

HOT RODS

BENCHMARKS and TASKS

SC.A.1.2.2 The student knows that common materials (e.g., water) can be changed from one state to another by heating and cooling.

SC.B.1.2.3 The student knows that most things that emit light also emit heat.

SC.B.1.2.6 The student knows ways that heat can move from one object to another.

- The student experiments to discover that some materials conduct heat much better than others, and poor conductors can reduce heat loss.
- The student experiences that heat energy moves from one place to another in three different ways: radiation, convection, and conduction.

KEY QUESTION

Which metal conducts heat the fastest?

BACKGROUND INFORMATION

The transfer of **heat** through a solid is called conduction. Heat always moves from warmer objects to cooler objects until both objects have the same temperature.

Conduction is the flow of heat through a substance from areas of higher temperatures to areas of lower temperatures. Conduction involves the **transfer of energy** from atom to atom. Conduction can be explained by the **kinetic energy** of **atoms** within the material. Heat causes the atoms to vibrate more rapidly. These atoms vibrate against nearby atoms, which do the same until the kinetic energy moves throughout the object. The faster the atoms vibrate, the warmer the object becomes.

Conductors, metals such as silver and copper, are best among common metals in conducting heat. Aluminum, then iron, follows silver and copper in order of heat conducting properties.

MATERIALS

Per group

safety goggles (1 pair per student)	2 large trays
1 candle	1 box of safety matches
2 spring-type clothespins	1 clock or timer
1 solid aluminum rod	1 solid brass rod
<i>Hot Rods</i> data sheet	1 solid copper rod
water (for fire extinguisher)	

TEACHING TIPS

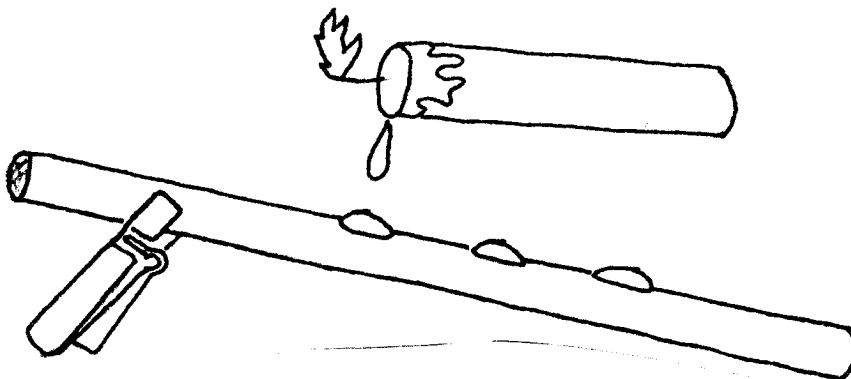
1. Caution students about open flames, hot metals and the safe use of matches.
2. **Ask for parents or other adult volunteers to help supervise groups while they are using open flames.**
3. All loose clothing and hair should be secured, and students should wear safety goggles.
4. Water should be available.
5. Rods can be obtained at local hardware stores or ordered from science supply companies.

ENGAGE

Ask students if they have ever played the game, Hot Potato. Ask: *How could you pass a hot potato to someone in such a way that would cause no discomfort?* Discuss the various ways in which they could protect their hands.

EXPLORE

1. Ask students if they think all metals conduct heat equally well. Discuss their responses and any prior experiences they may have had.
2. Hold up three metal rods: aluminum, brass, and copper. Ask: *Which metal rod – brass, copper, or aluminum - do you think will conduct heat the best?*
3. Distribute materials to groups. Allow students to practice using clothespins as rod holders. Students may need to use more than one clothespin to support the rods.
4. Have students put on their safety goggles and make sure all loose clothing and hair have been secured.
5. Show students how to drip three bits of melting wax from a burning candle onto each of the rods to act as heat indicators. The wax drops will melt and fall off as the heat passes under them and down the rod.
6. Ask adult helpers to light the candles and supervise as groups place the three rods on a tray and melt wax onto the rods. The drops should be evenly spaced. Have students place the drops the same distance apart (e.g., one inch apart or 1½ inches apart). Also, be sure you clarify for students what “drop” means. (Each “drop” may consist of one, two, or three drips of wax from the candle, but be consistent.) Once these drops are dripped onto the rods, set the rods aside to cool.



7. Once the wax drops have cooled on the metal rods, students should use clothespins to hold the rods over burning candles to determine melting times. Decide in advance what “melting” means. (It is usually determined by when the wax liquefies and rolls under the rod or actually falls off the rod.)
8. One student in each group should be the timekeeper.
9. Make sure students record on the *Hot Rods* data sheet the predicted melting time, starting time, and the time that the last wax drop on each rod melts.

EXPLAIN

Compare and discuss the data:

On which rod did the wax drop the quickest?

On which rod did the wax drop the slowest?

How long did it take to melt the wax on the slowest melting rod?

How long did it take to melt the wax on the fastest melting rod?

Which metal was the best heat conductor?

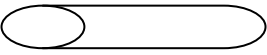
EXTEND/APPLY

Have students to look through their kitchen cabinets. Ask: *What kind of material is used for making pots and pans? Why do you think so?* (Metal. Copper is an excellent conductor. Some pots and pans have copper-coated bottoms to allow more even heating.)

ASSESSMENT

Explain why most long-handled barbecue tools are metal with wooden handles. Use the words *conductor*, *energy* and *heat* in your answer.

HOT RODS

	DROP 1		DROP 2		DROP 3	
	Predicted time	Actual time	Predicted time	Actual time	Predicted time	Actual time
						
Aluminum Rod						
Brass Rod						
Copper Rod						