# Interactive Notes-"Heat Transfer"

**Student Materials (per group of 4 students):**

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|---|---|
| Demo 1 | 1-beaker (any size)- half full of ice |
| Demo 2 | 1-desk lamp |
| Demo 3 | 1-candle on its own stand<br>1-ring stand<br>1-ring<br>1-wire pad<br>1-beaker (any medium size- 250mL, 400, or 600) half full of tap water<br>1-baggie with potassium permanganate ($KMnO_4$) granules<br>1-plastic spoon |
| Demo 4 | *(desk lamp again)* |
| …and | 4-note sheets |

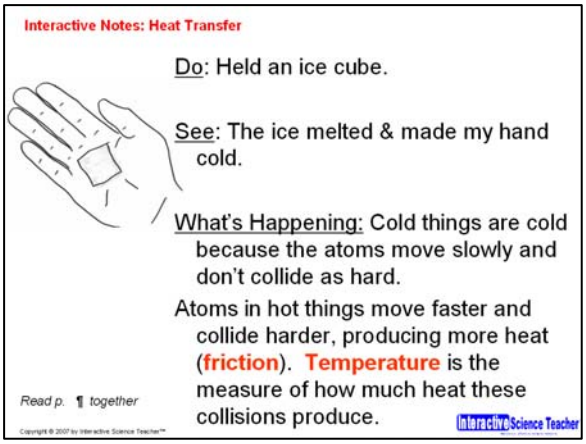
**Additional Teacher Materials:**

PowerPoint
1-lighter- the kind with the clicker
1-cooler of ice
Beaker of water and food coloring- optional with demo #2

**Beforehand:**

- Insert page and paragraph numbers from relevant pages in your textbook at the bottom of slides 1 and 2 if you choose to have the class read from it together. This is a good way to connect with your textbook as well as transition into the next demo. You can also delete these page inserts, or Copy and Paste them onto later slides if needed.
- Set out extension cords for the lamps, if needed.
- Pour a few $KMnO_4$ granules into plastic bags that can seal shut. Use black marker to write "potassium permanganate ($KMnO_4$)" on the outside of each.
- In preparation for demo #3: turn on exhaust fans if you have them. The candles will create smoke when blown out. Remind yourself what to do in case of an emergency.
- As with any other demonstration, try these out ahead of time for yourself so you know how they work best and so you know what to expect.
- Print extra copies of the notes pages on paper for yourself, students that are slow writers or can't see well, and for absentees. Click "File" → "Print" → then where it says "Print what:" select "Handouts" → and then "OK".
- Keep an extra lamp up front for yourself so you can refer to it as you're talking about demo #4. It wouldn't be a bad idea to have an entire set of materials for all demos either. *Showing* students what to do is about 100x easier than telling them.
- If your candles are brand new you might want to light them and let them burn a little so they're easier to light during class (when time is more valuable).

1.




*Before student #1 begins, student #3 needs to get their demo started now so convection currents are occurring in the beaker when their turn comes. Go around and light the candles, or light them all up front and have students come get them. Tell students that anyone who plays with the flame will have theirs put out (and be ready to do so!). Tell each student #3 to set up the ring stand with the ring and wire pad so it's 2-3 inches above the flame. Set the beaker on the wire pad and the candle below on the ring stand base.

Now back to demo #1. Ask student #1 to take an ice cube or two from the beaker, put it in their hand, and just notice the coldness. As they do, start leading them through a series of questions meant to give them a whole new understanding of temperature- "Would you all agree that ice is $H_2O$? And what about when it melts- still $H_2O$? If both are the same molecule, what makes the atoms in ice feel cold? Have you ever thought about that? Another clue is that we could take melted and re-freeze it and make it cold again, right? If the atoms themselves aren't changing, I wonder if their behavior is what's changing."

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What you're trying to do is put the thought in students' minds that temperature is really a measure of how active the atoms are. If we had the ability to see the atoms that make up air, we would see hot air moving much faster than cold air. And the faster they move, the harder they collide. Since those collisions generate heat due to friction, the harder they collide the more heat they give off.

Another example- "Imagine our class is at an amusement park and we're on the bumper cars. To make it more interesting we're all blindfolded! At first, before the switch is thrown, no one is moving, and with no collisions there's no heat generated (we're cold). Then the switch is thrown and the cars can move slowly. Every time they bump (*randomly…. consider mentioning Brownian Motion*), a little bit of heat is generated. When the switch is pushed all the way up the cars can go even faster, hit harder, and generate more heat." Students now see the connection between how fast atoms move and heat generated.

