Mass Balance and Our Ocean's Acidification

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Objective: To introduce students to a lesser discussed aspect of climate change, ocean acidification, via mass balance. Through lecture, group activity, and lab, students will learn about mass balance, how to use it, and about ocean acidification and its potential ramifications. The different modes of learning are purposefully used to access as many different kinds of learners as possible.

Lecture: The PowerPoint presentation will take students through what they will need in order to discover, understand, and use mass balance for environmental application. It will also introduce them to ocean acidification and the potential threats that come with it. Though this is likely more relevant to a coastal or island community, it still affects all of us around the world.

Mass balance is introduced though the law of conservation of mass. The presentation then defines what mass balance is and gives examples of its use. An equation for mass balance is given. There are many derivations of this equation depending on its application, but this one was chosen for its simplicity and application to environmental science. To make it a bit simpler to understand, the equation is used to solve some questions about filling a bathtub. At this point the equation is modified to deal with volume specifically. I mention here that volume has mass, so this equation is still valid. If time permits you could have the class work these equations. I then take the conversation to the environment. Earlier in the course we discuss nutrient cycles including the carbon cycle. I now return to that (slide 11) and have them practice using the mass balance equation they have just learned in a group activity. Originally I split each class into four groups, two solving for atmospheric carbon after a year and two solving for surface ocean (where corals grow) after a year. We then compared answers and I explained how to get the correct answer. I also use this time to explain why seeking multiple results is important (experimental repetition). I think what would be better is to have all groups solve for atmospheric carbon, go over their answers, and show how to properly solve the equation, then have them do the surface ocean carbon. This will hopefully see all of them getting at least one of them correct and build confidence. I finish the activity by solving for the amount of surface ocean carbon at the end of the century (here, slide 12, the answer will vary each year).

The focus now turns to ocean acidification by explaining it and its potential ramifications. Making the connection from what we see in the group activity about the increase in surface ocean carbon and ocean acidification. For us as an island nation the effect ocean acidification can have on coral reefs is quite dramatic and directly affects us in many ways.

Laboratory: The lab is used to add another type of hands on activity. They will be expanding on and reviewing their laboratory skills. At this point my classes have measured fluids and understand the importance of proper procedure and labeling, but have not used a pH meter. As it takes a while I recommend them starting the experiment before the lecture begins and then have them revisit it for results when the lecture is finished.

They will measure out the necessary volumes of solution A and B and pour them into trays they have appropriately labeled. I chose not to tell them what each solution is as to not bias their results, this can obviously be changed. Once they are all done pouring their solutions into trays, I have them, at the same time, add the tablets to the trays, this will keep all groups (this can also be done individually) together. After they finish they can see if any change has occurred with either tablet and if there is any difference between tray A and tray B. I did not specify how students should do this, so many did it by sight only. One student asked could they touch it and afterwards changed their mind on their results, so this might be advised. Then I would have them use a pH meter to test the difference between the solutions. A simple hand held meter with a 0.1 precision should be used. Solution A is plain seawater and solution B is seawater I reduced the pH by 0.3. I chose this amount because it is the midway projection for ocean pH by 2100. I then explain this to the students and what should have happened. We also discuss what could have been changed to improve the experiment focusing again on the scientific method.