2 Energy

Objectives

You will be able to

- Determine where thermal energy transfers to and from.
- Construct an argument based on evidence.
- Build on the ideas of other group members.
- Write a clear and logical argument using evidence.

How do we use and control thermal energy in a system?

Evaluation and Feedback

To evaluate your work, you will

- Use the "Engaging in Arguments from Evidence" row of the Science and Engineering Practices Rubric.

Task 2: Thermal Energy Transfer

As a group:

- Read Hilton's letter to the Science Wizard.
- Rotate through six Thermal Energy Transfer lab stations.
- Write an argument using evidence about thermal energy transfer.
- Respond to Hilton's letter to the Science Wizard.

Vocabulary

- particle
- particle drawing
- source (e.g., heat source and flame source)
- thermal energy
- thermal energy transfer
- transfer

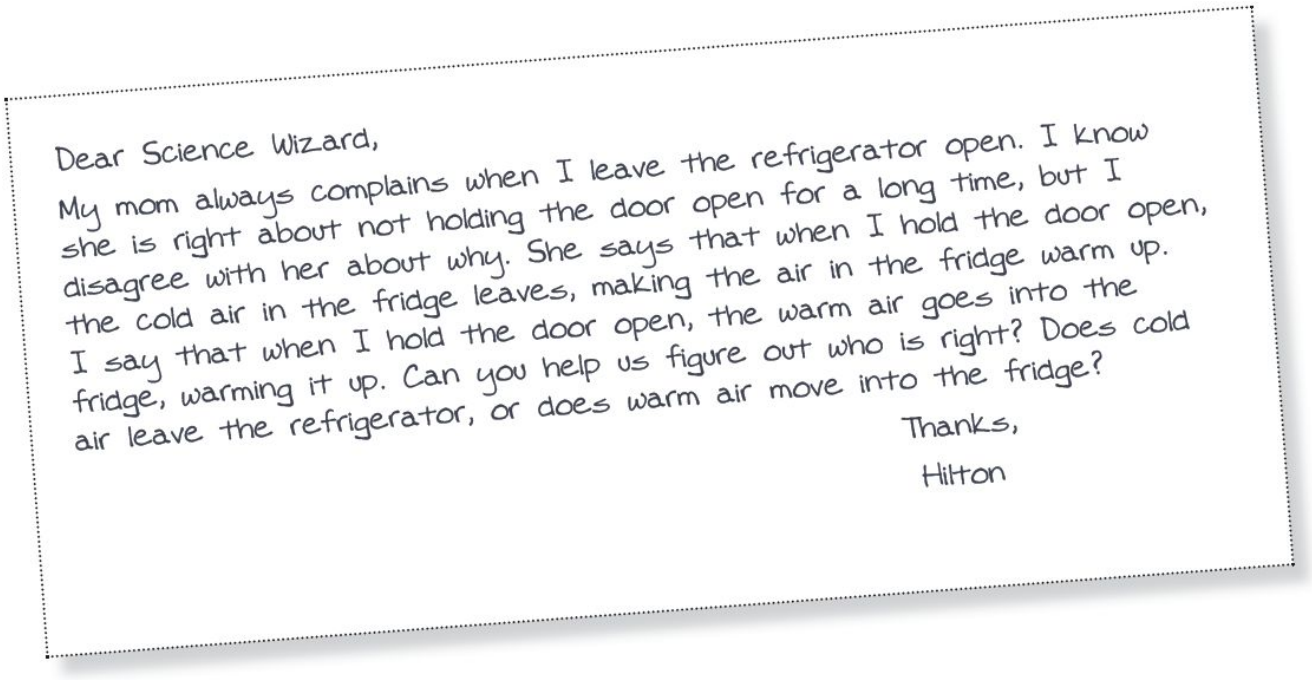
Connect to the Culminating Project

Update your client in your Individual Project Organizer:

- Sketch a model of your device and label the dimensions and materials.
- Re-sketch the model of your device identifying the thermal energy transfer.

Part I • Thermal Energy Transfer Lab Stations 1–6

1. In your group, read Hilton's letter.



Dear Science Wizard,

My mom always complains when I leave the refrigerator open. I know she is right about not holding the door open for a long time, but I disagree with her about why. She says that when I hold the door open, the cold air in the fridge leaves, making the air in the fridge warm up. I say that when I hold the door open, the warm air goes into the fridge, warming it up. Can you help us figure out who is right? Does cold air leave the refrigerator, or does warm air move into the fridge?

Thanks,

Hilton

2. Using prior knowledge, take a vote.

Who do you think is correct?	Mom	Hilton
How many votes?		

