SUGGESTED ACTIVITIES

(*Changes of Matter*)

From *Invitations to Science Inquiry 2nd Edition* by Tik L. Liem:

Activity	Page Number	Concept
The vanishing ice cubes	96	Melting and Boiling
The disappearing liquid	98	Evaporation
Cut through ice with a wire	104	Melting point
Heat water above its boiling point	105	Boiling point
Walk through a hole in paper	136	Physical Change
The blue and red cabbage	137	Chemical Change

From *NSF/IERI Science IDEAS Project*:

Activity	Page Number	Concept
Freezing water	See following pages	Freezing
The sweaty can	“ “ “	Condensation

From *Harcourt Science* Teacher's Ed. Unit E: (For <u>ALL</u> grade levels)

Activity	Page Number	Concept
One way matter can change	E14-15 (3rd grade text)	Physical Change
Chemical change	E44-45 (3rd grade text)	Chemical Change
Observing changes in states	E7 (4th grade text)	Physical Change
Changing states of matter	E12-13 (5th grade text)	Physical Change
Freezing points	E18 (5th grade text)	Freezing Point
Chemical properties	E20-21 (5th grade text)	Chemical Change

THE VANISHING ICE CUBES

A. Question: *Are there specific temperatures at melting at boiling points?*

B. Materials Needed:

1. A bag of ice cubes (3-4 cubes per pair of students).
2. A thermometer, beaker, alcohol burner, and stand (for each pair)
3. Graph paper for all students

C: Procedure:

1. Distribute the materials to the students and have them work in pairs.
2. Instruct the students as to how to set up the stand and burner.
3. They should fill their beaker with water and add in the ice cubes.
4. Have one student stir the ice-water mixture and another one observe the temperature every minute while it is being heated (A third student may record the temperature as it is called out).
5. After all the ice is melted, continue heating the water and have the students record the temperature every minute until the water has boiled for ten minutes.
6. Have the students plot the observed temperatures (Y axis) against the time (X axis) on a graph.

D: Anticipated Results:

The students should notice that as time passes the water mixture goes from ice cold to cold, to room temperature, to warm, to hot, and lastly, to boiling. Their graph should reveal a directly proportional relationship.

E: Thought Questions for Class Discussion:

1. What was the temperature doing while there was still ice present?
2. Where did the heat from the alcohol flame go during that time?
3. What did the temperature do while the water was boiling?
4. Where did the heat from the flame go during this boiling time?
5. What will eventually be left over if the boiling was continued?
6. When heat is not added to the melting process, what will the melting ice do to the environment?
7. When heat is not added to the evaporating process, what will water that is evaporating do to the environment?

F: Explanation:

In the beginning of the heating process, the heat was used to melt the ice. This is why the temperature stayed at 0° C. It remained at that temperature as long as ice was present. As soon as all the ice is melted, the temperature rose steadily until 100° C, it then leveled off and stayed at the boiling temperature until all the water was evaporated (this temperature may be close to 98° C depending on the elevation of the place). The heat during the boiling process is used to transfer the liquid into vapor state.

THE DISAPPEARING LIQUID

A. Question: *How long does it take for something to evaporate?*

B. Materials Needed:

1. A medicine dropper & wall clock (or timers)
2. Rubbing alcohol (isopropyl alcohol) or methyl hydrate

C: Procedure:

1. Have each of the students stretch out one of their hands with the palm facing up and held horizontally.
2. Come around with the “colorless liquid” (the alcohol) and the dropper; place 3-4 drops on each of the palms.
3. Have the students measure the time it takes for the liquid to evaporate completely.
4. You may repeat the activity, but this time have the students race to evaporate the liquid as fast as possible. They may do anything to the liquid except remove it from their palm or apply a match to it. Some may try blowing it, spreading it, etc.

D: Anticipated Results:

Within minutes the students should observe that the liquid disappears or evaporates.

E: Thought Questions for Class Discussion:

1. Where did the liquid disappear to?
2. What did you observe during the evaporation process?
3. How long did it take for three drops to evaporate?
4. Which method proved to be the most effective to speed up evaporation?
5. Where did the energy to change the liquid into a gas come from?

F: Explanation:

As alcohol is very volatile, it evaporates quickly. The three drops on the palm evaporate within a few minutes. The transfer of a liquid into its vapor state takes energy. This energy is usually supplied to the liquid in the form of heat. When this heat is not supplied to the liquid, and it evaporates by itself, it withdraws the heat from its environment. This is why the palm feels cool.

