Prior Knowledge Lesson Plan

Nicholas Merrill

Pre interviews with students

CAN HEAT BE TRANSFERRED FROM AN ICE CUBE TO SOMETHING ELSE?

- Student 1: “Yes, it makes water colder.” ‘How?’ “Heat goes from the ice cube to the water.”
- Student 2: “Yes heat is in everything… but I’m not sure because ice is 0 degrees.” ‘What about your desk?’ “Yes, I’m pretty sure.”
- Student 3: “I don’t know what you mean.”

Pre interviews with students (cont.)

WHAT IS HAPPENING WHEN YOU TOUCH SOMETHING AND IT FEELS COLD?

Student 1: “The coldness of the ice cube moves to your finger.”

Student 2: “The temperature is lower than your hand.”

Student 3: “Your fingers know you are hotter.”

Pre interviews with students (cont.)

WHAT CAUSES THE WIND?

Student 1: “The Earth is spinning”

Student 2: “Hot and cold air is mixing”

Student 3: “I don’t know… Solar and nuclear energy mix.”

Research on misconceptions

- Students believe temperature is a quantity for measuring the amount of heat.

- Student understand heat is a kind of energy, but fail to realize it can only be transferred from higher to lower temperature objects.

(Tanahoung, Chitaree, & Soankwan, 2010)

- 75% of students choose Aluminum foil over Styrofoam to keep a soda cold.

(Lewis, Linn, 1994)

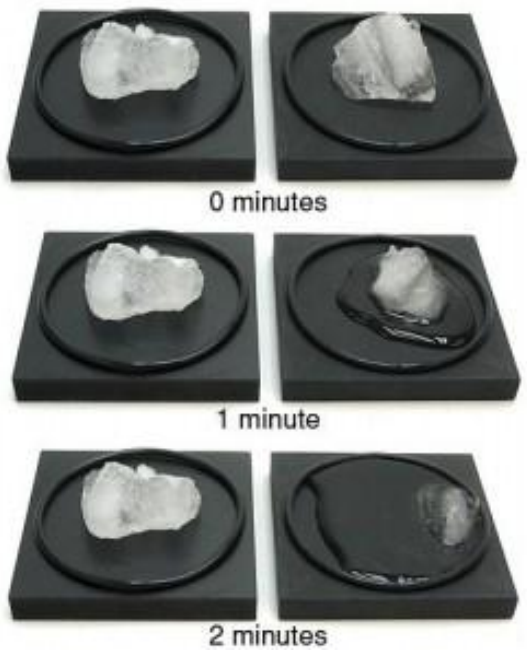
Lesson purpose

- Assumes the previous introduction to heat transfer, thermal energy, and temperature

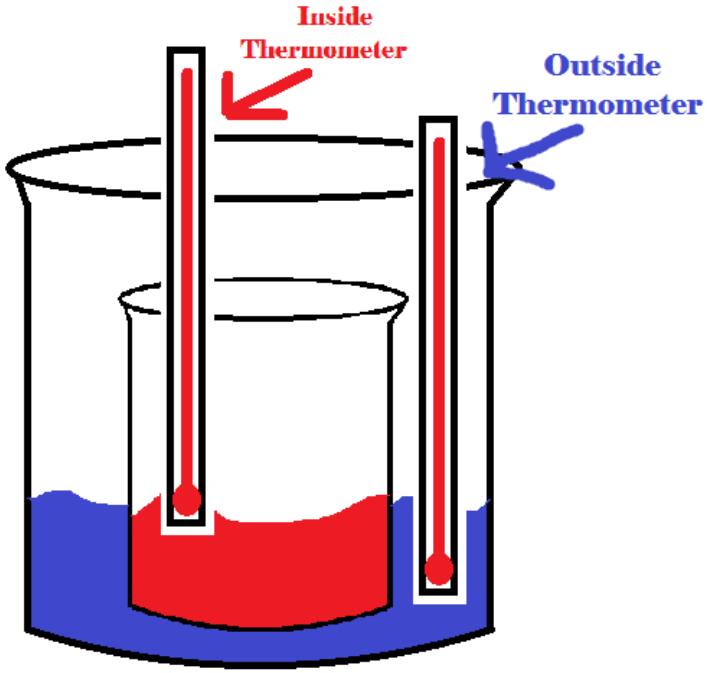
- The student will be able to identify heat transfer via conduction and convection in a system,
- Identify the direction of heat flow in a system,
- Compare different thermal conductivities,
- Understand natural convections role in the generation of wind.

