Essential Lens: Analyzing Photographs Across the Curriculum
Genetics and Bioengineering: The Societal Impacts of Mutations

Activity 2 Lesson Plan

This modified lesson plan was created by high school teacher Rima Givot who is featured in the Essential Lens video, *Evidence*.

Objectives:

- Discuss role of photography in science studies and data collection/record
- Use photographs to discuss specific examples of GMOs and their potential
- Impacts on society
- Understand role of myostatin in organisms (connection to genetics) through measurement and inquiry
- Use GMO in studying live tissues and organisms (in photos)

Standards:

NGSS: HS-LS3-1 & HS-LS3-2

Materials Needed:

Photos of myotubes with and without myostatin in color with photos labeled, both on one sheet (one per student).

Powerpoint of photos:

1. Roosters
2. Babies
3. Myotube micrograph
4. GFP mouse
5. Myotubes w/ & w/o myostatin (labeled w/ producer info/ citation) w/ question: "How do cells with and without myostatin compare?"
6. Student Generated Graph
7. Conclusion: Discuss conclusion in pairs and write bullet points, and then present to class.
    - What did you want to know? What did you think you would find? (question and hypothesis)
    - What did you learn from your data and graph?
    - What are some applications of this study? How does it apply to the world?
    - What is the relevance of GFP and photograph use in this study?
8. All photos w/graph
9. British Blue and normal British Blue

Support article: http://ajpcell.physiology.org/content/297/5/1124

Lesson:

1. Intro and set context:
    a. Use image of roosters with no feathers (connects to genetics and use of photos in science)
    b. Ask students to have journals ready

2. Explain the importance of photos as a data source in scientific study.

3. Question to Students: When could photos capture information/data we couldn't necessarily view without them? (Brainstorm in pairs and report back to class)
    a. Brainstorm in pairs and report to full class
        - cells/microscopic
        - change over time
        - hard to reach places (deep sea, space, etc.)
        - comparison of effects of different treatments (health issues, etc.)

4. Teaching through inquiry:
    a. Science is a process, starting with observation, we can apply those same methods when studying photographs.
    b. Note that we'll use photos to conduct a study that replicates a previous study on muscle cell growth in mice.

5. Show image of a babies:
    a. "Do you see any differences?" "What do you see?" (discuss in groups, then in class)
    b. "What is one factor that controls our muscle growth?" (ask students to discuss possibilities)
    c. Define myostatin (write in journals) and discuss role of myostatin (refer to heart study and Morissette, 2009)

6. Show myotube micrograph:
    a. Discuss need to stain cells to see parts, which usually kills them.
    b. Ask students "How can we study cell processes in living cells?"
    c. Need to be able see how myotube cells react with different treatments with myostatin

7. Show GFP mouse:
    a. Discuss use of GFP (green fluorescing protein) to study live cells (cells must be stained to view, GFP gives ability to view live cells w/o staining them)

8. Show myotubes slides:
    a. Powerpoint

9. Student question: "How do cells with and without myostatin compare?"
    a. Have students write the question down and make observations with a partner before writing hypothesis
    b. "I think…because…" group sharing

10. Discuss Methods:
    a. How would we quantify how the cells compare? (measure width of cells with and w/o myostatin in photographs) How many cells to measure? How many locations to measure on each cell?
    b. Have students discuss different possible ways to quantify cell size and report to whole group
    c. Each group can exercise a different method to see if similar outcome is found
    d. All should determine a method that results in adequate quantity and quality of data
    e. Students collect data by creating a data table (see Sample) to measure cells, working in pairs. Allow students to determine who does which role (measure or write), and describe how collaboration is done (students should discuss plan and decide what they will do).
    f. Conduct data analysis: Average each column and graph in bar graph

Student Created Data Table Sample

Width of cells without myostatin (mm)			**Width of cells with myostatin (mm)**		
Site #1	Site #2	Site #3	Site #1	Site #2	Site #3

Conclusion:

a. Discuss conclusion in pairs and write bullet points, and then present conclusion and graphs to class.
    - What did you want to know? What did you think you would find? (question and hypothesis)
    - What did you learn from your data and graph?
    - What are some applications of this study? How does it apply to the world?
    - What is the relevance of GFP and photograph in this study?

b. End discussion with Questions to Consider:
    - What conclusions can you draw from your measurements and graphs?

        A: Genetically modifying myotube cells with the GFP gene made it easier to see, photograph, and measure the cells. Without the GFP gene, researchers would have to kill, process, and stain the myotubes, which might change their shape and size. Normally, myostatin balances myotube growth. Normal myotubes are smaller than myotubes that are altered or treated to block the myostatin pathway. The scientists who did this experiment saw about a 4 fold difference in diameter between myotubes with and without myostatin. Myostatin slows and controls muscle growth.

- What is the connection between your results and the appearance of people or animals who make less myostatin than usual.

  A: Myostatin restricts muscle growth, so animals or people with certain mutations in myostatin have extra muscles.

- What medical or commercial implications might these findings about myostatin have?

  A: People with muscle wasting diseases such as muscular dystrophies might benefit from therapy to block myostatin, which might grow their muscles. Athletes might want to use the same therapy for a competitive advantage.

- What issues came up in your data collection that you would report if you were writing about this experiment?

  A: See notes above about deciding how many cells to measure, where to measure, etc.

- If you could genetically modify any organism, what would you modify and why? How might you do it?

  A: Students might think of applications in agriculture, arts, or science that could be a starting point for a writing assignment or presentation, investigating whether anyone has tried that application before and if so, what were the results.