

Lesson Plan

Subject area: Science

Grade level: 5

TOPIC: Heat Transfer - Radiation

OBJECTIVE: Following an investigation and group discussion TSWBAT write a paragraph of at least 5 sentences using information gathered during the inquiry investigation, including define radiation as one of three types of transfer of heat, explain that radiation does not require contact of the two objects for heat to be transferred, name the three types of heat transfer, explain that radiation transfers heat through electromagnetic waves, and give at least one example of radiation.

MATERIALS:

Teacher: transparency showing three methods of heat transfer, overhead projector, lighter or matches

Per Student: observation sheet, large marshmallow, metal fork, goggles

Per Group: one candle, one paper plate, one clothes pin, one thermometer

I. PROCEDURES

A. Beginning of lesson:

1. Classroom management step (to have students ready to learn, in listening position, where they need to be): “Give me five: eyes on me, ears listening, mouths closed, hands still, and feet quiet.” Acknowledge those students who comply quickly.
2. Statements to initiate or set the stage for the lesson; motivation; review: Place the transparency on the overhead. Ask students to name the two kinds of heat transfer they have already investigated (conduction and convection). Tell them they will now investigate a third kind of heat transfer.

B. Instruction Steps:

1. Ask students how the picture of the girl standing in front of the fireplace could show heat transfer. (The heat from the fire moves out of the fireplace into the room.)
2. Have students recall the last time they stood in front of a fireplace or bonfire. Students will orally answer the following discussion questions: How close did you have to stand to feel the heat from the fire? How could heat reach your skin without the fire actually touching it? ****** (To include the Mo/MH inclusion student, I will have Joe stand and be the “fire.” As he walks around the room, the rest of the class will feel the heat the fire produces. Again, I will emphasize that a person can feel this heat by radiation. If Joe is not present in class, I will have a kinesthetic learner be the fire.)
3. Share with the students that they did not have to touch the fire to feel the heat. Heat travels in electromagnetic waves. This type of transfer of heat is called

radiation. Students will record this information on side 2 of the worksheet, # 1, #2, and #4.

4. Inform students that they will be performing an investigation that will answer the question: How is heat transferred through radiation? They will answer this question at the end of the investigation on the record sheet.
5. Show students the supplies they will use during the investigation: thermometer, candle, fork, marshmallow, worksheet. Ask students if they can figure out what kind of investigation they will be doing.
6. Explain the steps of the investigation. Emphasize the importance of safety during this investigation. Students will be working with fire. **NO INNAPROPRIATE BEHAVIOR WILL BE TOLERATED!** Discuss the appropriate behavior for working with fire.
7. Divide the class into groups of three according to the seating arrangement. Students seated close together will be grouped together. Assign each member of the group a number, either a 1, 2, or 3. After all questions have been answered, groups may begin their inquiries.
8. Have Scientist #1 gather the supplies for their group. These will be located on a table in the front of the room. ******(The Mo/MH student will be assigned as Scientist # 1, so he can gather the materials. Joe will participate in the investigation but will not be required to complete the record sheet or complete the homework.)
9. Scientist #2 will hold a thermometer about 4" above the unlit candle. All students should record the air temperature on the investigation sheet.
10. Each student will stick a marshmallow onto the end of a metal fork. When students are finished with this task, the teacher will light the group's candle. Goggles will be worn from this step forward.
11. Each student in the group will take turns holding his/her marshmallow about 4" above the flame. Each student should observe what happens to the marshmallow, then lay the marshmallow on the paper plate and record the observation. ****** (Due to safety concerns, the teacher will observe closely when the Mo/MH student roasts his marshmallow.)
12. Next, have Scientist #3 use the clothes pin to hold the thermometer 4" above the flame for 15 seconds (count to 15) or until the temperature stops rising. **DO NOT HOLD THE THERMOMETER CLOSE TO THE FLAME, AS IT COULD BURST!** Each student will record the air temperature. **DO NOT TOUCH THE THERMOMETER WITH BARE HANDS.**
13. **BLOW OUT THE CANDLE.** Goggles may be removed at this point.
14. Have students discuss among their groups the answer to the inquiry question until all groups are finished with the investigation.
15. Invite volunteers to describe what happened to their marshmallow.
16. Ask the class to describe what their results showed about the transfer of heat energy. (Heat can be transferred through space. The heat source does not have to have contact to transfer heat. This type of heat transfer is called radiation.) Students will record the answer to #3 on side 2 of the worksheet.
17. Students will brainstorm other sources of radiation heat transfer. (Sun, oven, space heater) Students will record the answers on question #5 of side 2 of the worksheet.
18. Students may eat their marshmallows during closure.

