**Save a life, build a device!**

**Description**

* Students will design a hypothetical device that addresses a human disease state caused by an inability of the patient’s body to successfully monitor and maintain appropriate physiological levels of a substance.

**Introduction**

* Every human, animal or organism ultimately dies for the same reason, the loss of homeostasis. Life is possible only by the expenditure of energy to maintain a particular internal environment that allows metabolic reactions to properly occur. The term for the ability to maintain this internal environment is Homeostasis. All disease can be thought of as an inability of an organism to maintain homeostasis. This loss of homeostasis is associated with the organism’s inability to successfully engage in some particular underlying function. Thus an understanding of the mechanisms of homeostasis is also an understanding of human health. In this lesson students will be introduced to these mechanisms while developing the concept of a device that would allow an individual to monitor a physiological process as a marker for disease development.

**Curriculum Alignment**

* Bio.1.2.1 Explain how homeostasis is maintained in a cell and within an organism in various environments (including temperature and pH).
* Bio.4.1.1 Compare the structures and functions of the major biological molecules (carbohydrates, proteins, lipids, and nucleic acids) as related to the survival of living organisms.
* Bio 4.2.2 Explain ways that organisms use released energy for maintaining homeostasis (active transport).

**Objectives**

* Students will be able to describe several types of sensors that monitor aspects of human physiology
* Students will be able to describe how a loss of homeostasis can lead to a disease state.
* Students will be able to explain how technological advances can improve human health
* Students will be able to explain ways that organisms use released energy for maintaining homeostasis
* Students will be able to compare the structures and functions of the major biological molecules as related to the survival of living organisms.
* Students will be able to explain how homeostasis is maintained in a cell and within an organism in various environments.

**Time & Location**

* Two 90 min class periods
* Classroom setting with internet access

**Teacher Materials**

* Art supplies such as: colored pencils, markers, construction paper, etc. Needs will vary based on project and may be supplied by both teacher and students.
* 1 Copy of Save A Life Build A Device Student Handout per student
* Blank Copier paper, for illustrations
* 1 Ruler pre group (Optional)
* 1 copy per student of Necessary Life Functions Student Hand Out

**Student Materials**

* Device with internet access
* Colored pencils
* Blank copier paper
* Ruler
* Printed copy of Save a life build a device Student Handout
* Printed copy of Necessary Life Functions Student Handout
* Optional: Computer with printer for student’s device write-ups.

**Safety**

* No safety issues anticipated.

**Student Prior Knowledge**

* Students should be familiar with the concept of homeostasis and the 3 major components of a homeostatic feedback system.

**Teacher Preparations**

* Print 1 copy of Necessary Life Functions Student Hand Out per student
* Print 1 copy of Save A Life Build A device Student Hand Out per student
* Ensure materials for the design process are collected and available.
* Students will need access to the internet for research. The teacher should ensure that each group will have at least one internet capable device.
* Optional: Anatomy text books for reference.

**Activities**

* Teacher Says: Today we will be unlocking the secrets to immortality. But, first we must know what we are trying to do.
* Teacher Asks: What is immortality?
* Students respond with answers, these may be recorded on the board. Student answers will likely circle around “living forever.”
* Teacher Asks: What is living?
* Students respond. Answers are recorded on board. If student group is shy or struggling, try small group discussion with share out or a think – pair – share.
* Teacher asks: So we are trying to continue living, why do we die?
* Students respond.
* Teacher says: Ultimately we die because we cannot maintain life. We maintain life through uncountable interactions between an incredible number of complex processes. But ultimately these processes achieve several main functions.
* Teacher provides students with life functions hand out.
* Review the list of functions providing examples of each of these functions in the human body.
* Review examples of each of these functions failing and the health outcomes of each.
* Teacher says: So we know that we die because we cannot achieve one of these functions. However technology has been developed that allows us to still achieve these functions when our biology fails. Examples are the artificial heart (transportation), and insulin pumps (metabolism).
* Today you will be working with a small group to create an idea for a device that would allow a person to continue achieving this function after their biology has failed.
* Hand out the Save A life Build A Device Student Hand out
* Teacher will review the handout with the students.
* Allow students 1 to 2 days to work on the project. If time allows this can be done in class or assigned to be completed outside of school.
* After allocated work time, students will present their device to the class.
* Optional extension is the post the project and allow students to vote for several categories using multiple colors of small sticky notes.
  + Best appearance
  + Most useful
  + Most realistic
* During the presentation teacher will use the guidelines outlines in the Save a life build a device handout to grade the assignment

**Assessment**

* Teacher will evaluate student projects based upon the criteria listed on the Save a Life Build a Device! – Student Handout

Rubric

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **0** | **1** | **2** |
| **Illustration of the device.** | External casing/appearance. | Missing/Unclear | Shown |  |
| Wear/implantation of device. | Missing/Unclear | Shown |  |
| Size and location of device | Missing/Unclear | Shown | Illustration clear and has measurements. |
| **A schematic of the device** | Power source | Absent or unclear | Clearly depicted | Clearly depicted and well described. |
| Communication | Absent or unclear | Clearly depicted | Clearly depicted and well described. |
| Sensor (receptor) location and description | Sensor is hypothetical | Sensor exists but specifics unclear | Sensor exists and is specifically indicated. |
| Outcome generator (effector) | Absent or unclear | Clearly depicted | Clearly depicted and well described. |
| **A short description of the device.** | An explanation of how the device works. | Absent or unclear | Description is vague or not specific | Description is clear and reasonable. |
| What the device detects/monitors. | Absent or unclear | Description is vague or not specific | Description is clear and reasonable. |
| How the device can be adjusted/calibrated (how to control the control center) | Absent or unclear | Description is vague or not specific | Description is clear and reasonable. |
| How the device would cause an effect to maintain homeostasis (effector). | Absent or unclear | Description is vague or not specific | Description is clear and reasonable. |

**Critical Vocabulary**

* Homeostasis- the tendency toward a relatively stable equilibrium between interdependent elements, especially as maintained by physiological processes.
* Receptor- A specialized cell or group of nerve endings that responds to sensory stimuli. A molecular structure or site on the surface or interior of a cell that binds with substances such as hormones, antigens, drugs, or neurotransmitters.
* Control Center- receives information from the receptor and compares this information to a set point. If the input is different from the set point the control center can trigger a response via the effector
* Effector- an organ or cell that acts in response to a stimulus.

**Author Information**

Eric Baker has been teaching science teacher at Sanderson High School in Raleigh NC for the past 4 years.

This lesson plan was developed in collaboration with Dr. Elena N. Veety at the ASSIST center on the campus of NC State University.

Questions should be directed to ebaker2@wcpss.net.