Lesson Plan Template

**Video Presentation Title:** Researching Bacteria’s Virulence in Space

**Unit of Instruction:** Homeostasis

**Subject/Course:** AP Biology

**Overview & Purpose:**
- Learn about virulence (disease causing potential) research
- Learn about doing research in space
- Hypothesize how virulence will be affected by spaceflight
- Design an experiment to be flown that will test your hypothesis based on a number of constraints

**Resources Needed:**
- *Space Bugs: TI-Nspire™ Lab Activity*
- Computer and projector to show video
- Internet access to Spark101.org
- Think-Write-Pair-Share Student Templates, Value Based Problem Solving Student Templates (found on the educator resource page at spark101.org)
- Constraints Sheet

**Standard(s):**
AP Biology course description, 2013

**Science Practice 3:** The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course.
- 3.1 The student can pose scientific questions.
- 3.2 The student can refine scientific questions.
- 3.3 The student can evaluate scientific questions.

**Science Practice 4:** The student can plan and implement data collection strategies appropriate to a particular scientific question.
- 4.1 The student can justify the selection of the kind of data needed to answer a particular scientific question.
- 4.2 The student can design a plan for collecting data to answer a particular scientific question.

**The topics included in the video could also be extended to include discussion or additional research to cover the following themes:**

**Big Idea 2:** Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.

**Enduring understanding 2.C:** Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis.

**Essential Knowledge 2.C.2:** Organisms respond to changes in their external environments.
- a. Organisms respond to changes in their environment through behavioral and physiological mechanisms.

**Enduring understanding 2.D:** Growth and dynamic homeostasis of a biological system are influenced by changes in the system’s environment.

**Essential Knowledge 2.D.3:** Biological systems are affected by disruptions to their dynamic homeostasis.
- a. Disruptions at the molecular and cellular levels affect the health of the organism.
Disruptions to ecosystems impact the dynamic homeostasis or balance of the ecosystem.

**Big Idea 3:** Living systems store, retrieve, transmit and respond to information essential to life processes.

**Enduring understanding 3.B:** Expression of genetic information involves cellular and molecular mechanisms

**Essential Knowledge 3.B.1:** Gene regulation results in differential gene expression, leading to cell specialization.

**Essential Knowledge 3.B.2:** A variety of intercellular and intracellular signal transmissions mediate gene expression.

**Essential Knowledge 3.B.3:** Both positive and negative control mechanisms regulate gene expression in bacteria and viruses.

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<th>Objectives</th>
<th>The teacher will:</th>
<th>The student will:</th>
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| **Objectives** *(Specify skills/information that will be learned)*        | Share and discuss learning objectives with students. Use this Spark 101 Video to  
 Demonstrate current NASA research in the area of microbiology and virulence of bacteria.  
 Investigate how experiments are designed to meet requirements of spaceflight.  
 Reinforce the scientific method.  
 Discuss career paths in the field of Microbiology and at NASA. | Discuss learning objectives with classmates and teachers.  
 **Learning Objectives:**  
 - Learn about current research on virulence of bacteria  
 - Write a hypothesis for a research question  
 - Design a research experiment  
 - Compare their design to that of the research investigator |
| **Activator** *(Prior to showing the video presentation)*                  | This activity may be done shortly after students participate in the AP Biology Lab 6: Molecular Biology where they work with gel electrophoresis. If TI-Nspire technology is available at your school, you may use the Math and Science @ Work Activity: Space Bugs: TI-Nspire™ Lab Activity, which is a virtual gel electrophoresis lab that highlights NASA research.  
 If your students perform Lab 6 rather than the Space Bugs: TI-Nspire™ Lab Activity read the background section of this activity before going into the video.  
 Develop some questions or prompts for students to do the Think-Write-Pair-Share activity. You may choose one or more of the following or create your own:  
 1. How would you design an experiment to... | - **Think** about what they already know about the question (2 minutes)  
 - **Write** those thoughts for later reference (3 minutes)  
 - **Pair** with a partner as directed by teacher; discuss thinking and ask questions of partner (5 minutes)  
 - One person from pair will **share** their thoughts with the class and identify the value of the consequences of the chosen solution. |
| **Think-Write-Pair-Share Activity**                                      |                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                              |

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- One person from pair will **share** their thoughts with the class and identify the value of the consequences of the chosen solution.
1. Research the virulence (disease causing potential of a bacteria here on Earth?)
2. What does research about microbiology in extreme environments teach us? List some extreme environments where you know some research has been performed and expound on what you know about it.
3. How would research be different with a lack of gravity?
4. What questions might be beneficial to research on the international space station?

- Describe the TWPS strategy to your students and provide questions for the discussions that will take place.
- Follow the directions given on the Think-Write-Pair-Share template provided by Spark 101.

| Problem Solving Activity (Describe process for identifying possible solution(s) to the problem presented) | - Before showing the video, review the problem-solving strategy to be used. (Value-Based Problem Solving template w/ directions found in the Spark 101 resources)
- Provide a brief background to the video presentation and introduce the topic. Watch the first segment of the video.
- Direct students to redefine the problem before starting to think about a solution. Provide students the constraints sheet or write/project them for the class to refer to.
- Group students to work through the problem.
- Have students determine a hypothesis to the research question before moving on to the design of the experiment.
- Have students follow the value-based problem solving template to design the experiment according to each constraint.
- Watch the second section of the video describing the actual design of the experiment and how the constraints were met. |
| Value Based Problem Solving Activity | - Ask any clarifying questions needed related to the problem solving task.
- Watch the first segment of the video and take notes that will help solve the problem.
- Redefine the problem before thinking about solution listing all the constraints and limitations discussed.
- Determine a hypothesis for the research question
- Follow the value-based problem solving template to design the experiment according to each constraint.
- Watch the second section of the video describing the actual design of the experiment and how the constraints were met. |
| **Checking for Understanding**  
**Steps to take along the way** | - Lead class in a discussion asking students how the actual design of the experiment compares to their own.  
- If you assigned different groups different constraints, have each group share out loud how their experimental consideration compares to the actual.  
- Answer any questions students have about the video to this point. |
| --- | --- |
|  | - Participate in class discussion comparing your design to the actual design. Discuss why you think your solution would be useful to consider.  
- Ask any questions needed to understand the design or to understand the results of the experiment. |
| **Summarizer** | - Show the final segment of the video  
- Encourage student discussion on career paths  
- Have students discuss the team of professionals that must work together to complete research – in space research, that involves different scientists (sometimes from different organizations), astronauts, statisticians, and so on.  
- Answer questions students may have about career paths |
|  | - Watch the final segment of the video  
- Discuss what career paths you may have that relate to the video and ask any questions you may have as a result of the video. |
| **Additional Notes:** | - **Optional Extension:** Dr. Nickerson and Dr. Ott have collaborated on several research experiments since the initial one discussed in this video. Have students research the findings that they have come up with and what they are still researching. Have students report their findings and include what areas they would like to investigate further. |