers are not reasonable. Hand drawn graph for questions #6. Printed graph of data.	Follows lab procedure and records observations. Processing the data is in complete sentences and answers are mostly reasonable. Hand drawn graph of questions #6. Printed graph of data.	Follows lab procedure and records observations. Processing the data is in complete sentences and all answers are reasonable. Hand drawn graph for question #6. Printed graph of data.	
Extension to Boiling Temperature of Water 25% of grade for the Lesson	Does not complete extension problem.	Completes extension problem. No record of boiling temperature of salt water and not printed graph of data.	Completes extension problem. Record of boiling temperature of salt water. No printed graph of data.	Completes extension problem. Record of boiling temperature of salt water. Printed graph of data.	
Total / Grade					



Name_____
Date_____

Heat Unit
Lesson 3

Heat Activities

Station 1: Heat Lamp
Describe what happened when you placed your hand under the card stock:

How is heat getting to your hand?

Definition:

Examples:

Station 2: Conduction

Describe what happened when you placed your hand on the jar.

How is the heat from the jar getting to your hand?

Definition:

Examples:

Station 3: Convection

Describe what you observe in the glass container.

Draw and label what you see.

Definition:

Examples:

Name_____

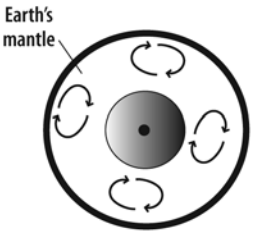
Date_____

Heat Unit

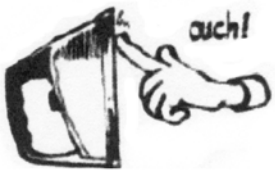
Lesson 3

Heat Transfer

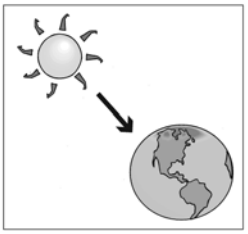
The following pictures show the different types of heat transfer. Review each picture and determine which type of heat transfer is correct. Is it RADIATION, CONDUCTION, or CONVECTION? Write the correct response under each picture.



1. _____



2. _____



3. _____

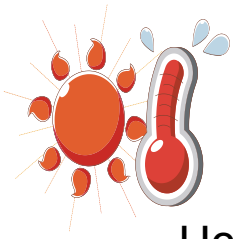
4. _____

5. _____

6. _____

Radiation, conduction, and convection — what processes of heat transfer apply to:

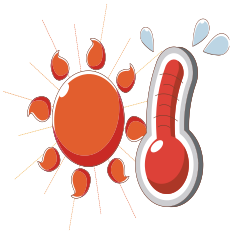
- the weather?
- Earth's mantle?
- ocean or lake currents?



Name_____

Heat Activities and Transfers Lesson 3 Rubric

	Beginning 1	**Developing 2**	**Accomplished 3**	**Exemplary 4**	**Score**
Participation in Skit Activity 10% of grade for the Lesson	Contributes very little the skit session and is not respectful of others when they are speaking.	Contributes some to the class discussion about the skit and is respectful of others when they speak.	Contributes to the class discussion about the skit and is respectful of others when they speak.	Contributes a great deal to the discussion about the skit and is very respectful of others when they are speaking.	
"Heat Activities" 50 % of grade for the Lesson	Follows lab procedure and records observations. No questions have been answered.	Follows lab procedure and records observations. Questions have been answered; however, answers are not reasonable.	Follows lab procedure and records observations. Questions have been answered in complete sentences and answers are mostly reasonable.	Follows lab procedure and records observations. Questions have been answered in complete sentences and all answers are reasonable.	
"Heat Transfers" 30% of grade for the Lesson	No questions have been answered.	Questions have been answered; however, answers are not reasonable.	Questions have been answered in complete sentences and answers are mostly reasonable.	Questions have been answered in complete sentences and all answers are reasonable.	
Participation in class discussion of labs 10% of grade for the Lesson	Contributes very little the brainstorming session and is not respectful of others when they are speaking.	Contributes some to the class discussion and is respectful of others when they speak.	Contributes to the class discussion and is respectful of others when they speak.	Contributes a great deal to the discussion and is very respectful of others when they are speaking.	
Total / Grade					