PS.7 c & d) conduction, convection, and radiation; and applications of thermal energy transfer

5-E MODEL - ENGAGEMENT



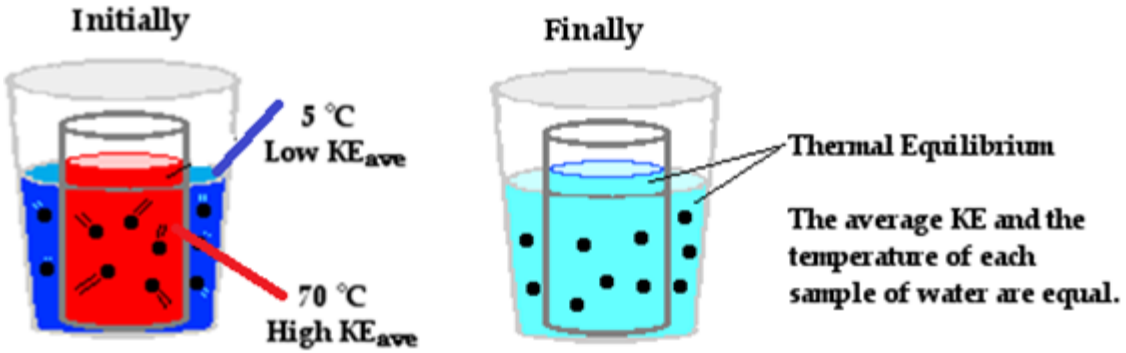
5-E MODEL - EXPLORATION

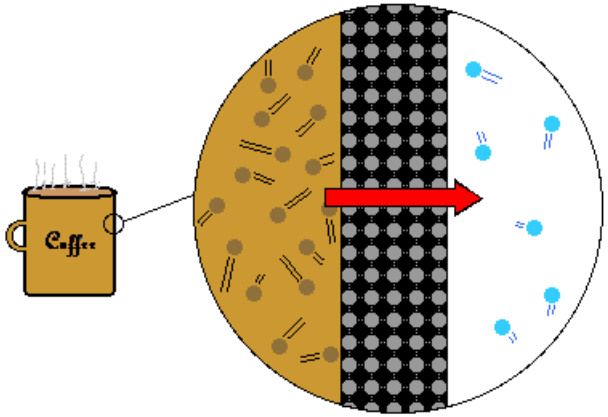


Time (s)	Inside Temperature (°C)	Outside Temperature (°C)	Temperature Difference (°C)
90 s			
180s			
270s			

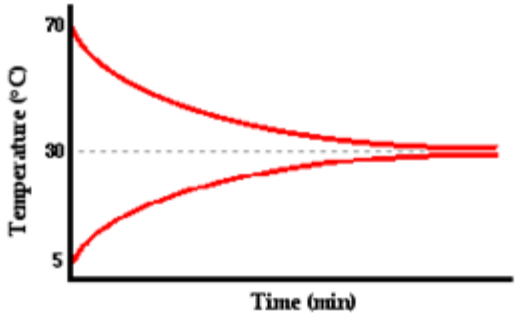
Styrofoam
Glass
Glass in Glass
Paper
Plastic
Aluminum Soda Can

5-E MODEL - EXPLANATION





Coffee particles with a higher average kinetic energy collide with the container wall and transmit their energy to the surroundings.

