

## Observational Protocol

The goal of the project is captured in the three goals below:

- Lesson: Observe how students respond to a lesson in which they apply the physics principles of pressure to understanding biological function and structure in a model-building format.
- Physics: As a result of the lesson, students should be able to understand how the principle of pressure is relevant to understanding various physiological facts about different organisms. More specifically, students should be able to: (1) provide real examples (2) provide quantitative analysis of their examples (3) recognize the limitation of the relevance (*Primary Learning Goal*).
- Model: Be able to appreciate the broad relevance of physics to real life, build simple models using physics principles that explain some real-life facts, and evaluate different models based on their advantages and disadvantages (*Developmental Learning Goal*).

Your primary task as an observer is to observe how students respond to the lesson and collect evidence on how well the students learned. Please note the behaviors of the students and the benefits/difficulties of the lesson, NOT the behaviors of the instructor.

Please take notes on your group's behavior. All observations will be used to determine how students respond to the lesson.

Here are the **general** observations you might make. Please try to observe the context in which you make the observation.

In order to observe...	You might look for...
Misconceptions	Wrong applications of the concept of pressure
Derailing of the Lesson	Expressions of boredom Conversations unrelated to the lab
Group Dynamics	Dominant students vs. passive students Lazy students letting everyone else do the work Respectful exchange of opinions
Engagement	Continued effort in the face of difficulty or confusion Requests to know more about the subject Spontaneous expressions of interest or curiosity Expressions of excitement
Problems with understanding directions in the lab	Expressions of confusion about what they are supposed to be doing Signs of frustration

Here are some **specific** observations you might make to decide **to what degree students achieved their learning goals**. Look for examples and evidence that students understand (or are able to explain) how physics principles such as pressure can be applied to biological phenomena:

- Do students recognize that the concept of pressure may be important for understanding various physiological facts (e.g. do they mention it in their discussions)? If not, what difficulties are they having? **Physics**
- Do students use the idea of pressure when constructing explanations of observations? If not, what difficulties are they having? **Physics**
- How well do students use the idea of pressure when constructing explanations of various facts (quality of their explanations)? **Physics**
- Do students use an appropriate example of the concept of pressure? Do they use it in a novel context? **Physics**
- Do students explicitly or implicitly use the concept of pressure to make a prediction from a model or explanation? **Physics**
- Do students use equations or diagrams related to pressure when constructing explanations or making predictions? **Physics**
- Do students reflect on the models that they develop? (Do they say things like these? “I don’t see how these two parts fit together.” “We need more information before drawing any conclusions.” “I still don’t get this.” **Physics, Model**
- Do students use explicit standards to evaluate their own models and compare with alternative models? **Physics, Model**
- Do the students integrate previous examples of model building or previous knowledge about physics in constructing their own models? **Model**
- Do students recognize the value of making predictions from existing models? **Model**
- How comfortable were the students in coming up with explanations/models at the beginning of the lesson? At the end of the lesson? Were there any improvements or changes in how they constructed models? **Model**