Thermal Energy Transfer Lab Stations

For each lab station:

1. Read and complete the directions.
2. Write and draw in your science notebook (see example below).
   a. Make a **model** (labeled drawing) of what you observed.
   b. Write a short **description** of what you observed.
   c. Write an **explanation** of the movement of thermal energy.
   d. Draw a **model using particles** in which you show how and why the thermal energy moved in the experiment.

Remember to follow the directions and use your observation skills.

Science Notebook Station Notes Format (example)

Lab Station Number: _____ Lab Station Name: _____	
Model Draw a model (a diagram with labels) of what you observed in the experiment.	**Description**
Explanation The thermal energy transferred from _____ to _____. I know this because _____.	**Model Using Particles** Draw a model (a diagram with labels) using particles in which you show how and why the thermal energy moved in the experiment.

Part II • Debrief Lab Stations

Group Discussion

1. List at least three things you noticed that were the same in each station.

2. Refer back to the energy terms from Task 1. Pick one lab station, and write a description of what happened using the terms **kinetic energy, thermal energy**, and **temperature**. Use the space below to write your description.

3. Look back at Hilton's question to the Science Wizard. Make an **argument** explaining the answer to her question, "Does cold air leave the refrigerator, or does warm air move into the refrigerator?"

   Use evidence and particle drawings from your investigations to support your argument. Your argument must also include a counterclaim and refute the counterclaim. Brainstorm (share ideas) with your group. Use the space below to take notes, and then write your own response in your science notebook.

Claim	
Evidence	
Reasoning	
Counterclaim	
Refute the Counterclaim	

4. With your group, brainstorm (share ideas of) three more examples of thermal energy transfer that you see in everyday life. Describe where the thermal energy starts, where the thermal energy goes, and the results of the thermal energy transfer.

Part III • Optional: Thermal Energy Transfer Terms

1. Read the Thermal Energy Transfer Resource (on the next page) as a group. Underline all definitions.

2. Make a model (a diagram with labels) to represent the behavior of particles during each type of thermal energy transfer.

Make a model (a diagram with labels) to represent the behavior of particles during *conduction*.	Make a model (a diagram with labels) to represent the behavior of particles during *convection*.
Make a model (a diagram with labels) to represent the behavior of particles during *radiation*.	**Make another model (a diagram with labels) of *conduction*, *radiation*, or *convection*.**

3. Determine which lab stations are an example of conduction, convection, or radiation. Fill in the chart below.

Conduction Lab Stations	Convection Lab Stations	Radiation Lab Stations

4. Pick one example and explain your choice of energy transfer.

   I think Lab Station _____ is an example of (conduction, convection, or radiation) because _____
   _____.

Thermal Energy Transfer Resource

As you read, underline the definitions of each word (**conduction**, **convection**, and **radiation**).

Conduction

Even in solid matter, like hot pots and cold feet, the particles are always doing a dance, jiggling up and down and all around. We can't see them jiggle, but we can feel their energy. How? As thermal energy!

Adding thermal energy to matter makes its particles jiggle even faster. As they speed up, they bump against their neighbors and get them jiggling faster too.

Put a cool pan on a hot stove, and soon the pan is hot. If the handle is metal, it will get hot too, as the faster-moving particles in the metal pass their energy along.

That's conduction: Matter "conducting" energy throughout itself, through particles bumping into each other.

Convection

Like conduction, convection happens in matter too, but only in liquids and gases like water and air. The particles in liquids and gases are farther apart than in solids. Because they have more room between them, they are freer to move around. As they heat up and jiggle faster, they move much farther, carrying the thermal energy with them.

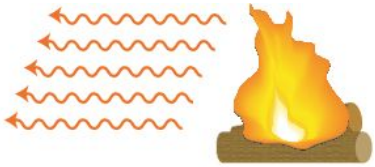
The particles themselves move in currents. For example, a candle flame (which is made of gases so hot they glow) heats the air right around it. The warmed air rises, making a current. Cooler air moves in to replace the warmed air, gets warmed up too, and rises into the current.

Radiation

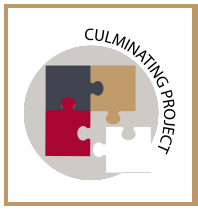
Radiation moves energy without any help from matter.

We say the sun's energy radiates through space to reach Earth. That means it travels in waves and doesn't need particles to move along. Energy that travels by radiation is called *electromagnetic radiation*. Light is one kind of electromagnetic radiation we can see. But light is just one tiny part of all the kinds of electromagnetic radiation.

Although we can't see it, the heat we feel on our skin when we stand in the sun or stand in front of a fire is caused by infrared radiation, another type of electromagnetic radiation.

Conduction	Convection	Radiation
Energy is transferred by direct contact.	Energy is transferred by mass motion of particles.	Energy is transferred by electromagnetic radiation.
		

Part IV • Connect to the Culminating Project and Assessment



Complete the individual Project Organizer for this task.