- C. Closure statement (brief lesson review, summary; what will follow; doesn't have to be the last step if something is going to be made or an activity will follow):

I will inform the class that they will write a paragraph about radiation tonight for homework. Now we will practice creating that paragraph. I will ask volunteers to share some fact learned from question # 1 on side 2 of the worksheet, then #2, and so on until all five areas of information have been covered. The homework assignment is to write a paragraph of at least 5 sentences using the information in numbers 1-5 on side two of the worksheet.

20. The student whose class number is closest to 14 should return all the investigation materials to the front table.

II. **ASSESSMENT (objective met by students; observation, written work, presentations, quiz, etc.):**

Students will complete a self-evaluation according to the level of cooperation displayed in group work.

Students' paragraphs will be scored on the following criteria:

- includes the statement that radiation is a method of heat transfer,
- names the three methods of heat transfer (radiation, convection, conduction),
- explains that heat travels through electromagnetic waves,
- mentions that contact is not required in radiation for heat to transfer,
- includes an example of radiation.

One point will be given for each criteria included in the paragraph, for a maximum of 5 points.

** (Mo/MH student will be assessed orally to check for understanding. I will ask Joe what happened to the marshmallow when he held it over the candle. Suggested answers are, "It got hot. It turned black. It burned." Why did the marshmallow burn? "The fire made it hot."

III. **EXTENSION AND REMEDIATION:**

Extension: Students will be challenged to perform an experiment at home for extra credit. Suggested experiment includes: Which warms faster in the sun: water or milk?

Remediation: I will have another experiment for remediation. At the beginning of the lesson, I will show the class two glasses I brought from home. I will fill the glasses with the same amount of cold water. A student volunteer will read the initial temperature of the water and record it on the chalkboard. One glass will be placed in the sun coming through the window. (If no sun is available, I will use a spot light.) The other glass will be placed out of the sun. At the end of class, those students who had trouble understanding the concept of radiation will read

the two temperatures in the glasses. As we as a class discuss what happened, I will call on those students who are having trouble and help guide them to an understanding of radiation.

IV. HOMEWORK ASSIGNMENT:

Students will write a paragraph of at least 5 sentences about radiation according to the above criteria.

Name _____

Other group members _____

Radiation Heat Transfer Investigation

1. Scientist #1 - Gather the following supplies: one candle, 3 forks, three marshmallows, one thermometer, one paper plate
2. Scientist #2 - Hold a thermometer about 4 inches above the candle. Measure and record the air temperature.
Air temperature above the unlit candle: _____
3. Each person - Stick a marshmallow onto the end of a metal fork.
4. Each person - Hold the marshmallow about 4 inches above the lit candle and rotate it. Make sure the marshmallow does NOT touch the flame. What happens?

(Now, place the marshmallow on the paper plate until the end of the investigation.)

4. Scientist #3 - Once again, using a clothes pin this time, hold the thermometer about 4 inches above the candle. Keep it there for 15 seconds (count to 15). Measure and record the temperature.
Air temperature above lit candle: _____

(BLOW OUT THE CANDLE)

5. How is heat transferred through radiation?
