Monitoring Gas Exchange for Plants or Animals

*you can access this document through the SeaVuria Biology Collaboration folder to access the hyperlinks.

Purpose of kit:
This kit helps support student understanding of gas exchanges between living organisms and the environment. In the study of photosynthesis, students often struggle with the idea that carbon dioxide is the primary source of mass for a plant and that organisms expel carbon from their bodies through carbon dioxide. This kit provides them with evidence of how carbon moves into and out of living organisms.

The investigation is most powerful if it comes *before* students are taught photosynthesis or cellular respiration equations. It allows them to collect evidence of the matter transformations that are happening and take some ownership of constructing that understanding. If students are first told the equation, they will memorize the equation and give little thought as to what the equation is actually representing.

A good follow-up to this kit is the Molecular Model kit.

Contents:
- Biochamber (round plastic container with two holes)
- CO2 probe
- O2 probe
- LabQuest with power source
- BTB
- Straws

Preparation:
1. Make sure the LabQuest is fully charged
2. Check with a SeaVuria chemistry teacher if you are unsure of how to use the LabQuests. **Practice running the investigation before doing it in front of students!**
3. You will need the following additional supplies:
    a. If doing photosynthesis, you will need a living plant that will fit in the biochamber
    b. If investigating cellular respiration, you will need small organisms (beetles would likely work well) to fit in the container. Alternatively you can use a plant in the dark to do cellular respiration.
4. If using the BTB, you will need to dilute the BTB and possibly titrate it. To do this, see instructions here.

Lesson:
Photosynthesis with Probes:
1. Introduce the investigation: Students are going to determine inputs and outputs of a plant at the macroscopic scale. Ask them to predict what will go into and out of the plant. While students are making predictions, ask them what they think the plant will do with any molecules that the plant absorbs from its environment
    a. Talk strategy: This would be a good opportunity to have students share with an elbow partner then share out with the class
2. After students have made their predictions, run the demonstration. Put the plant in the Biochamber and attach the probes to the LabQuest and place probes into the container. Place Biochamber in the light (by a bright window or outside in the sun works best) for approximately 10 minutes to get results.
3. Have students record results. They should see that the CO2 in the container decreased while O2 increased.

4. Students can write claims about their observations: a claim includes both a statement of the observation as well as a possible reason why this happened. For example, “The carbon dioxide in the container decreased because the plants absorbed it and turned it into oxygen.” While the “why” in this idea is incomplete, it reveals what the student is thinking is happening to the carbon dioxide. This would be different from a student who says, “The carbon dioxide in the container decreased because the plants absorbed it and turned it into glucose.” While this idea is also not entirely correct, these two ideas could be shared and argued about in class
    a. Talk strategy: Have groups of students work together to draw a picture of what they think is happening at the atomic molecular scale. This could include a “zoom bubble” of what’s happening inside the leaf of the plant.
5. Have student groups share out their claims and record somewhere for the class to see. This activity is best followed with the molecular modeling kits. After that activity, students can revisit these claims to see if they can improve them.
6. Have students write in their summary charts to document their understanding. An example of the summary chart can be found here.

Photosynthesis with BTB.

1. Follow the same lesson flow as above, but instead of using the probes, place the plant in a large zip-lock bag with two small dishes: one with yellow BTB and one with blue BTB. Show students that when you blow bubbles into the blue BTB it turns yellow. So yellow BTB is an indicator of high CO2 in the environment.
2. Seal the bag and place in the light, being careful to not overturn the BTB.
3. If the plant is in a bright window, you should get results in 30-40 minutes. The yellow BTB should turn blue, while the blue BTB stays blue.

Respiration:

1. Follow the same procedure as photosynthesis, but put an animal in the container (such as a few beetles) rather than a plant. Alternatively, you could put a plant in the container and then put the container in the dark to show that plants do cellular respiration as well as photosynthesis.

<u>Back pocket questions:</u>

If students are stuck:

- Summarize what we did in the lab.
- What are our results?
- Can you draw a picture of the plant/animal and draw arrows showing what’s going in or out of it?

For students who are moving along:

- Why do you think CO2/O2 decreased?
- What do you think is happening inside the organism?
- Where in the organism do you think the chemical change is happening?
- What other molecules might be involved in this process? What makes you think that?