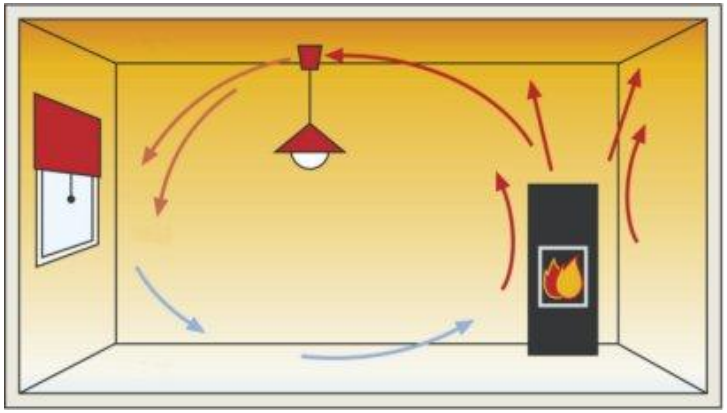


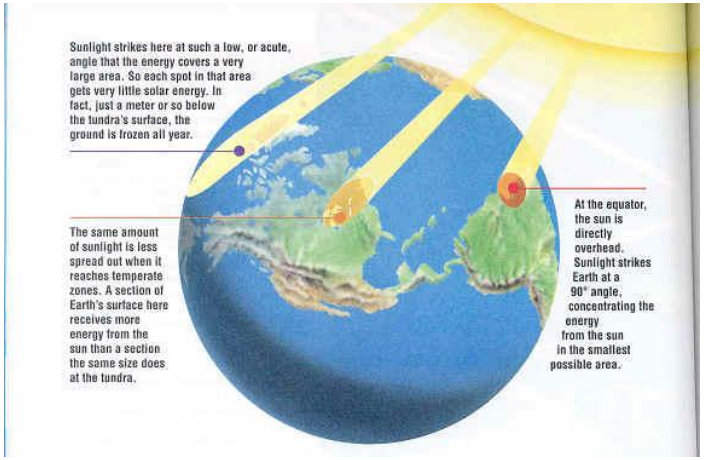
5-E MODEL - ELABORATION

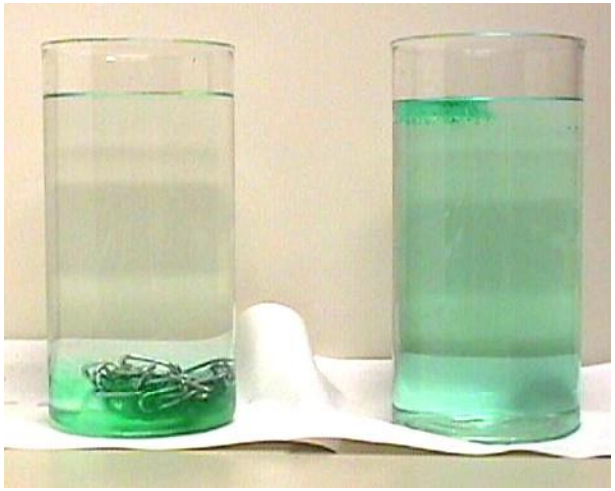
Convection and Wind

Should be extended

to separate lesson.







5-E MODEL - EVALUATION

Say we repeated the insulator experiment using a tin can. Would the TEMPERATURE DIFFERENCE at the end of the experiment be BIGGER or SMALLER compared to the Styrofoam cup?

Why did the aluminum block feel "colder"?

Multiple choice, using misconceptions as distractors, could work well

Post interviews with students

HOW CAN TWO THINGS AT THE SAME TEMPERATURE FEEL WARMER OR COLDER?

Student 1: “One conducts heat better.” ‘What do you mean by better?’ “Heat leaves your hand faster.”

Student 2: (hesitation) ‘How is heat transferred?’ “From hot to cold.” ‘Does it happen at the same speed?’ “No, the metal was fast and the plastic was slow”

Student 3: (hesitation) “Metal absorbs heat better.”

Post interviews with students (cont.)

IF I HOLD MY FINGER ON BOTH BLOCKS FOR 10 SECONDS, WHICH BLOCK WILL BE AT THE HIGHER TEMPERATURE? WHY?

Student 1: “The metal one because it got more of your heat because it’s a better conductor.”

Student 2: “The plastic one because it feels hotter.”

Student 3: “I metal one, but I don’t remember why.”

Post interviews with students (cont.)

WHY DOES WARM AIR RISE?

Student 1: “It’s less dense.” “Because it’s hotter… so it’s molecules are moving around more.”

Student 2: (hesitation) ‘Why does ice float on water?’ “Oh! It’s less dense.” ‘So is hotter air more or less compact?’ “Less.”

Student 3: “Because it’s less dense. ‘So is hotter air more or less compact?’ (hesitation) “More”

Reflection

- Useful addressing “non-common” misconceptions specific to students (Ice can’t be colder than 0 °C)
- Difficult to address every misconception (thermal equilibrium differing masses)
- Helps develop both the lesson and the evaluation
- Can construct an objective specifically around a misconception
- Students can be hesitant to share ideas about how they think things work
- Promotes student interest