

Title: Let's Get Physical! : The Chemistry of Emerging Pathogens.

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Abstract: Chemistry is everywhere it's the science that builds on matter, its properties, and interactions as it relates to energy. Nonetheless, students should have a fundamental understanding of biology and discover a way to merge the two. Allowing students to apply prior knowledge to enhance their understanding of pathogens. Students will relate the size of pathogens to the SI system. Additionally, students will be able to understand how water chemistry is helpful in the analysis diseases. Students will relate this understanding and utilize various separation techniques and water test in order to connect the concept. This entire project focuses on an approach to incorporate biotechnology using chemistry methods. "The Let's Get Physical" lesson plan will provides students with the understanding that science is interconnected and with all the advancements in science the opportunities are endless. The lesson plan teaches techniques and applications that students will be able to apply to future endeavors. It challenges the students to think outside the box and broadens the aspects of science in general.

Rational: The purpose of doing this project is to stimulate an interest in biotechnology (emerging pathogens) and how it relates to chemistry. This project also allows the student to use separating techniques such as electrophoresis, micropipette techniques, southern blot, and ELISA.

Description of teaching unit or module(s), including expected outcomes:

These modules/ units will require around 3-4 weeks to complete from beginning to end, but each lesson will require reinforcement throughout the year.

Module # 1

Pre- Lesson Activities

Students will receive a pretest focusing on prior knowledge from biology (primarily viruses and pathogens) and how to calculate units of measurements. This pretest will also cover their knowledge of separating techniques and how to differentiate between physical and chemical characteristics.

During the Lesson

After the pretest, students will be introduced to the scientific method and units of measurement using the SI System by relating them to

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pathogens. This will include a teacher-directed lesson followed by an activity that involves measuring the size of different viruses by scientific measurements. Another activity would include a scientific method challenge in which the student would apply the 6 parts of the scientific method and create an experiment that would cure a particular disease/infection. The last activity includes a lab that involves a virus scenario in which students use the simulated ELISA test to determine whether it is positive or negative based on the scientific method.

After the Lesson

At the end of module, the students will receive a quiz of units of measurements and the scientific method.

Module # 2

In the second module student will learn water chemistry and apply this concept to the spread of diseases by mosquitoes. The students will conduct a lab testing various water samples. The student will also use graphic organizers to group the characteristics and review the meaning of qualitative versus quantitative data.

Pre-lesson activities

The students will be assessed on water chemistry to determine if they understand water's unique characteristics. Student will receive a lesson of the properties of water and how they can be used to determine various factors. An inductive interactive lesson on water sample will also be introduced at this time.

During the lessons

During this module the students will engage in performing tasks that allow them to complete a series of labs that involves analyzing water samples. In this activity (second in a series), the students will collect water samples from various places (lakes, ponds, barrel, etc.). After collecting the samples the student will perform a water test to gather data of the best standing water breeding ground for mosquito. The student will also see if certain areas house infected female mosquitoes.

After the lesson

After this lesson the students will be able to assess the data from the experiment and a quiz will be administered to ensure that the students have a thorough understanding of the subject. The student will also be responsible for writing a lab report.

Module # 3

In the third module the student will learn about the various separation techniques and how it relates to biotechnology.

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Pre-lesson activities

By this point students will know the basic techniques used in a laboratory setting. The student will receive a survey that covers all the separating techniques used in chemical analysis. Students will not obtain any prior information; the survey will serve as a pacing tool.

During the lesson

After the survey data information will be compiled together and a clarification discussion will follow. Once every technique is explained the students will be able to apply their knowledge through a series of labs. The first lab requires that the students learn all the different techniques via a station lab. Each team will consist of two students, and every station will require that the student learn how, and when to use the technique given. Another simulation/ lab would be to place different scenarios around the lab benches and have student perform the technique they think fits the case. The last lab would require that the student create a scenario (Comic Strip) using a pathogen and illustrate ways to isolate the substance (protein, DNA, enzyme, etc) in order to detect the infection.

