Research Experiences for Teachers (RET - 2013

Owen Ambrose
Montclair High School Biology
RET 2013

MODULE TOPIC:
Ideal Conditions and Cell Stasis

RATIONALE: The necessity for maintaining homeostasis is a major concept in biology. This lesson provides students with an interactive experience in which they will be able to observe changes in cell stasis based on minute alterations to the cells environment. Upon completion of this lesson, students will have an increased understanding of the correlation between variables such as pH and temperature and cell health.

STANDARD(S) & INDICATOR(S):
HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

OBJECTIVE(S): Students will be able to:
- Explain why variations in cell count occur in correlation with different pH solutions and temperatures.
- Conduct sample counts of organisms within set amounts of space.
- Infer the relationship between ideal pH and the human body.

MATERIALS:
Micro Meter marked slides
    Acetic Acid
    Baking soda
    pH paper
    Pure water (pH of 7)
    Beakers
Ameba cultures
Microscopes

BACKGROUND INFORMATION:
In nature, all reactions require conditions set within specific parameters in order to take place. The enzymes in cells require pH and temperature within ideal ranges in order to sustain life. During this summer's RET program, it was made clear that the functionality of medicine works on the same principle…the medicine is designed to carry out specific functions when placed in conditions meeting ideal or expected pH and temperature.

The lab associated with this unit is designed as an enrichment opportunity. Student comprehension regarding the functions of pH and temperature in living systems will be assessed through a traditional paper/pencil assessment.

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CLASSROOM ACTIVITY DESCRIPTION (LABORATORY/EXERCISES/PROBLEMS) including detailed procedures:

Following this module, students will have gained an understanding of equilibrium, critical abiotic factors, and biological homeostasis. Students will demonstrate understanding of these concepts by determining the most biologically conducive set of parameters for living ameba cells.

1. **Part 1 A:** The module will begin with a lesson on cellular requirements. Themes such as diffusion, osmosis, permeability, solubility, **homeostasis**, **equilibrium,** and **pH** will be taught in a lecture based format (see attachment: Cellular requirements).

2. **Part 1 B: Extending the concept of cells**: Students will learn that cellular organization does not always mean that cells are parts of complex life forms. Students will observe footage on paramecium, Ameba, and other protists, and will be presented with the roles played by such single celled organisms in ecosystems.

3. **Part 2 A:** Combining the themes from parts 1A and 1B, students will be asked to hypothesize on which cellular requirements are needed in order for ameba to survive/behave ideally.

4. **Part 3: Unit Project**
   - As an introduction to the project, students will be asked to discuss what they know about the ideal temperature and pH of the human body. The teacher will provide an overview of how the body maintains these factors, and how many other organisms lack the ability to maintain them.
   - Students will be asked to consider what they have learned about the cells ability to acquire, and reject substances, as well as the cells ability to manipulate or exert temperature.
   - Students will be given an overview of the project. In this activity, students will form solutions of different pH's and maintain solutions at different temperature intervals. Students will add samples from an ameba culture solution, and use a microscope to measure the number of living cells in each solution based on the number of ameba counted in an area of 5 by 5 micrometers.
   - Upon completion of the initial count, students will design ways in which they can maintain set parameters regarding pH and temperature for each solution. Students will be able to utilize hot water baths for maintaining temperature.
   - Students will resample/recount the number of living ameba in each solution in one day intervals. Following ten days of data collection, students will organize and communicate their data to the class.
   - The class will convene as a whole, and the teacher will guide them in creating a line graph that shows the correlation between pH, temperature, and living cells counted.
   - Students will write an accompanying conclusion that describes the correlation between the environmental factors pH and temperature and homeostasis in living cells. Students will be asked to compare what they learned regarding the ideal conditions of the ameba to their hypothesized ideal conditions for human cells.

SAMPLE QUESTIONS TO ELICIT CLASS DISCUSSION:

Which factors were the most important in allowing ameba cells to perform reactions necessary for survival?
How does this activity relate to homeostasis?
What were the independent and dependent variables in this test?
Why were we able to look at more than one variable yet still come up with meaningful results?
If you were creating medicine, how would the themes in this experiment apply to your work?
Were the most ideal conditions for the Ameba based on pH, temperature, or both?

