TEACHER'S GUIDE: THINKING ABOUT HEAT

The hands-on activity in '**Activity Sheet: How are Light and Heat Related?**' can be used to encourage students to think about the connection between light and heat. This guide is designed to support teachers in classroom instruction around the theme of 'Heat' in the middle-stage science curriculum. It can help students move beyond a comparison of which object or surface is warmer to a discussion of **how** and **why** heating occurs.

The guide is organised into three non-sequential sections for discussion and inquiry. Each section includes a set of prompts along with connections to the middle-stage science curriculum. Each set of prompts is designed to provide one possible sequence of questions that can help students move in small steps towards developing an understanding of heat transfer. The questions in each prompt are meant to be indicative, not exhaustive. Not all of them need to be used in class, nor do they need to be followed in the exact sequence offered here.

Section I: Heating properties of materials:

This section can help students move from: *"Objects in the Sun become hot"* to: *"Do all objects heat up in the same way?"* and *"What difference do different materials or surfaces make?"*.

a) Prompts:

- Why choose metallic spoons? How does metal respond to heating? Compared to other materials, does metal heat up quickly or slowly? Does it retain heat or cool down quickly?
- What would you expect to observe if you used wood, plastic, metal coins, clay, or pebbles instead of spoons? How are the heating properties of these materials different from metal spoons? What everyday observations support your ideas?
- Can you think of any other everyday material (apart from the ones we have already thought of) that could replace spoons? What kind of material would you use and why? How would the size or shape of this material change the activity? For example, would the material need more time in the sun, or would you need to place it differently on the paper?
- Why choose black paper, white paper, and aluminium foil? How do these materials respond to sunlight? What everyday observations support your ideas? What do you expect to happen when sunlight falls on each of these surfaces?
- Why were the spoons 'placed' on different surfaces? If the spoons were 'wrapped' in black paper, white paper, or foil instead—how would it change the way they receive or lose heat? For example, would wrapping the spoons trap air around them? How might that air change how quickly the spoons warm up or cool down?

b) Connections with Chapter 7 ('Heat Transfer in Nature') of the Grade VII science textbook (NCERT, 2025):

- **Absorption and reflection:** Dark-coloured surfaces absorb more of sunlight, while

light-coloured and shiny surfaces reflect more. Surfaces that absorb more sunlight tend to become warmer.

- **Thermal conductivity:** Some materials (like metals) allow heat to pass through them easily (conductors), while others (like wood, plastic, or clay) do not (insulators).

Section II: Sensing heat:

This section can help students move from *"This feels hotter"* to: *"What factors affect what I feel?"* and *"Can I measure it more exactly?"*.

a) Prompts:

- Is touch a reliable method to compare the warmth of the spoons? Does this method have any limitations? Can you think of a tool that would help you get an exact measurement of the temperature of the spoons? What changes would you need to make to the activity to include this tool in it?
- Is 15–20 minutes of exposure to the Sun necessary? How do you think your observations would change if the time were shorter or longer? What factors (such as sunlight intensity or the material used) might affect how quickly the spoons warm up? How would you find the shortest time needed to see a clear difference in the warmth of the spoons? Can you think of a way to test this? What would you keep the same in such a test and what would you change? At what point do you think the spoons would stop getting hotter?
- Imagine the spoons and paper in this activity were replaced with other materials. Can you think of any everyday materials that would make differences in warmth easier to feel? Why? What properties of these materials (such as how quickly they let heat pass through them) would make these differences easier to notice?

b) Connections with Chapter 7 ('Temperature and its Measurement') of the Grade VI science textbook (NCERT, 2025):

- **Subjectivity:** Our sense of touch can be misleading. Materials at the same temperature can feel different because they transfer heat to our skin at different rates. Metals, for example, feel colder because they conduct heat away from your hand quickly, and feel hotter because they conduct heat to your hand quickly.
- **Tools:** Instruments like thermometers provide a more reliable and exact measurement of temperature than our senses can.

Section III: Transfer of heat:

This section can help students move from *"The Sun heats things"* to: *"How exactly is heat transferred?"* and *"Are different processes happening in different parts of the setup?"*.

How many different examples of heat transfer can you identify in this image? Hint: Look closely at why the mother is using a cloth, why the boy's hand is to the side rather than above the fire, and how the heat travels from the hot milk into the girl's hands!

a) Prompts:

- Have you found a steel spoon becoming too hot to hold after you dip it into a bowl of hot *kheer*? If only one end of the spoon is in the hot kheer, how does the heat reach your fingers at the other end? How do your feet feel when you walk barefoot on hot ground? Would you feel the same heat if you were wearing *chappals*? What does this tell you about this specific kind of heat transfer?
- In this activity, is the Sun in direct contact with the spoons? How do you think heat from the Sun reaches the setup through empty space? What makes this different from the *kheer* and *chappal* examples?
- Can you think of other everyday examples where heating happens without physical contact? Are such examples limited to the Sun, or can they involve other sources?
- You may have felt the warmth of a *chulha* or stove when you sit near it. How is its heat reaching you without physical contact? If you place your hand (at a safe distance) above the flame, it feels much hotter than when your hand is to the side. Why? What does this suggest about the direction in which heated air moves? How is this different from heat coming directly from the Sun?
- Could the Sun still heat the spoons if there were no air in between? Can you think of a way you could test or verify this idea? For example, if we put the spoon in a glass jar and sucked all the air out, would the spoon still get hot? Would this result support the idea that air is needed or challenge it?
- How does heat from the paper surfaces reach the spoons? How does heat from the spoons reach your hand? Are these processes the same or different? How can you tell?

b) Connections with Chapter 7 ('Heat Transfer in Nature') of the Grade VII science textbook (NCERT, 2025):

- **Three modes of heat transfer:** Heat is transferred through direct contact (conduction), through the movement of liquids or gases (convection), and without needing contact or a medium (radiation).
- **Radiation:** The sun heats the paper and spoons through radiation. This transfer can occur without physical contact and even without air.

We invite you to test this guide in your classroom. Since classroom discussions can move in many unexpected directions, the hope is that each such discussion will help develop other possible examples and sequences to build understanding of the same ideas. We would be interested in hearing your experience. Do tell us:

(a) Which sections and prompts did you use?

(b) How did you adapt them to match your students' prior knowledge and observations?

(c) What new prompts would you add based on their responses?

Share these with us at: iwonder@apu.edu.in.

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