The evaporation process can be sped up by blowing over the liquid and by making its surface area larger by spreading it over the whole palm. Doing both at the same time would probably be the most time efficient. Each of these methods would increase the rate of evaporation.

CUT THROUGH ICE WITH A WIRE

A. Question: *Can a huge block of ice be cut through using only wire and weights?*

B. Materials Needed:

1. A large ice block
2. An iron or copper wire (about 1m long)
3. Two 1 kg weights or large rocks
4. A tripod (or tall tin can)

C: Procedure:

1. Place the ice block on the stand or on a tall tin can such that the ice block overhangs the edge of the can (the ice block should be larger in diameter than the can or tripod).
2. Tie the wire ends to the weights and hang it over the ice block, such that the weights are hanging (dangling) freely.
3. Leave the wire hanging for a while and observe the top part of the ice block which the wire rests (hang heavier weights on the wire to speed up the process).

D: Anticipated Results:

With time, the ice block will eventually be split in half.

E: Thought Questions for Class Discussion:

1. Why does the wire cut into the ice?
2. What happened to the water above the wire?
3. What property is being lowered by increasing the temperature?
4. Would a smaller ice block be cut faster?

F: Explanation:

Under high pressure the melting point of solids gets lowered. Under the wire, the ice molecules are pressed and thus they move faster. Immediately under the wire then, we get faster moving molecules, thus higher temperatures and melting of ice. The wire moves through this water, but as soon as the water gets above the wire, the pressure is off and the temperature of the water gets below 0˚C and it freezes again.

The larger the weights, the higher the pressure on the ice, and thus the faster the temperature under the wire is raised. This increases the rate at which the wire cuts through the ice. The same thing happens when the size of the ice block or the surface area between the wire and the ice is reduced.

HEAT WATER ABOVE ITS BOILING POINT

A. Question: *Can water be boiled beyond its boiling point?*

B. Materials Needed:

1. A small beaker (100ml) & thermometer
2. A burner and stand
3. Table salt

C: Procedure:

1. Let students work in pairs. Distribute the above materials to each pair of students.
2. Heat about 20ml water, place the thermometer in the beaker and record the temperature every half minute (one student stirs with the thermometer and reads off the temperature while the other records it).
3. As soon as the water boils, let students add different amounts of salt to the water (2, 4, and 6g of salt could be given to three groups of student pairs).
4. Continue heating, stirring, observing the temperature, and recording it very half minute until the water boils again.

D: Anticipated Results:

The students should see that the addition of salt to the boiling water drops its temperature and boiling ceases.

E: Thought Questions for Class Discussion:

1. What happened to the boiling when the salt was added?
2. What happened to the temperature after the salt was added?
3. What is the normal boiling point of water?
4. Which of the three groups had the highest boiling point?

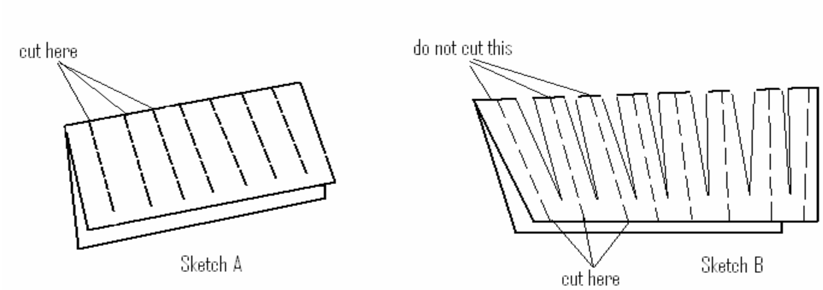
F: Explanation:

As soon as the salt is added to the boiling water, the temperature drops and the water stops boiling. This is because the salt has a lower temperature and dissolving it in water dissolves some of the heat. With the salt in the water, the water molecules adhere not only to each other-- but also to the salt ions, which makes it harder to transfer the water into the gaseous state. This is why the water has to have a higher temperature to boil. The more salt, the higher the boiling temperature of the solution. However, the temperature of the water vapor stays at 100˚ C (this can be checked by lifting the thermometer above the liquid).

This demonstration shows that impure water (water that contains minerals and salts) has a higher boiling point than pure (distilled) water.

