



Grade Level:
10th Grade

Subject:
Biology

Exhibit:
#14 Reclamation
(Factors that Affect
Dissolved Gasses in
Liquids)

**Approximate
Time Frame:**
2 hours (more than one
class period)

Materials:

- paper
- pencil
- soft drinks
- Erlenmeyer flask
- gold fish
- fish tank
- beaker

Lesson Plan - Gas it Up!



Science TEKS:

1. A Demonstrate safe practices during field and laboratory investigations.
1. B Make wise choices in the use and conservation of resources and the disposal or recycling of materials.
2. A Plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting equipment and technology.
2. B Collect data and make measurements with precision.
2. C Organize, analyze, evaluate, make inferences, and predict trends from data.
2. D Communicate valid conclusions.
3. A Analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information.
3. B Evaluate promotional claims that relate to biological issues such as product labeling and advertisements.
3. C Evaluate the impact of research on scientific thought, society, and the environment.
3. D Describe connections between biology and future careers.
3. E Evaluate models according to their adequacy in representing biological objects or events.
3. F Research and describe the history of biology and contributions of scientists.
4. D Identify and describe the role of bacteria in maintaining health such as in digestion and in causing diseases such as in streptococcus infections and diphtheria.
11. A Identify and describe the relationships between internal feedback mechanisms in the maintenance of homeostasis.
11. D Summarize the role of microorganisms in maintaining and disrupting equilibrium including diseases in plants and animals and decay in an ecosystem.

- 12. A Analyze the flow of energy through various cycles including the carbon, oxygen, nitrogen, and water cycles.
- 12. D Identify and illustrate that long-term survival of species is dependent on a resource base that may be limited.
- 12. E Investigate and explain the interactions in an ecosystem including food chains, food webs, and food pyramids.

Related TEKS: Physics and Chemistry

Vocabulary of Instruction:

sewage	saturation of oxygen
powered carbon	respiration
electrons	BOD

Advanced Preparation: Organize students' into groups

Instructional Procedure (5 E)

Engage: The students will: Describe the biological processes involved in water reclamation and purification of wastewater.

Explore: 1. Soda bubbles: Carbon dioxide dissolved in a soft drink is the highlight of any soda drink. Just try a flat soda and you will know what I mean. Since carbon dioxide is a gas that is dissolved in solution with the soda is can be used to represent the factors that affect all other dissolved gasses such as oxygen. This demonstration may take a while so it might not be something you can do in a single class period. Give it one day and you will get good results. You can set up several different trials testing a variety of independent variables to determine the affects on the dependent variable of dissolved gasses.

To test for the affects of temperature you start with two cold cans of soda. Open both of them and keep one out in the warm sun for a day and the other one put back in the refrigerator. The next day you can set up a gas collecting device through water displacement in an inverted container attached to a tube to a cork that fits on an Erlenmeyer flask. Pour the soda into two separate flasks and cork them so that the only gas that escapes is to the gas collection device. Shake the flask with the soda the same pre-determined amount of time for each trial to help release the dissolved gasses. Measure the amount of gas remaining in each of the samples.

To test for the affects of pressure you can open only one can of soda and keep the second one closed and under pressure from the factory. Let both cans sit on the counter for one day. Use the same gas collecting device mentioned above and compare the two trials for remaining dissolved gasses.

You can buy kits to measure dissolved oxygen in water and set up other trials measuring just the concentration of this gas. These kits are nice and the measurements can be done in a short class period. You can test for the concentrations of oxygen in solutions of different temperature or solutions that are being aerated or not. A fish tank air pump works well in this case and can lead to understanding why the sewage treatment plants aerate the BOD (biochemical oxygen demand) process. You can get measurable



What is biochemical oxygen demand?

differences in dissolved oxygen amounts using these kits and testing the water under a variety of conditions.

If you have some inexpensive gold fish you can observe different respiration rates of the fish under different temperature conditions. Set up the fish at room temperature and in a large clean beaker with an aerator running in it. You can measure the respiration rate at that temperature by counting the movement of their opercular plates that cover their gills for one minute. After you record the rate you can then place the beaker in an ice bath to lower the temperature slowly about 5 degrees and determine the respiration rate again at that temperature. Drop the temperature another 5 degrees in the ice bath and repeat the process to determine the respiration rate at that temperature. After recording your data place the beaker on the counter to let it warm back up slowly. The drop in temperature does not lower their metabolism that much but the availability of dissolved oxygen in the water increases as the temperature decreases as long as you keep the aerator going in the water you should get noticeable results. Graph the data to help make a conclusion about the results.

Explain: During secondary treatment of sewage a symbiotic relationship between humans and bacteria takes place that may not have been part of the evolutionary plan. Nature's decomposers can be fooled into thinking they are on the holiday luxury cruise with unlimited buffet bar. One of the main ingredients in secondary sewage treatment that aid the bacteria the most is the saturation of oxygen in the sewage solution. Powdered carbon acts as a dinner table and the oxygen acts like a bottomless stomach. During cellular respiration, oxygen is the final receptor of electrons in the electron transport chain that is used to produce most of the ATP energy molecules used in the cells daily processes. The presence of unlimited amounts of oxygen will enable the bacteria to decompose organic matter without stopping or slowing down using the process of cellular respiration. This process is called biochemical oxygen demand. If we rely on dissolved oxygen to help the bacteria do the work of decomposing sewage for us, it is important to know what factors affect how oxygen gas becomes dissolved in water.

Elaborate/Extend:

Questions:

What were some of the factors that effected the concentration of dissolved gasses in liquid?

How does aerating the water help maintain a steady supply of dissolved oxygen?

What is the importance of aerating the sewage treatment process?

What is biochemical oxygen demand?

Evaluate: Closure of class will consist of student groups developing and presenting a statement about what they learned today and how it may change their ideas toward their water use and the use of reclaimed water in the city.