

Intertidal Stressors

Duration:

Set up – 1 class
Running time – 1 week
Observations and analysis – 2 classes

Objectives:

Students will:

- Set-up intertidal areas in tubs with differing environmental conditions
- Observe and record changes
- Analyze the results

Vocabulary:

Intertidal zone

The area between the high tide and the low tide where organisms are sometimes under water, and sometimes exposed to the air during a tidal cycle

pH

Measure of H⁺ ions in a solution, a measure of acidity

Temperature

Measure of the thermal energy of an object; the average speed of the molecules in the substance

British Columbia PLO's:

Science 6, 7, 8

Background:

This activity is best done after the introductory *Ocean News* activities on climate change to introduce the topic and the associated vocabulary.

The intertidal zone is where humans get to take a glimpse at what is found beneath the waters of the oceans. We have all walked along the beaches to see what we can discover. With abrupt climate change happening across the planet, the intertidal zone will be affected in many different ways. In this activity students will get to examine and test how the intertidal zone will be affected.

The first experimental set-up will examine how increased storm activity will affect coastlines with high onshore winds battering intertidal communities. Students will create low and high wind shorelines to examine different outcomes.

The second set-up will increase the acidity in the water. Changes to ocean pH are a threat to many marine organisms. Students will create acidic and neutral beaches to test the affects. This is an important topic because as the acidity of the ocean increases it becomes more difficult for marine

organisms to create the hard shells they depend on for protection.

The third experimental set-up will be combining the effects of increased wind and decreased pH to test what overall affects these changes will have on shell bearing organisms.

Materials:

- *Ocean News* article *Intertidal trouble*
- Totes or tubs (number will be determined by your set-up)
- Fans with at least 2 speeds
- Electronic scale
- pH paper strips
- Measuring cups and spoons
- Chalk (not dust free)
- Tap water
- Markers/felts
- Vinegar
- Oven
- String

Procedure:

1. With the class, read the *Intertidal Trouble* article from *Ocean News* (out loud or individually).
2. Have the students summarize what the article was about in their notebooks.

3. Introduce the plan to create shorelines in tubs to test out the affects changing climate will have on shorelines. Ask the students what variables will need to be altered; what controls will be needed, etc. If experimental design is new to the class thoroughly review this procedure before proceeding.
4. Break the class into small working groups that will set-up the different experiments, 3 to 4 people is ideal. Depending on the size of your class you can have each group set up one of the necessary tubs dividing and assigning treatments so that you get the desired total six tubs. If time and equipment allows you can have each group set-up the entire experiment.
5. Consult with the Experimental Set-up diagram to explain the experimental procedure.

pH impacts experiment

1. Set-up two totes to create a shoreline. This can be done by propping up one end of the tote with a rock or piece of wood, for (approximately) a 10-degree tilt. This will create a deep-end and a shallow-end. You want to have a few centimeters of dry shoreline at the top of your bucket but not much more.
2. The tubs will need to have water added to them to create the shoreline. Your water amount will vary depending on the size of your totes. The amount of water in each tote needs to stay constant as one of the controls. The neutral tote can be filled using a measuring device to figure out what volume is needed. The pH can be measured using pH paper. Make sure to measure the pH at the beginning of this exercise to see what your starting value is (tap water pH values may differ from time to time).
3. The acidic tub will need a few calculations. For the acidic tote the addition of ¼ teaspoon of vinegar for 1 cup of water takes the pH from 7 to 5.5.

You should not have to account for the increased volume due to the vinegar addition as the amount will probably be small enough to be negligible. Add the vinegar in small amounts using pH paper along the way to test the acidity until reaching your target pH. You should aim to have your acidic tote at around a pH of 6 to 6.5. Your results should be more noticeable with lower pH values (but we want to keep the results somewhat realistic). Surface pH in the oceans is normally 8 to 8.5 (it's predicted to drop to 7.7 over the next century).

