Ocean Acidification Lab – The Naked Egg

Name:______________________________
Date:____________________________

**Prelab Questions:**

1. What is vinegar’s pH?

2. Is it acidic or basic?

3. Compounds make up vinegar?

4. What is the main component in egg shells?

5. Name 3 animals who have shells composed of this material.

**Hypothesis:** What do you think will happen to the egg after it’s left in Vinegar for 24 hours? Why?

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**Materials:**

- White vinegar (5% acetic acid)
- 1 egg per cup
- Cup

**Procedure:**

1. Pour 1 cup of vinegar into jar
2. Add the egg
3. Record what you see
4. Leave the egg in the vinegar for one day.
5. Remove the egg and feel it.
6. Record your observations

Observations:

Questions:

1. What happened to the egg's shell?

2. Describe the reaction(s) that occurred

3. Oceans are large carbon sinks, meaning the water is able to dissolve large amounts of CO₂ from the atmosphere. They actually dissolve 1/3 of CO₂ made from fossil fuel combustion. While this is good for our environment, it will have an effect on our oceans because when CO₂ is dissolved it causes the pH to do down. Below is the reaction that occurs:

   \[ \text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{H}_2\text{CO}_3 \]

   Carbonic acid (H₂CO₃) is the product.
   a) Is H₂CO₃ a strong or weak acid?
b) Write out its dissociation in water

c) If more and more CO$_2$ is dissolved in the ocean, what will happen?

4. In addition to changing pH, additional hydrogen ions in the water will react with any carbonate ions that may be present with the following reaction.

\[ \text{H}^+ + \text{CO}_3^{2-} \rightarrow \text{HCO}_3^- \]

Carbonate ions are essential because organisms with shells need to make CaCO$_3$ for their shells with Ca$^{2+}$ ions and CO$_3^{2-}$.

The ocean’s depth is separated into two sections: the surface that is saturated with CaCO$_3$, meaning there are enough Ca$^{2+}$ and CO$_3^{2-}$ ions to be used to form shells. And the deep sea, which is undersaturated, or the water is corrosive enough to dissolve CaCO$_3$.

a) What does corrosive mean?

b) Where do you think the majority of shellfish and coral form CaCO$_3$ for their shells and exoskeleton?

5. With the continual addition of CO$_2$ to the ocean, the volume of saturated CaCO$_3$ surface water is decreasing.

a) Explain this phenomenon.
6. Pick one of the following life forms and research what effect ocean acidification will have on them.
   i) Coral
   ii) Phytoplankton and Zooplankton

7. How does the egg experiment connect to ocean acidification? What is similar and what is different?
Ocean Acidification Lab – The Naked Egg

Prelab Questions:

1. What is vinegar’s pH?
   
   2.4-3.8 depending on concentration of acetic acid.

2. Is it acidic or basic?
   
   acidic

3. Compounds make up vinegar?
   
   acetic acid and water

4. What is the main component in egg shells?
   
   CaCO₃

5. Name 3 living organisms who have shells composed of this material.
   
   Some include: Echinoderms (star fish), Crustaceans (crabs), Mollusca (snail)

Hypothesis: What do you think will happen to the egg after it’s left in Vinegar for 24 hours? Why?

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Materials:

• White vinegar (5% acetic acid)
• 1 egg per cup
• Jar

Procedure:

1. Pour 1 cup of vinegar into jar
2. Add the egg
3. Record what you see
4. Leave the egg in the vinegar for one day.
5. Remove the egg and feel it.
6. Record your observations

**Observations:**

**Questions:**

1. What happened to the egg’s shell?

   It dissolved.

2. Describe the reaction(s) that occurred

   $$2\text{CH}_3\text{COOH} + \text{CaCO}_3 \rightarrow \text{H}_2\text{CO}_3 + \text{Ca(\text{CH}_3\text{COO})}_2$$

3. Oceans are large *carbon sinks*, meaning the water is able to dissolve large amount of CO$_2$ from the atmosphere. They actually dissolve 1/3 of CO$_2$ made from fossil fuel combustion. While this is good for our environment, it will have an effect on our oceans because when CO$_2$ is dissolved it causes the pH to do down. Below is the reaction that occurs

   $$\text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{H}_2\text{CO}_3$$

   Carbonic acid (H$_2$CO$_3$) is the product. Is H$_2$CO$_3$ a strong or weak acid?

   Weak

   Write out its dissociation in water

   $$\text{H}_2\text{CO}_3 \leftrightarrow \text{H}^+ + \text{HCO}_3^-$$

4. If more and more CO$_2$ is dissolved in the ocean, what will happen?

   - more carbonic acid will form, the reaction will move to the right.
   - increased amount of H$^+$ ions, increased acidity.
5. In addition to changing pH, additional hydrogen ions in the water will react with any carbonate ions that may be present with the following reaction.

\[ \text{H}^+ + \text{CO}_3^{2-} \rightarrow \text{HCO}_3^- \]

Carbonate ions are essential because some organisms in the ocean need \( \text{CaCO}_3 \), to make their shells with \( \text{Ca}^{2+} \) ions and \( \text{CO}_3^{2-} \) ions.

The ocean’s depth is separated into two sections: the surface that is saturated with \( \text{CaCO}_3 \), meaning there are enough \( \text{Ca}^{2+} \) ions and \( \text{CO}_3^{2-} \) ions to be used to form shells. And the deep sea, which is undersaturated, or where the water is corrosive enough to dissolve \( \text{CaCO}_3 \).

What does corrosive mean?

6. Where do you think the majority of shellfish and coral form \( \text{CaCO}_3 \) for their shells and exoskeleton?

- In the zone that is saturated with \( \text{CaCO}_3 \), where the ions are available.

7. With the continual addition of \( \text{CO}_2 \) to the ocean, the volume of saturated \( \text{CaCO}_3 \) surface water is decreasing. Explain this phenomenon.

- The acidity of the water is going up, which caused more \( \text{H}^+ \) ions to react with \( \text{CO}_3^{2-} \) ions, which would normally react with \( \text{Ca}^{2+} \). This causes \( \text{CaCO}_3 \) to become undersaturated.

8. Pick one of the following life forms and research what effect ocean acidification will have on them.

1. Coral
2. Phytoplankton and Zooplankton
9. How does the egg experiment connect to ocean acidification? What is similar and what is different?