



## **Classroom Teacher Preparation**

### **Physics 15: How Does Heat Flow?**

**Please use the following to prepare for the next SfS lesson.**

#### **Description:**

Students will experiment with the flow of thermal energy to and from materials that have different thermal conductivities, breaking the misconception that whether something “feels” cold or hot can give sufficient information about the material’s temperature. They will be introduced to the term “thermal conductivity” and, if time allows, use this knowledge to explain the design of and/or propose designs for insulated beverage carriers which minimize thermal energy transfer with the environment.

#### **Lesson Objectives – SWBAT (“Students Will Be Able To...”):**

**6<sup>th</sup>-8<sup>th</sup>**

- Explain that thermal energy flows from objects at high temperature to objects at low temperature in terms of the thermal conductivity of materials
- Construct a table ranking materials based on their observed thermal conductivity
- Optional: Use above knowledge to explain and/or design an insulated mug that keeps water warm

#### **Disciplinary Core Idea (DCI)**

*PS3 Energy - PS3.A Definitions of Energy and PS3.B Conservation of Energy and Energy Transfer*

- (6<sup>th</sup>-8<sup>th</sup>) Kinetic energy can be distinguished from the various forms of potential energy. Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter.

#### **Science & Engineering Practice (SEP)**

*Constructing Explanations*

- (6<sup>th</sup>-8<sup>th</sup>) Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena.

#### **Crosscutting Concept (CCC)**

*Energy and Matter*

- (6<sup>th</sup>-8<sup>th</sup>) The transfer of energy can be tracked as energy flows through a designed or natural system.

#### **Preparation:**

This lesson is an introduction to heat transfer via conduction. The other two mechanisms of heat transfer (convection, and radiation) are not a focus of this lesson, although the concepts might be touched upon if time allows.

#### **Room Set Up for Activities:**

Students will work in groups of 2-3 (15 groups maximum) and need a clear, flat surface.



## Safety:

If the demonstration of insulated beverage cups is performed, there is a risk of burning by hot water. Students should not handle the electric kettle. Otherwise, there are no safety issues, but students will be working with melting ice, so things that must stay dry should be put away.

## Related Modules:

This lesson may be taught as part of a sequence or group of related modules on **Energy**. Modules include:

*Physics 16: Energy* – This station-based module familiarizes students with many forms of energy. Students explore various conversions of energy through different activities.

*Physics 13: Light Reflection, Transmission, and Absorption* – Students work in small groups through three activities demonstrating how light interacts with objects and how light is absorbed or transmitted by filters.

*Physics 3: Collisions* – Students ask questions about either force or energy and then test their questions with a marble roller coaster.

For other module sequences and groups, look here: [www.sciencefromscientists.org/sequences](http://www.sciencefromscientists.org/sequences)

## Standards Covered:

Please click the following link to our website to review the standards covered by this lesson, listed by state: [www.sciencefromscientists.org/standards/](http://www.sciencefromscientists.org/standards/)

Lessons are matched to both national NGSS and local state standards.

## After Our Visit:

*Extend this activity by exploring the American Chemical Society's simulation of a heated spoon and what happens as two materials reach thermal equilibrium.*

Access this Extension activity by visiting the Classroom Post found on our website at [sciencefromscientists.org/cohorts](http://sciencefromscientists.org/cohorts). Use the name of your school/cohort and password to log in.

To help Evaluate, check out our Open Response questions online at [sciencefromscientists.org/open-response-questions](http://sciencefromscientists.org/open-response-questions). They are freely available for all of our lessons for current teachers. Use the password supplied by your instructor to log in.

## Additional Resources:

- Lesson on thermal conductivity: <https://mass.pbslearningmedia.org/resource/726e8c0a-eba5-42a6-868c-1c74bfdc3f18/unit-8-segment-c/>
- American Chemical Society lesson on Heat, Temperature, and Conduction: <http://www.middleschoolchemistry.com/standards/ngss/chapter2/lesson1>
- How Do Wetsuits Keep You Warm? (2:53) <https://www.youtube.com/watch?v=6B05sU20-Jw>
- How to show convection currents in water: <https://www.exploratorium.edu/snacks/convection-currents>
- There are many videos online of food coloring diffusing through water at different temperatures; for example: <https://youtu.be/YbhwXSv9rk4>