WHAT IS A STORYBOARD DISCUSSION?

Storyboarding consolidates evidence so students can consider how their data fits into their models. By **sharing** their stories and allowing others to **question** their conclusions, students learn to **reconcile** evidence as scientists do. This is sometimes referred to as ***scientific thinking***.

Creating a Storyboard:

A storyboard consists of the following elements:

- The research question
- How students investigated that question
- How students know the experiment was technically successful (i.e., that the method worked)
- Data summaries
- What the data mean
- A model of how the biological process being studied works, including how the data fit the model
- Data from other teams' experiments that are/are not consistent with their explanations/model

After an ***open inquiry*** (optional for a *guided inquiry*), students should create team storyboards. Once these are ready, all teams present their work to the class, then answer questions from classmates. All teams should both provide and receive feedback. A rubric to help guide peer assessment may be helpful. If many classes are completing an inquiry, all classes can gather for the Storyboard Discussion, even across different grades.

Alternatively, for a ***guided inquiry*** the teacher can diagram the processes described by students as their ideas emerge in discussion. This is also helpful to let students see how to make a storyboard for a second inquiry, as the teacher models its construction.

Integrating Writing and Discussion:

Students should be encouraged to diagram ideas on paper to develop and supplement their explanations, especially as they are developing a storyboard. Diagramming can be good shorthand for students to get their working ideas on paper -- scientists often use this approach too! If students are not used to sketching out their thoughts in pictures, teachers can model this during the initial ScienceTalk by drawing pictures as the class develops a working model. If poster-sized whiteboards are available for each team, a large erasable working surface can be helpful as students work through their thinking as a team. If desired, their final "story" can then be presented off the whiteboard when they are ready.

Alternatively, the **Making Sense of the Data** worksheet is available in MS Powerpoint format for students to develop their "story." Let students know that they are not restricted by the size of a rectangle! The rectangles can be resized on a computer by moving the cursor over the cell border until two diverging arrows appear. Cells can then be "stretched" or "shrunk" to the desired size.

Scientific posters are basically very formal storyboards. Students may therefore find it helpful to see examples of how scientists communicate using posters to get ideas for their storyboard presentations.

If you are teaching at or near a university, you could ask local faculty members if they have posters that you can bring to class, or even have the class visit the posters in hallways near faculty offices or labs.

Focus of Class Discussion:

The class discussion should center on class data to (a) build and revise working models about the biological process(es) being studied, and to (b) develop critical thinking skills linking past experience and empirical observations in an experimental context. Based on part (a), many of the questions that will arise are likely to be specific to the biological process(es) the students have studied. However, many discussion questions can deal more generally with inquiry-related skills. Such questions may include:

- What constitutes evidence?
- How does the team's data fit into its working model of the biological process?
- If some data do not fit the team's working model, how could the model be updated?
- In what ways was the team's experimental design limited?
- What is still unknown even after completing the experiment?
- How could the team learn more about it?

Ground rules for productive class discussion:

- During the discussion, students will fully consider all data, everyday experiences, and what they think they know about the science at hand.
- Students should consider **all completed experiments**.
- Students should support their explanations with evidence or facts from background research.
- Students should distinguish between what they *know* is true (data) and what they *think* might be true (inference).
- All students on a team should understand their data and be able to point to evidence from their experiments or the literature to support their ideas.
- The discussion is not about right answers, but about the quality of evidence and reasoning to form coherent explanations.
- If teams are presenting storyboards, allow each team to complete its presentation before asking questions.
- Some students may find holes in their reasoning while presenting; a team can and should reconsider its story if this happens!
- Students can provide each other with constructive feedback in addition to questions.
- The inquiry cycle should inform peer critiques.
- Teams are encouraged to revise their stories to reconcile data from other teams.
- Teams may diagram their working models.
- The teacher can diagram and reflect back to the students what they are saying.

Final Product:

At the end of the discussion, the class should arrive at a **consensus model** relating to the biological process(es) being studied in the module. The class may also speculate more broadly about the biological process(es) as it (or they) relate(s) to additional factors that were not studied by any teams.