LESSON PLAN TEMPLATE

MODULE TOPIC:
Engineering Polymeric Nanoparticles for Delivering Therapeutics to Brain

- Introduction to formulation – A Gateway to Drug Discovery
- Physical properties/phenomena
- Polymer/Nanomer

BACKGROUND INFORMATION:
This lesson is for pharmaceutical Science class. Students discuss different formulation techniques and the importance of formulation in drug industry. Students compare different physical properties of compounds like hydrohilicity and lipophilicity which are essential in determining the ideal formulation to achieve maximum efficacy. Particle size is also considered.

Lesson 1: Physical properties and phenomena

Students will study various physical properties as well as biological phenomena as they are important aspects in formulation techniques.

STANDARD(S) & INDICATOR(S):
NGSS:
MS-LS1-2. Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.

LEARNING OBJECTIVE(S): Students will be able to:
Define hydrophilicity, hydrophobicity, lypophilicity, biodegradabilility and bioavailability.
D**esign** a model for Osmosis.
Identify real world application of diffusion/dialysis.

MATERIALS

- cellular fluid, 12 mL
- Water,150 mL
- Balance, 0.01-g precision
- Cup, clear plastic or beaker
- Dialysis tubing clamp, disposable, 2
- Dialysis tubing, presoaked, 15 cm
- Glucose test strips, 3
- Graduated cylinder, 250-mL
- Paper towels
- Pipet, extra-large bulb
- Weighing dish,
- White paper

Learning Experience (Instructional Plan - Summary)
Students will be introduced to lypophilic and hydrophilic substances. They will be given learning prompts or asked questions like

- Why oil and water not miscible?
- Why hydrophilicy is important in drugs?
- What is bio availability?

For Osmosis lab, students will be doing a research on designing a model for Osmosis. That will be discussed in class.. Students will gain experience and understanding using semi-permeable membranes to simulate the absorption of nutrient molecules into cells.

CLASSROOM ACTIVITY DESCRIPTION (LABORATORY/EXERCISES/PROBLEMS) including detailed procedures:
Students are introduced to the formulation and its importance in drug discovery through a power point lesson on formulation (used AphA resources).

This osmosis laboratory experience brings passive cell transport to life. Students create an artificial cell using dialysis tubing and simulated cellular fluid containing a special dye and glucose. The diffusion of dye through the membrane can be directly observed, but what about the water and glucose?

Mass and volume measurements prove that osmosis takes place, while glucose test strips confirm that the unseen glucose molecules also diffuse through the pores in the artificial cell membrane.

For the vocabulary exercise, students are given the Frayer model handout and asked to compare the given vocab words like osmosis and diffusion.

S**AMPLE QUESTIONS TO ELICIT CLASS DISCUSSION:**
Why oil and water not miscible?
Why hydrophilicy is important in drugs?
What is bio availability?

ASSESSMENTS:
1. Frayer model for vocabulary
2. Lab report
3. Quiz /Analysis questions
4. Class/lab participation or formative assessment

(https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=418)

PARAMETERS TO EVALUATE STUDENT WORK PRODUCTS:
Accuracy of definitions and description for Frayer model activity.
Accuracy of data collected from osmosis laboratory.
Authenticity of information on real-world applications.

ACKNOWLEDGEMENT

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Supporting Program: Center for Pre-College Programs, at the New Jersey Institute of Technology
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Lesson 2: Nanomers and Polymers

Students will learn about the nano particles and their importance in pharmaceutical field.

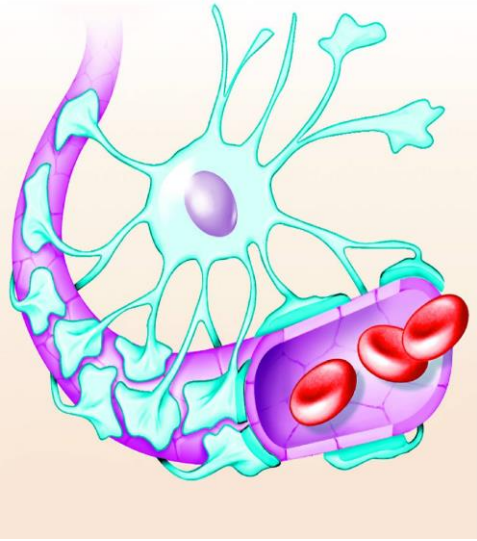
STANDARD(S) & INDICATOR(S):
CCSS-Math:
5.MD-1. Convert among different-sized standard measurement units within a given measurement system.

LEARNING OBJECTIVE(S): Students will be able to
I**dentify** and **describe** the use of polymer in daily life including the medical industry
Compare nano to kilo. (Metric system conversions)

MATERIALS:

Aluminum Chloride	2 Plastic Teaspoons
Cobalt(II) Nitrate	Graduated cylinder
Copper(II) Chloride	Eelectronic Balance scale
Iron(III) Chloride	Paper Towel
Sodium silicate solution	Rubber Band
One large beaker and three small beakers	Gloves, apron, goggles
Distilled water	

BACKGROUND INFORMATION:
Difficulty for the treatment of CNS disorders like Alzheimer's disease, Parkinson's disease and brain cancer.
Getting drugs into the brain –(BBB crossing).
New drug delivery strategies are in demand.
Improving bioavailability.



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

- Students will be introduced to metric unit conversions. They will be solving few problems on unit conversions.

Students will learn:

- What is the importance/advantages of nano particles in drug formulations?
- What are biodegradable polymers??
- What is bio availability?

Students are introduced to the formulation and its importance in drug discovery through a power point lesson on formulation. Students analyze the concepts of polymer (formation of insoluble silicates), osmosis and crystal structure with the silica garden experiment. They will observe in a matter of seconds column of various colors sprout up from the bottom of a beaker containing a liquid. The crystals form like stalagmites in a cave and continue to grow for several days. This beautiful crystal garden are fascinating to watch and apt for visual learners.

SAMPLE QUESTIONS TO ELICIT CLASS DISCUSSION:

HOMEWORK ACTIVITY/EXERCISES/PROBLEMS:

PARAMETERS TO EVALUATE STUDENT WORK PRODUCTS:
Assessment on accuracy of metric unit conversions.
Assessment of knowledge gained from silica garden lab/ demonstration

REFERENCES:
https://www.youtube.com/watch?v=S7szY4J7Hvw

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