After the lesson

Student will complete several laboratory reports and a comic strip dealing with the various techniques used in separating substances. Knowledge of these techniques will also require a post-test and a lab practical.

Citation

John McLaughlin and George Glasson 2001 Protein Lab- High School Lab Daleville, VA: The Science Teacher

DeCourcy, K. 1999. Protein Electrophoresis Kit: Information Manual. Blacksburg, Va.: Fralin Biotechnology Center.

Kreuzer, H., and A. Massey. 1996. Recombinant DNA and Biotechnology. Washington D.C.: ASM Press.

National Research Council. 1996. National Science Education Standards. Washington, D.C.: National Academy Press.

National Academy of Sciences. 1998. Teaching about Evolution and the Nature of Science. Washington, D.C.: National Academy Press.

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Budget and budget justification

8 Electrophoresis Gel	Available from CPET
12 Micropipettes	Available from CPET
1000/pkg TBR-35 pipette tips	Available from CPET
Western blot Kit	Available from CPET
4-5 Reagents	Price Varies \$13-45 each
Water Testing Kit	\$25.00 per kit
Microbe measuring size kit	Available from CPET
Buffer solution (Tris)- TBE 5X	\$34.70

SAMPSON'S SCIENCE LESSON PLAN

TITLE: "Let's Get Chemical"! : The Chemistry of emerging pathogens.

KEY QUESTION(S):

1. How does the knowledge of Chemistry relate to emerging pathogens?
2. What separation techniques can be utilized to detect emerging pathogens?
3. How could you measure a microorganism using the SI system?
4. What are some characteristics/special properties of water?
5. What is the purpose of using various separation techniques?

***SCIENCE SUBJECT:** Chemistry

***GRADE AND ABILITY LEVEL:** Honors 10-12th

SCIENCE CONCEPTS: SI Units (measurements), properties of water, separation techniques, pathogens, and bacteria.

OVERALL TIME ESTIMATE: 2-3 weeks

LEARNING STYLES: The students will learn about scientific measurement, water properties and how to test for pathogens, various laboratory techniques, and science skills to work in any lab.

VOCABULARY:

SI System	Nano
Electrophoresis	Pico
Filtration	milli
Distillation	centi
Chromatography	Centrifuge
Kilo	surface tension
Micro	capillary action
Adhesion	cohesion

LESSON SUMMARY:

Week One- The lesson will discuss how to measure the size of bacteria based on the SI unit of measurement. The students will be able to relate units to real life measurements. **Week Two-** The lesson will focus of the characteristics of water. Discussion should focuses on the unique properties of water. Learn how to gather and test water sample. Use a control to test whether standing water is contaminated with bacteria prevalent in infected mosquito species. The students will use water testing kits as well as immunostrip. **Week Three-** This lesson focuses on separation technique and how the can be used in the lab to identify pathogens. Labs include: ELISA, electrophoresis, western blot, chromatography, etc.

***STUDENT LEARNING OBJECTIVES WITH STANDARDS:**

SC.912.N.1.3- Scientific Method, Units of Measurement, and Using Scientific Measurements. Recognize that the strength or usefulness of a scientific claim is evaluated through scientific argumentation, which depends on critical and logical thinking, and the active consideration or alternative scientific explanations to explain the data presented.

SC.912.N.1.7- Recognize the role of creativity in constructing scientific questions, methods, and explanations.

MA.912.S.1.2- Determine appropriate and consistent standards of measurement for the data to be collected in a survey or experiment.

SC.912.P.10.1- Differentiate among various forms of energy and recognize that they can be transformed from one form to others.

SC.H.3.4.2; SC.H.3.4.3; SC.H.3.4.4; SC.H.3.4.5; SC.H.3.4.6- Demonstrate understanding of interactions between science and technology.