HOMEWORK ACTIVITY/EXERCISES/PROBLEMS:
Students will be asked to complete the written portion of this activity for homework
Section Reviews
Lab data charts

PARAMETERS TO EVALUATE STUDENT WORK PRODUCTS:
Students write a description of the effect of environmental factors, such as temperature and pH, on the survival of cells.

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Name:_____

Biology
Session/Notes Outline

Cellular Requirements

By the end of today's lesson you should…
Know: The importance of homeostasis
Understand: the difference between hypertonic, hypotonic, and isotonic solutions.
Be able to: Explain the process of diffusion.

Opening Activity: All living things require a specific set of chemicals in order to stay healthy. These chemicals are used on a cellular level. Use the next five minutes to explain what I mean by "cellular level":_____

_____

Cellular states of being: Healthy cells are those that have a stable level of organic chemicals, nutrients, and H2O both inside of the cell, and in the cells environment. The cell attempts to maintain homeostasis continually.

Homeostasis: _____

_____

_____

When homeostasis is not maintained, the cell is inflicted with one of the following ailments:

Cytolysis: _____

_____

Low turgor: _____

_____

Methods for maintaining Homeostasis: Cells maintain homeostasis by utilizing the following functions:

Passive transport:_____

Diffusion: _____

_____

Osmosis: _____

_____

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Concentration gradient: _____

_____

Diffusion and living systems

We learned that cells attempt to maintain homeostasis and that diffusion allows them to do that. Today we will learn how cells react to different types of environments.

Solution: _____

Parts of a solution

Solute **Solvent**

_____ _____

Hypertonic solution: _____

illustration

Hypertonic solutions effect on cells: _____

Hypotonic solution: _____

Illustration

Hypotonic solutions effect on cells: _____

Isotonic solution: _____

illustration

Isotonic solutions effect on cells: _____

Methods of surviving non-isotonic environments

Active transport: _____

Endocytosis: _____

Exocytosis: _____

Pinocytosis:_____

Phagocytosis (in heterotrophic microorganisms) :_____

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Illustration of Phagocytosis

Closing questions:

If a cell were in an environment that had more salt outside of the cell, would the cell grow larger or smaller? _____

A potato has 10% salt inside, and it is placed in a solution that has 0% salt in it. Is the potato placed in a hypertonic solution, or a hypotonic solution? _____

Fish cells have mechanisms that allow them to actively pump out any excess salt that they take in. Is this an example of endocytosis, or exocytosis? _____

Define the following in your own words:

Diffusion: _____

Concentration: _____

Homeostasis: _____

Explain the difference between active transport and passive transport:

_____

_____

Thinking Ahead: In HETEROTROPHIC bacteria, food is gathered through phagocytosis. What other ways might non heterotrophic bacteria get food? Do you think all bacteria/organisms get energy through eating? Explain your answer.

_____

_____

_____

_____

_____

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Biology
Session/Notes Outline

Cellular requirements part 2:

By the end of today's lesson you should…
Know: The difference between hypotonic, hypertonic and isotonic
Understand: How diffusion allows homeostasis
Be able to: Compare an example (aka lab) system to a living system.

Opening Activity: If I were to spray cologne in the front of the room, would everyone in the class eventually smell it? If so, what process allows that to happen?

_____

Diffusion and living systems
Last class we learned that cells attempt to maintain homeostasis and that diffusion allows them to do that. Today we will learn how cells react to different types of environments.

Solution: _____

Hypertonic solution: _____

illustration

Hypertonic solutions effect on cells: _____

Hypotonic solution: _____

illustration

Hypotonic solutions effect on cells: _____

Isotonic solution: _____

illustration

Isotonic solutions effect on cells: _____

_____

Active transport: _____

Endocytosis: _____

Exocytosis: _____

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Closing questions:
If a cell were in an environment that had more salt outside of the cell, would the cell grow larger or smaller? _____

A potato has 10% salt inside, and it is placed in a solution that has 0% salt in it. Is the potato placed in a hypotonic solution, or a hypotonic solution? _____

Fish cells have mechanisms that allow them to actively pump out any excess salt that they take in. Is this an example of endocytosis, or exocytosis? _____

Define the following in your own words:

Diffusion: _____

Concentration: _____

Homeostasis: _____