Thermal Energy – Investigation 2B

What's the energy story of the rock in the water?

Plan Investigation 2B

Your students have likely produced 5 or 6 posters in Investigation 2A, but there was not really time to share their work with classmates, receive feedback from them, or to study and learn from the works of others. The first part of this investigation is for engaging in that sharing. This sharing will also give you the opportunity to highlight posters that include all of the important poster elements and that address all of the Energy Tracking Lens questions. Communicating one's ideas to others and evaluating the ideas of others are important practices of science.

After the poster sharing, the class addresses a series of questions designed to broaden one of the key concepts of the investigation: whenever there is a transfer of thermal energy, thermal energy *always* flows from an object at a higher temperature to an object at a lower temperature. In this instance, thermal energy flowed from the warm water into the cooler rock. How do we know? The indicator of thermal energy transfer is temperature change: the rock's temperature increased (it gained thermal energy) and the water temperature decreased (it lost thermal energy).

The only thing that causes thermal energy to flow is temperature difference. The amount of an objects *thermal energy* is, by itself, *not* a factor. For example, a bathtub full of 110 degree water has dramatically more thermal energy than a thimble full of 110 degree water, but if you dip the thimble into the tub, there would be no flow of thermal energy, despite the great difference in thermal energy. No *temperature* difference means no flow of thermal energy.

By the end of this investigation, students will have improved their skill of communicating their ideas to others and will have deepened their understanding of the factor that drives the flow of thermal energy, which is a difference in temperature. They will also understand that thermal energy always flows from a warmer object to a cooler object.

Learning Targets Introduced in this Investigation

- Thermal energy transfers spontaneously from hotter (higher temperature) objects to cooler (lower temperature) objects

Sequence of Experiences		
1. Introduction	All Class	5 Minutes
2. Poster Sharing	Groups of 4	30 Minutes
3. Discussion	All Class	15 Minutes
4. Quick Check	Individual	10 Minutes

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Materials

For each group of four:

- The poster they made during Investigation 2A
- Large sheet of paper or a whiteboard

For each student:

- 1 room temperature rock

Preparation

- Hang the set of posters around the room. If possible, hang the posters well before the start of this Investigation so that students will have a chance to look at all of the posters before the class starts.

1. Introduction

All Class – 5 Minutes

Provide an overview of the class:

- The class will visit each poster. The team that made the poster will share the energy story that their poster tells, and the class can ask one or two questions.
- For the last 15 minutes, the class will gather in a circle to talk more about thermal energy transfer.

2. Poster Sharing

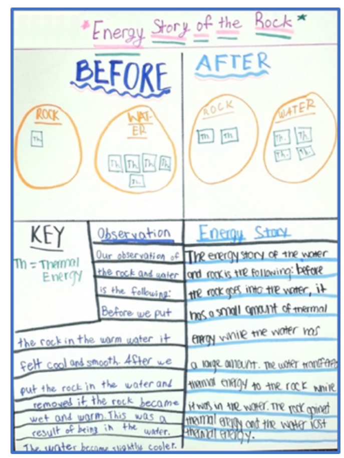
All Class – 30 Minutes

The purpose of sharing posters is to expand students' visions about what techniques they can employ in their posters, to give students an experience sharing their findings with their classmates, and to reinforce the key ideas about thermal energy transfer introduced during Investigation 1.

Assuming 5 or 6 posters, spend no more than 4 to 5 minutes at any one poster. Try to split that time at each poster between the team presentation and giving feedback or asking questions.

Ask:

These posters all tell the same energy story. Do you think they tell the same story?



Tell students to examine each poster carefully.

Notice each important part:

A title
A key
An observation (What do your senses tell you about what happened?)
An energy story

Notice how the poster tells the energy story

Words?
Arrows?
Energy cubes?
Energy bars?
Drawings?
Other methods?

After a team has introduced their poster, here are some questions for everyone:

1. What about this poster helps you understand the energy story of the rock and hot water?
2. Are there any questions or comments about what you see in the poster?

3. Discussion

All Class – 15 Minutes

The purpose of this discussion is to have students consider the flow of thermal energy in a variety of everyday situations that are in some way parallel to their experience with the rock and the water, and to make the case that thermal energy always flows from an object at higher temperature to an object at lower temperature.

Gather the class in a discussion circle. Each of the questions below could possibly launch an interesting conversation.

Ask:

*Did any group find that the **rock** became cooler during the three minutes it was in the water? Do you think thermal energy flowed from the rock into the water?*

Draw the first 2 circles on the board representing Rock and Warm Water, adding just an arrow to show the direction of the flow of thermal energy. (Figure 1, below.)

> *When you hold a cup of hot cocoa in your hand, does your hand get warmer or cooler? Do you think thermal energy every flows out of your hand and into the cup? What makes you think that? Does your hand get cooler?*

Draw 2 more circles on the board representing Hand and Cocoa, adding just an arrow to show the direction of the flow of thermal energy. (Figure 2, below.)

> *When you hold a cold can of soda or a cold glass of water in your hand, does your hand every get warmer? Do you think energy ever flows from the cold water or soda into your hand? What makes you think that? Does your hand get warmer?*

Note: The topic of "cold energy" is likely to come up. Address the fact that scientists do not consider "cold" to be a form of energy. There are just different amounts of thermal energy. Really cold objects are objects that have lost most of their thermal energy. They do not have "cold energy".