*Caution concerning the fire in demo #3: Locate all fire safety equipment and be familiar with their operating procedure BEFORE doing this; keep the lighter for the candles in your pocket the whole time and blow out candles as soon as possible (right after demo #4); warn students to keep clothing, hair, hands, and any other flammables away from the flame; comply with the fire codes in your building.*

***(end of Teacher Notes preview)***

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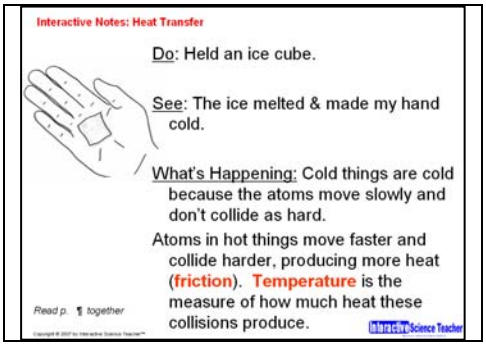
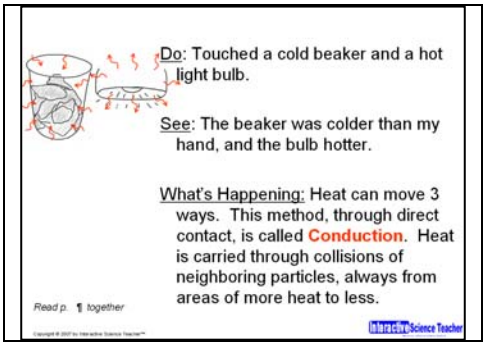
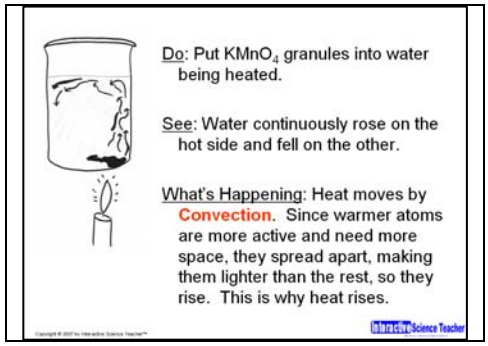
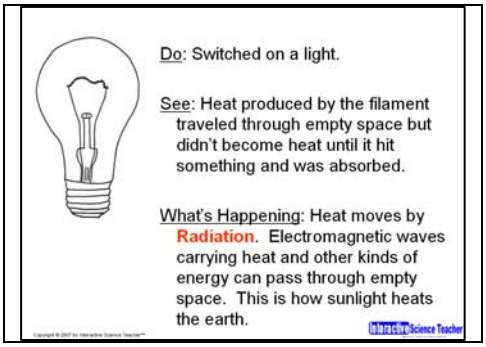
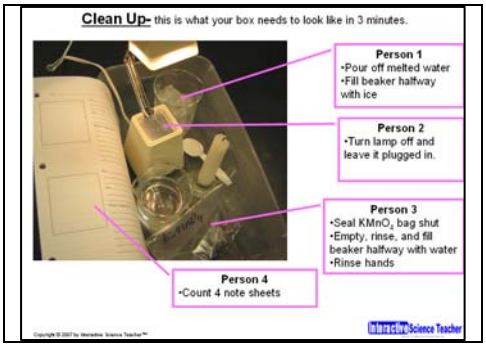
## ♦ PowerPoint- Don't have PowerPoint? Download it FREE: Mac / PC



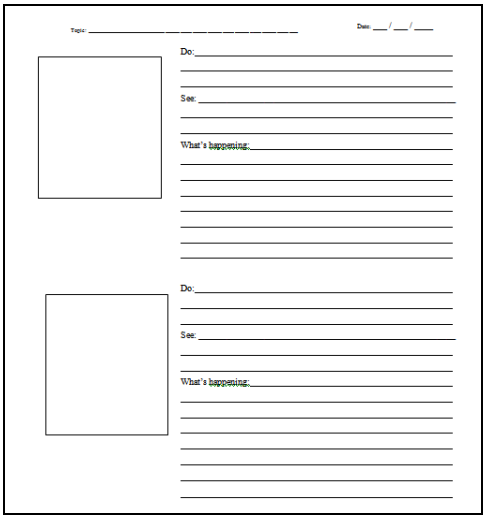



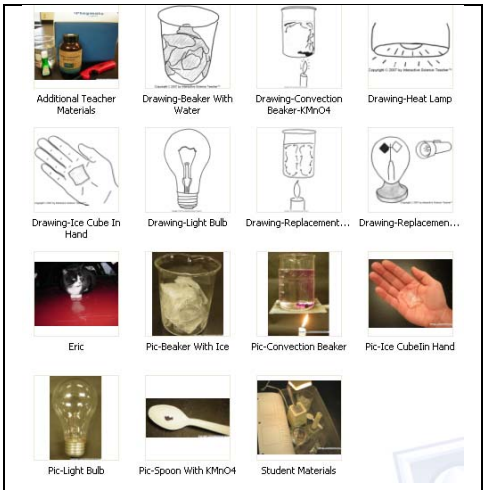



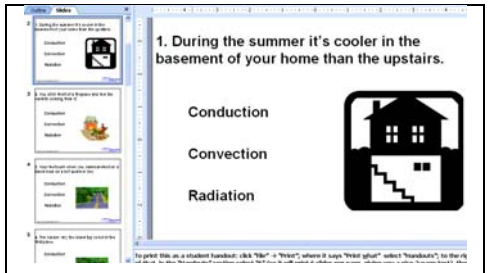

## ♦ Student Handout




## ♦ Drawings & Pictures




## ♦ 10 Question Quiz



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