FISH

LESSON 13: DISSOLVED OXYGEN

TEACHER GUIDE

BACKGROUND INFORMATION

- Gases, such as oxygen, are capable of dissolving in water. Some gases are more soluble that others. For example, oxygen is approximately twice as soluble in water as is nitrogen.
- Oxygen is also more soluble in water than carbon dioxide. It is for this reason that carbon dioxide is used in carbonated beverages instead of oxygen. Carbon dioxide remains as bubbles whereas oxygen would just dissolve.
- When a gas dissolves in water, the molecule of that gas remains intact. It simply becomes "trapped" amongst the water molecules.
- Gases are more soluble in colder water. This is because as the temperature of water increase, the kinetic activity of the water molecules also increases. This activity forces the gas molecules (such as oxygen) to escape the water.
- Boiling demonstrates this concept nicely. The bubbles that appear when the water is boiling are actually the gas that was previously dissolved, escaping. Bubbles also form when liquid water gets hot enough to transform into water vapor.

- Fish breathe oxygen through the use of their gills.
- Water flows into the gills of a fish. The oxygen which is dissolved in the water diffuses into the blood stream, while the carbon dioxide from the blood diffuses out, back into the water. The water never actually enters the fish's body.
- Water movement is essential for the well-being of fish. The moving water creates a stirring action between the atmosphere (containing oxygen) and the water. This stirring infuses the water with gases from the atmosphere, thereby oxygenating the water.

LESSON OBJECTIVES

- To understand that animals function in a similar way to humans, using fish and breathing as an example.
- To expand the students' knowledge of the properties of the forms of matter by understanding that gases such as oxygen can dissolve.
- To understand and visualize how the oxygen from the air actually gets into the water for the fish to breathe.
- To practice graphing.
- To practice reading and understanding graph trends.
- To practice drawing conclusions from graphs and trend lines.

LESSON MATERIALS

- Graph paper for each student
- A pencil for each student
- Rulers to create the straight lines on the graphs
- Copies of the assessment

ASSESSMENT ANSWER KEY

1) Fish breathe oxygen (B)
2) Oxygen dissolves more easily in cold water (A)
3) Water movement does help oxygen get into water (A)
4) Fish would not be able to breathe if the water they lived in were boiling. This is because when water boils the air that was dissolved in it is escaping. There would be little or no oxygen in the water for the fish to breathe.

STUDENT GUIDE – HOW DO FISH BREATHE?

VOCABULARY

Oxygen – The gas in the air that animals breathe. It accounts for about 21% of Earth's air.

Dissolve – To combine by mixing with a liquid. When sugar disappears after being mixed with water, it has dissolved.

Trend – The general direction something is going.

Parts Per Million – A measure of how many parts something takes up per million parts. 100 chocolate doughnut parts per million would mean that 100 out of a million doughnuts were chocolate.

Disturbed – Moved around.

Aeration – To put air into something.

LECTURE AND DISCUSSION

- Begin the lesson by asking the class: do fish breathe?
- Fish are animals just like we are, and therefore do need to breathe in order to stay alive.
- Ask the class: what do you think fish breathe?
- Fish breathe oxygen, just like we do.
- Fish use their gills to get oxygen out of the water. (power point)
- Ask the class: how do you think oxygen gets into the water?
- Oxygen can dissolve in water. (power point)
    - Oxygen dissolves in water just like salt and sugar dissolve in water.
    - Ask the class: have you ever seen a solid dissolve in water?
    - Gases such as oxygen dissolve in the same way.
- Oxygen can easily get into the water when the water mixes with the air. (power point)
    - This happens in the ocean with waves.
    - This happens in our fish tank with an aerator or when the water comes from the plant tank and splashes into the fish tank.
    - Let the students observe the fish tank and look for the air bubbles, which is the air going into the water.
- This is how fish are able to breathe, by using their gills to get the dissolved oxygen out of the water.

ACTIVITY

- The amount of oxygen that can dissolve in water varies as a result of the water temperature.
- Have each student create a graph with a "best-fit" line using the following values: (note: these values are approximate)

Water Temperature (degrees C)	Level of dissolved oxygen (parts per million)
1	14
10	11
15	10
20	9
25	8
30	7

CONCLUSION

- Go over the trends of everyone's graphs.
    - The level of dissolved oxygen decreases as the water temperature increases.
- Ask the class: what does this trend mean? Does oxygen stay in cold or warm water better?
    - This means that oxygen stays in cold water better than warm water.

- A good example of this is boiling water.
    - Ask the class: who has seen water boil? What does it mean for water to be "boiling"?

- When water is boiling it means that there are bubbles escaping from the water.
- Some bubbles are from liquid water getting hot enough to turn to gas called water vapor. But, some of these bubbles are actually the air that was dissolved in the water, but is no longer able to stay because the water got too hot.
    - The air leaves in the form of bubbles – this is why water "boils"!
- Reiterate the idea that fish breathe just like we do, and they breathe oxygen just like we do.
- Fish get this oxygen by using their gills to extract it from the water.
- Oxygen gets into the water more easily when the surface of the water is disturbed, like with waves or aeration.

EXTENSION

- Social studies – the topic of dissolved oxygen could lead into a discussion of "lake and ocean dead zones" for more advanced students.

- Science – If you have, or wish to acquire, an instrument to measure oxygen levels in water, this opens up a number of interesting science experiments. Your class could test how oxygen levels vary with the temperature of the water, the disturbance of the water or within other liquids. Also, discussions of the components of air, as well as the varying solubility of gases are appropriate within this lesson. Note: carbon dioxide does not dissolve well in water; this is why it is used in soft drink production.

Name_____ Date_____

ASSESSMENT 13 – DISSOLVED OXYGEN

1) What do fish breathe? (Circle one)
    A. Carbon dioxide
    B. Oxygen
    C. Fish do not breathe
    D. Nitrogen

2) Does oxygen dissolve more easily in: (Circle one)
    A. Cold water
    B. Hot water
    C. Oxygen does not dissolve in water.
    D. The temperature does not matter in dissolved oxygen.

3) Does water movement HELP oxygen get into water? (Circle one)
    A. Yes
    B. No
    C. Sometimes

4) Would fish be able to breathe if the water they lived in were boiling? Why or why not? (In your own words)