Teacher Guide

Pharmaceuticals: Designing & Producing Effective Medicines

HOOK QUESTION: Why might drugs be administered in different ways, like by mouth or by injection?

Purpose: The purpose of this laboratory is to explore pharmaceutical design principles by acting as pharmaceutical scientists to investigate how pharmaceuticals can be engineered and delivered to reach the correct location in the body at the appropriate time.

Curriculum Connections:

- Aligns with chemistry and biology curriculums in high school
- Chemical Engineering: using math, science, and engineering concepts to design an enteric coating to delay the release of colored tablets inside the human body
- Biomedical Engineering: designing and constructing drug delivery devices

Students will be able to:

- Analyze real-world problems and use critical thinking skills in order to solve them
- Explore developments in drug delivery systems
- Design and build a small-scale dual delayed drug release delivery system using material provided
- Explain the engineering process as it pertains to their design and reflect on opportunities to improve it

Content Vocabulary/Terms:

- Pharmaceuticals: chemical substances used for the prevention or treatment of a disease, and to help restore or correct functions in the body
- Drug Delivery Systems: engineered technologies for the targeted delivery and/or the controlled release of the active pharmaceutical ingredient in the human body
- Diffusion Flux: the movement of particles
- Fick's First Law of Diffusion: diffusion flux from high to low concentration is directly proportional to the particle's concentration gradient
- Polymers: materials of long, repeating chains of molecules

NEXT GENERATION SCIENCE STANDARDS:

HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-PS1-5: Apply scientific principles and evidence to provide an explanation about the effects of changing temperature or concentration of the reacting particles on the rate at which a reaction occurs.

Lab Resources Files

- **Intro Video** (~10 min)
- **Student Files** (Choose 1 of the following)

  - Student Workbook
  - Abbreviated Student Worksheet

- **Answer Keys** for the Student Workbook or Student Abbreviated Worksheet can be given upon teacher request.

MATERIALS:

PHARMACEUTICALS

PHARMACEUTICALS TEACHER KIT		
Materials will be distributed throughout the class.		
Item/Link	**Quantity**	**Photo**
Box of Paper Clips	1	
Colored Tablets	1 jar , 60 tablets	

PHARMACEUTICALS STUDENT KIT		
1 kit for every 3 students		
Item/Link	**Quantity**	**Photo**
Paper Strips	10	
Napkin	1	