U.S. BIOLOGY TEACHING
Save Time, Engage Students, Love Teaching

Experimental Design-Using the Scientific Method

Unit Title: **Experimental Design**

Amount of Preparation Needed Prior to Class: 10-20 minutes

Lesson Plan- 3-5 (50 Minute Periods)

Standard(s):
NGSS
Practice: Planning and Carrying out an investigation.

- **HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. [Response to stimuli]**

- **Note:** Unit 1 and 2 are designed to set teachers up for the year. The units review the nature of science and allow for teachers to implement lab expectations while engaging them in the content. This unit build up to HS-LS1-3 which is covered more directly in other units.

Objectives

1.) Students will be able to discover the scientific process.
2.) Students will create a scientific investigation to solve a real world problem.
3.) Students will carry out a scientific investigation and report their findings.
4.) Students understand the importance of laboratory safety.
5.) Establish procedures for safety and classroom expectations.

Essential Questions

1. Why is important use the scientific method properly?
2. How can the scientific method help solve real world problems?

Assessments Summative and Formative
(What strategies will be employed? How will we know instruction has been successful?)

1.) Students will complete various worksheets
2.) Students will report their findings in a formal report and/or presentation
3.) Students will take to formative and summative assessment.

Materials Needed

1.) Printer paper and many other types of paper (news, tissue, wax, card stock, colors ect.)
2.) Paper Folding Worksheet
3.) Beach ball (optional)
4.) Student names cards- index card with their names on them used to randomly call on students and determine groups for labs and other activities.
5.) 2 liter bottle with 3 holes and tape –see post for activity instructions

TIME: 3-5 (50 minute Periods)-The first part of this lesson can be completed in a 50 minute class period or be extended to a 90 minutes.

Bell Ringer/Warm Up/Engagement

Day 1-BR

- Optimize your bell ringers by using an online timer. This will allow you to take attendance while students are working. Set this expectation now and it will buy a lot of time in the future.
- During the bell ringer, handout the paper folding worksheet. You may want to have an area where students pickup handouts as they enter the room. After going over your procedures, engage students by showing the students a piece of 8.5x11in piece of paper and asking them how many times it can be folded in half.

Day 2-BR

- Review the classroom procedures from the first day of school. Do this by having the bell ringer on the board/projected (this bell ringer is in slide 1 of the Experimental Design PPT)

Day 3 –BR

- Students will complete the IV and DV Scenarios worksheet
- Answer Key

Day 4-BR or Exit (optional depending on how many days you need)

- Beach Ball Review

Exploration/Explanation/Elaboration

Lesson 1:

DAY 1

1.) Prior to folding the paper in HALF the teacher will ask the class to establish criterion for what is going to be considered a fold. The teacher will write these on the board for reference.

2.) After establishing the criterion for the paper folding students will work with a partner to fold the paper in HALF as many times as possible. (Most students will get to 6-7, if they get more check their folds)

3.) Students will follow the instructions on the paper to finish the activity. You may to scaffold the first few questions.

4.) At the end of the worksheet, show the student this Myth Busters video on paper folding. Have a discussion about the video.

DAY 2

1. Go over the **Experimental Design PowerPoint.** Students can complete the guided notes PPT outline or hand write the notes into their notebooks.
2. When students have completed the notes they can practice applying the vocabulary terms using the experimental design scenarios worksheet.

Day 3

1. Complete the 3-hole bottle activity.
2. Experimental Design Vocabulary Quiz

Day 4

1. Tie up loose end or move to the next lesson plan day 5: Lesson 2-Mealworm lab

Closing the Lesson/Summary of Learning/Evaluation

Day 1 and 2 Closing activity- Beach ball vocabulary review. Using a dry erase marker write the key vocabulary terms from the day on the ball. I leave one spot on the ball for wild and let students pick a word of their choice if it lands on it. Toss the ball to students and where the left thumb lands have them tell you something about the word (definition in their words, examples, ect.) Words from the activity that could be used: bias, independent variable, dependent variable, hypothesis, constant, control. See my post for more details: http://www.usbiologyteaching.com/beach-ball/

Day 3- Have student complete the **Scientific Analysis** worksheet

Option: Have students tell you one thing they learned/found interesting. Choose students randomly using their name cards created from index cards. (Note: Have students write their interests and birthday on the cards since you will use them a lot, it allows you to learn your students and develop positive relationships with them.)

Day 4(if needed)-Using the note card have student present their 3 hole bottle diagrams and have them describe to the class what is happening in their drawings.

Differentiating the Lesson

Higher Differentiation –Do not offer scaffolding throughout the process. Add a third factor to be tested and have them create a graph of the results using multiple trials for each.

Lower Differentiation – Offer more scaffolding, partner them with a higher level learner, frequent checks for understanding and progress.

Learning/Lesson Reflection

Lesson Extension

-Have student evaluate their experimental design for the paper folding experiment. Have them identify area where their design was flawed. Have them design solutions to make their experiment more valid.