**Ocean Acidification Module - Professional Development**

**Materials (per group of 2-3 teachers):**

* 1 goodie bag (GB8? TBD)

1. **Introduction**
   1. The purpose of this training will be to discuss the best ways to add hands-on components to classes that generally deal with topics that are more abstract, and maybe are taught with only a lecture-based component.
   2. Why concrete experiments to teach abstract concepts?
      1. We want to foster exploration in the classroom
      2. We want to reinforce concepts through tangible actions, so that students may better retain the information and so that what they are learning feels more “real” to them.
      3. We want to engage students with different learning experiences
      4. We want to enhance both individual and collaborative “discovery-based” learning moments that cannot be predicted
   3. The problem with trying to initiate this hands-on approach is that limited resources prevent large-scale experiments
2. **The 3.091 approach: the “goodie bags”** 
   1. The approach taken at MIT in 3.091, which is an introductory chemistry class taken mostly by new freshmen: mini hands-on take-home experiments

* Given out once a week
* Includes instructions for the experiment and questions about the experiments
* Need to be brought in class the following week to be used during weekly quiz
  1. The teachers will be split into groups of 2 or 3. If possible, have the groups be split by discipline (i.e. math teachers together) or perhaps age of the students they teach (i.e. eighth grade teachers together).
  2. Each group will receive a goodie bag #8, the ocean acidification GB. They should be given the chance to look through the bag’s contents; read the problem sheet and look at the materials.
  3. Background about the GB: This GB is given out during the kinetics section of the course. It ties the concepts that the students are learning in class (reaction rates) with the real-world problem of ocean acidification, and lets the students see the effect that ocean acidification has on sea life (here represented by the dissolving shells).
  4. What we’ve learnt about GBs:
     1. Content needs to be explicitly tied to graded assignments. This provides students with the motivation to complete the activity and retain as much knowledge as possible from it.
     2. Bonus points aren’t a good enough motivation to complete
     3. Connection to learning needs to be obvious, otherwise only partially done. I.e. Questions in the GB must be similar to what they later see on quizzes.
     4. Always received with excitement
     5. Encouraged class attendance (distributed in lecture)

1. **Develop your own**
   1. The teachers will now work to develop a hands-on component for one of their lessons. With their group, they should decide on a topic around which to design the activity.
   2. Next, each group should think of a tangible way to exemplify their topic (resting/falling ball for potential/kinetic energy, picking differently colored marbles out of a bag for probability, etc.).
   3. The group should make a list of materials for their activity, a procedure (step-by-step instructions) and write 3 questions to go along with it. Be sure that:

* These questions relate to what the students will see happening in the activity
* The questions also tie back to the theoretical concepts (e.g. have the students measure the height at which the ball will fall and ask them to calculate potential energy, or calculate how likely it it to pick out a blue marble, etc.)
* Assess each question and activity by assigning it as contributing to “enduring understanding,” “important to know and do,” or “worth being familiar with”
* Suggest ways to integrate the activity into the learning process to ensure effectiveness (e.g. tested on a quiz).
  1. After the groups have their materials, procedure, and questions ready, they will present the activity to the rest of the teachers, and ask for feedback.