Draw two more circles on the board representing hand and soda, adding just an arrow to show the direction of the flow of thermal energy. (Figure 3, below.)

Distribute room temp rocks.

> *Squeeze the rock in one hand. Is your hand getting warmer or cooler? What is the energy story?*

Note: The rock feels cold to the touch because thermal energy flows from your skin to the rock.

(Thermal energy flowing from my hand into the rock. Hand losing TE, rock gaining TE. How do I know? Hand starts feeling cooler so is losing thermal energy.)

Draw 2 more circles on the board representing Hand and Rock, adding just an arrow to show the direction of the flow of thermal energy. (Figure 4, below.)

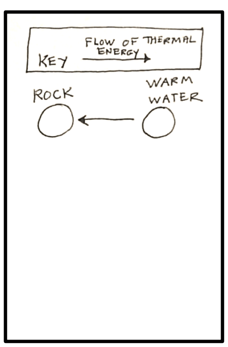


FIGURE 1

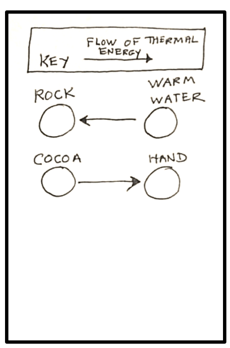


FIGURE 2

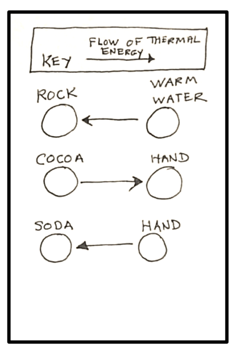


FIGURE 3

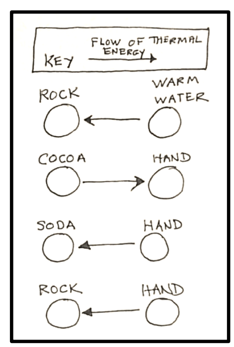


FIGURE 4

> *Can we make a rule about the flow of thermal energy?*
> ➔ Thermal energy always flows from something that is warmer to something that is cooler.
>
> *If we dropped a room-temperature rock into a cup of room temperature water (draw two more circles labeled R.T Rock and R.T Water) what do you want me to do about the arrow?*
> ➔ If both are at the same temperature, there is no flow of thermal energy. So no arrow.

Wrap-Up

Direct the group's attention to the list of statements about energy that is the developing Model of Energy.

> *Did we learn something in the thermal energy investigations that the class would like to add?*
>
> *Is there anything that needs changing?*

Listen for the following:

Thermal energy can transfer from one object to another.

Thermal energy always moves from a warmer object to a cooler object.

4.Quick Check

Individuals – 10 minutes

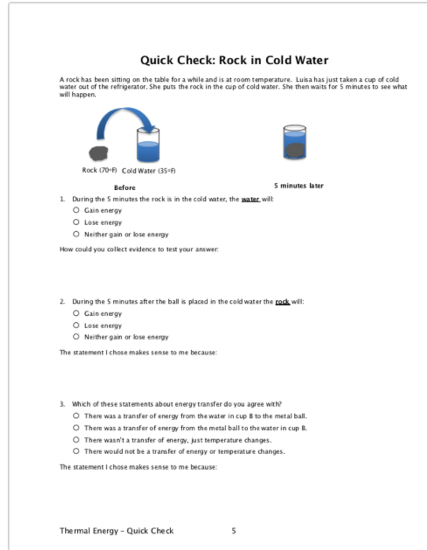
> *If students are unable to complete the Quick Check prior to the end of the science period, find another time to implement it and to review student responses prior to starting the next Investigation. Quick Check results can help shape how you proceed.*

Rock in Cold Water

This item will provide evidence of students' progress toward the learning goals for this investigation.

Read the text our loud and make sure students understand the scenario and the questions. Students will need 5–10 minutes to complete the Quick Check. After you review student results, plan time for students to discuss their responses.

The interpretation guide (available on the *Focus on Energy* website, under Curriculum Units -> Thermal Energy -> Resource Quick Links) will help you interpret student multiple choice answers and open-ended explanations.



Quick Check: Rock in Cold Water

A rock has been sitting on the table for a while and is at room temperature. Luisa has just taken a cup of cold water out of the refrigerator. She puts the rock in the cup of cold water. She then waits for 5 minutes to see what will happen.

Rock (70°F) Cold Water (35°F)

Before **5 minutes later**

1. During the 5 minutes the rock is in the cold water, the water will:
   - Gain energy
   - Lose energy
   - Neither gain or lose energy

How could you collect evidence to test your answer:

2. During the 5 minutes after the ball is placed in the cold water the rock will:
   - Gain energy
   - Lose energy
   - Neither gain or lose energy

The statement I chose makes sense to me because:

3. Which of these statements about energy transfer do you agree with?
   - There was a transfer of energy from the water in cup B to the metal ball.
   - There was a transfer of energy from the metal ball to the water in cup B.
   - There wasn't a transfer of energy, just temperature changes.
   - There would not be a transfer of energy or temperature changes.

The statement I chose makes sense to me because:

Thermal Energy – Quick Check 5

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Quick Check: Rock in Cold Water