WALK THROUGH A HOLE IN ORDINARY NOTEBOOK PAPER

A. Question: *Can something be changed physically but not changed chemically?*



B. Materials Needed:

1. One sheet of ordinary notebook paper
2. A pair of large, sharp scissors

C: Procedure:

1. Tell the students that you are going to cut a hole in the ordinary piece of paper, and that you are going to walk through the hole without tearing the paper!
2. Fold the paper in half, then make a series of straight cuts from the folded side, about 2cm apart stopping about 1cm from the edge pf the opposite side.
3. Turn the paper around and make cuts from the other side, and also stop about 1cm from the edge of the opposite side.
4. Except for the first and last strip at each end, now snip off the folded ends of the strips.
5. Then carefully open up the paper without tearing anything and walk through the hole.

D: Anticipated Results:

The students will see that the paper has changed and they will see you walk through it.

E: Thought Questions for Class Discussion:

1. Do you think you could ride a bicycle through the hole?
2. We've changed the paper by cutting it; was it a physical or chemical change that the paper underwent?
3. Did we change any of the chemical properties of the paper?
4. What is the difference between a physical change and a chemical change in a sample of matter?
5. What are some other ways that you could make a physical change in this piece of paper?
6. What are some ways that you could make a chemical change in the paper?

F: Explanation:

Of course, the change that we made in the paper was a physical one. No chemical properties of the paper were changed, before or after the change. When a chemical change is occurring in a sample of matter, the chemical properties in the products after the change are completely different from those before the change. To make a chemical change in the paper, it could be burned or placed in sulfuric acid. The products of the burning process of paper would be CO2 (carbon dioxide) which is a gas, plus water vapor and carbon. All three products have totally different properties compared to those of paper (the sample pf matter before the change).

THE BLUE AND RED CABBAGE

A. Question: *What is the purpose of an indicator in chemistry experiments?*

B. Materials Needed:

1. Few leaves of red cabbage.
2. A small beaker and four test tubes.
3. Test tube rack.
4. An alcohol burner and stand.
5. Vinegar, lemon juice, baking soda, lime.

C: Procedure:

1. Cut a red cabbage leaf in small pieces; place it in the beaker and add about 10mL of water to it.
2. Heat it above the burner until boiling, then pour equal amounts of the liquid in the liquid in the four test tubes.
3. Place a few drops of vinegar in the first and a few drops of lemon juice in the second test tube. Have the students observe closely the color of the liquid.
4. Add a pinch of baking soda to the third and a pinch of lime to the fourth test tube. Observe the color change!

D: Anticipated Results:

The students should expect to observe a color change when they add the different liquids such as vinegar, lemon juice, baking soda and lime to the test tubes containing the red cabbage mixture.

E: Thought Questions for Class Discussion:

1. Which two chemicals colored the cabbage juice red?
2. Which two chemicals colored the cabbage juice blue?
3. What would happen if we added baking soda to the cabbage leaf?
4. To which of the two groups of chemicals would orange juice belong? Pineapple juice? Grape juice? Soap water?
5. What would happen if we added vinegar to the blue liquid?

F: Explanation:

The red cabbage juice acts like litmus, which is an indicator that turns red in acids and blue in bases. Vinegar, lemon juice and other sour tasting juices are all acids; whereas baking soda, lime and soap water are bases. Chemists utilize a scale denominated the pH scale in order to determine if a substance is basic or acidic. The pH scale will be dealt with in higher grades, and it is the negative logarithm of the hydrogen ion concentration. A pH of 7 indicates that the liquid is neutral, a pH less than 7 indicates acidity and a pH higher than 7 indicates a basic liquid.

Other common indicators are: litmus paper, phenolphthalein, methyl orange and methyl red.

FREEZING WATER

KEY OPENING QUESTION: When water freezes does it expand or contract?

MATERIALS: 2 small identical cans
Water
Refrigerator with freezer

PROCEDURE:

1. Fill both cans to the top with water.
2. Place one of the cans in a freezer.
3. Place the second can in a refrigerator.
4. Let the cans stand until the next day (or until the one in the freezer is frozen).
5. Compare the two cans.

OBSERVATIONS AND DATA:
Draw what the two cans look like. What happened to the water in each can?

Explain your observations

What happens to the volume and density of water as temperature decreases?

CONCLUSION: (Answer the question)

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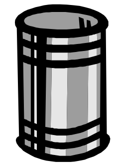
THE SWEATY CAN



KEY OPENING QUESTION: **How Does Water Vapor Condense?**

MATERIALS: Shiny can
Water
Ice cubes

PROCEDURE:

1. Fill the can with water until it is half full.
2. Add some ice cubes and stir. (May need to go outside!!!)
3. Record observations

OBSERVATIONS AND DATA:

What did you observe?

Why did this happen?

CONCLUSION: (Answer the question)

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