***MATERIALS:** Per Class

ESSENTIAL:

1. Class set of bacteria unit conversions.
2. E-Gel, Immunostrips
3. Western Blot Simulation
4. Water Testing Kits
5. ELISA
6. Sets of jump drive for student to store information from the water testing lab.

***PROCEDURE AND DISCUSSION QUESTIONS WITH TIME ESTIMATES:**

WEEK ONE

Pre- Lesson Activities

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During the Lesson

After the pretest, students will be introduced to the scientific method and units of measurement using the SI System by relating them to pathogens. This will include a teacher-directed lesson followed by an activity that involves measuring the size of different viruses by scientific measurements. Another activity would include a scientific method challenge in which the student would apply the 6 parts of the scientific method and create an experiment that would cure a particular disease/infection. The last activity includes a lab that involves a virus scenario in which students use the simulated ELISA test to determine whether it is positive or negative based on the scientific method.

After the Lesson

At the end of module, the students will receive a quiz of units of measurements and the scientific method.

WEEK TWO

In the second module student will learn water chemistry and apply this concept to the spread of diseases by mosquitoes. The students will conduct a lab testing various water samples. The student will also use graphic organizers to group the characteristics and review the meaning of qualitative versus quantitative data.

Pre-lesson activities

The students will be assess on water chemistry to determine if they understanding water's unique characteristics. Student will receive a lesson of the properties of water and how they can be used to determine various factors. An inductory interactive lesson on water sample will also be introduced at this time.

During the lessons

During this module the students will engage in performing task that allows them to complete a series of labs that involves analyzing water samples. In this activity (second in a [series](#)), the students will collect water samples from various places (lakes, ponds, barrel, etc.). After collecting the samples the student will perform a water test to gather data of the best standing

water breeding ground for mosquito. The student will also see if certain areas house infected female mosquitoes.

After the lesson

After this lesson the students will be able assess the data from the experiment and quiz will be administered to ensure that the students have a thorough understanding on the subject. The student will also be responsible for writing a lab report.

WEEK THREE

In the third module the student will learn about the various separation techniques and how it relates to biotechnology.

Pre-lesson activities

By this point students will know the basic techniques used in a laboratory setting. The student will receive a survey that covers all the separating techniques used in chemical analysis. Students will not obtain any prior information; the survey will serve as a pacing tool.

During the lesson

After the surveys data information will be compiled together and a clarification discussion will follow. Once every technique is explained the students will be able to apply their knowledge through a series of lab. The first lab requires that the students learn all the different techniques via a station lab. Each team will consist of two students, and every station will require that the student learn how, and when to use the technique given. Another simulation/ lab would be to place different scenarios around the lab benches and have student perform the technique they think fits the case. The last lab would require that the student create a scenario (Comic Strip) using a pathogen and illustrate ways to isolate the substance (protein, DNA, enzyme, etc) in order to detect the infection.

After the lesson

Student will complete several laboratory reports and a comic strip (Comic Life) dealing with the various techniques used in separating substances. Knowledge of these techniques will also require a post-test and a lab practical.

***ASSESSMENT SUGGESTIONS:** Describe specific assessments for EACH objective:

For objective 1/module 1- Discussion of scientific measurement and how they are use to determine the size of real life elements such as bacteria.

Complete a series of conversion unit. Use common conversion such as size, height, and weight.

Review the scientific method. Quiz students thoroughly by providing them with a scenario and having them come up with the supporting procedure in carrying out an experiment.

For objective 2/module 2- Learn the unique properties of water and how to conduct testing water sample. Learn how to detect contamination in water.

Simulate how to take a water sample and process the information. Demonstrate how to write a laboratory report that includes graphs and data.

For objective 3/module 3- Identify the various separating techniques. Using ELISA, Western Blot, Immunostrips, electrophoresis, centrifuge, filtration, distillation, etc.

***RESOURCES/REFERENCES:**

Water Quality Testing- <http://water.usgs.gov/>