Name_____

Date_____

Heat Unit

Lesson 4

Rubber Band Experiment

Materials

- Rubber Band

Process

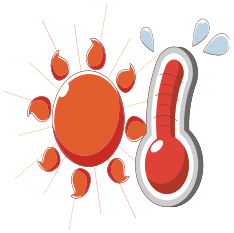
1. Obtain a rubber band and hook it around your thumbs and hold it so that it is taut, but not stretched.
2. Touch the rubber band to your forehead and pay attention to its temperature.
3. Stretch the rubber band out about 20 – cm or so and then immediately touch it to your forehead. Does the rubber band feel colder or warmer? Record your answer in the chart below.
4. Let the rubber band return it its normal size.
5. Repeat steps 3 – 4 two more times and record your results.

Data Table

Trial #1	Trial #2	Trial #3

Challenge Question:

1. Compare your results to the results of others in your class. What was the conscience of the class?



Name_____

Date_____

Heat Unit

Lesson 4

Taking the Temperature

Materials

- Vernier temperature probe
- Styrofoam cup
- Film canister
- Hydrogen peroxide
- yeast

Process

1. Fill the film canister half full of hydrogen peroxide.
2. Carefully place the canister inside the Styrofoam cup.
3. Put the temperature probe inside the canister and record the temperature of the hydrogen peroxide in the table below.
4. Remove the temperature probe.
5. Add about a ¼ a teaspoon of yeast to the canister and mix the solution with the end of the thermometer. Hit Start on the Logger Pro program and leave the thermometer in the canister.
6. Record the temperature for 5 minutes.
7. Save and print the graph created.

Starting Temp. of Hydrogen Peroxide: _____°C

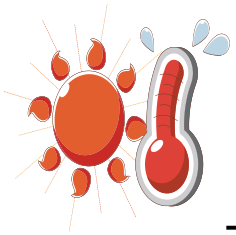
Challenge Question:

1. What happened to the temperature of the solution in the canister after you added the yeast?

2. What do you think caused this to happen?

3. What type of energy was turned into heat energy in this experiment?

4. Was this experiment an example of an endothermic reaction or an exothermic reaction?



Name_____

Taking the Temperature Lesson 4 Rubric

	Beginning 1	**Developing 2**	**Accomplished 3**	**Exemplary 4**	**Score**
Participation in Skit Activity 10% of grade for the Lesson	Contributes very little the skit session and is not respectful of others when they are speaking.	Contributes some to the class discussion about the skit and is respectful of others when they speak.	Contributes to the class discussion about the skit and is respectful of others when they speak.	Contributes a great deal to the discussion about the skit and is very respectful of others when they are speaking.	
"Rubber Band Experiment" 30 % of grade for the Lesson	Follows lab procedure and records observations. No questions have been answered.	Follows lab procedure and records observations. Questions have been answered; however, answers are not reasonable.	Follows lab procedure and records observations. Questions have been answered in complete sentences and answers are mostly reasonable.	Follows lab procedure and records observations. Questions have been answered in complete sentences and all answers are reasonable.	
"Taking the Temperature Lab" 50% of grade for the Lesson	No questions have been answered and no graph.	Questions have been answered; however, answers are not reasonable and not graph.	Questions have been answered in complete sentences and answers are mostly reasonable and graph is complete.	Questions have been answered in complete sentences and all answers are reasonable and the graph is complete.	
Participation in class discussion of labs 10% of grade for the Lesson	Contributes very little the brainstorming session and is not respectful of others when they are speaking.	Contributes some to the class discussion and is respectful of others when they speak.	Contributes to the class discussion and is respectful of others when they speak.	Contributes a great deal to the discussion and is very respectful of others when they are speaking.	
Total / Grade					