4. If the water you start with is already below 8 you can use baking soda to increase the pH of your neutral tote to a higher value. ¼ teaspoon of baking soda in 1 cup of tap water will take the pH from 7 to approximately 9.
5. For each neutral and acidic tote take three pieces of dry chalk and have the students record the mass of each. Make sure to mark each chalk with a number and letter on the end that will not be submerged in the water so that each piece can be tracked (ex. A1, A2, A3 for the acidic tub).
6. In the deep end of the tubs suspend the pieces of chalk tied around the top suspended so that they are submerged in the water.
7. Once the experiment is set-up with chalk suspended in the neutral and acidic waters leave the totes where they can be observed for 1 to 2 weeks.
8. Have the students create an observation page where each day they can write some qualitative descriptions of what they see.
9. At the end of the 1 to 2 week period take the chalk out of the water and put them aside to dry. This can be done in an oven (350°C for 2 hours) in order to remove all the water from the chalk before taking the second mass.
10. Record the mass of the dried chalk and make comparisons with the original

weights. Averages can be taken to examine any trend

Wind experiment

1. Set-up three totes in the same way as with the pH tubs, with equal amounts of water in both and shorelines at one end with three chalk pieces strung along the deep end. These tubs will contain tap water. If you wish to bring the pH to the oceanic normal of 8 to 8.5 you can use baking soda or vinegar accordingly.
2. Place the tubs in an area that they can be observed without disturbance near an electrical outlet. In both tubs, place the fans so that they are blowing from the deep end towards the shallow end mimicking onshore winds. Have one fan blowing on high in one of the tubs, and the other blowing on the low speed creating two different wind treatments. The third tub has no wind blowing and is a control to see how much chalk is lost to the water without wave action. If you have the pH experiment running as well you can also use the neutral tub for this same purpose.
3. Have the students create an observation page where each day they can write some qualitative descriptions of what they see.
4. After 1 to 2 weeks take the pieces of chalk out of the water, dry the pieces, measure and record their masses, and make comparisons with the original masses for each piece. Averages can be used for the treatments to look for trends.

Wind and pH experiment (this exercise can be used when you have large groups, or for an extension for older students or advanced groups)

1. This final treatment is a combination of the two previous treatments, so there is a total of four tubs. Each tub is set-up with the same amount of water and the same tilt to create the shoreline.

2. Set-up the two sets of tubs with neutral and acidic water in the same way as the pH comparison. There should be two with acidic and two with normal water.
3. For the neutral tubs set-up one with a fan on high and one on low speed. Do the same for the acidic tubs.
4. Place all four tubs where they are easily observable and will not be bumped or disturbed frequently.
5. Have the students create an observation page where each day they can write some qualitative descriptions of what they see.
6. After 1 to 2 weeks take the pieces of chalk out of the water, dry the pieces, measure and record their masses, and make comparisons with the original masses for each piece. Averages can be used for the treatments to look for trends.

Wrap-up

1. Have the students create a bar graph to illustrate the results of their experiments.
2. Put the discussion questions up on the board or overhead and have the students answer them individually or in small groups.

Discussion:

- What are the treatments and controls in this experiment?
- Why did we have to completely dry the chalk before taking the mass the second time?
- Relate how each of the experiments is testing a real world condition that may happen in the intertidal zone.
- Why is it important to test both the wind speed and the pH in one scenario?
- What sources of error are there in this experimental design and how would you correct them in the future?
- Why do we want to place the tubs in an area where they will not be bumped or disturbed frequently during the experiment?

Extension and Resources:

- See the PowerPoint document “Intertidal Stressors Experimental Set-up” for a diagram illustrating the lab set-up
- Temperature is another variable that can be tested with a similar set-up by placing the totes in warm and cool climates. This can be achieved by finding rooms in the school that have different temperatures. The set-up will be the same as the totes to test wind and pH separately. You can also combine temperature with either pH or wind in the same way as pH and wind were combined.
- Split up the experiments into three sets. With the class in three groups, run the experiments while allowing the remaining class members to observe and record them (ideally each group would create a presentation for the other groups; the outcome could be something similar to a science fair day).

Risk management:

Having water and electrical fans near each other can be dangerous. Make sure that all the electrical outlets are ground faulted and are safe for use. Adults should do all the plugging and unplugging of the electrical units with clean, dry hands. Electrical safety should be discussed as a class to ensure that everyone is carrying out safe procedures.

All labs should utilize proper equipment. All the materials in this lab are household items and are not harmful but this lab can be used to practice and reinforce good experimental procedures and practices. Gloves and goggles should be used by all students.