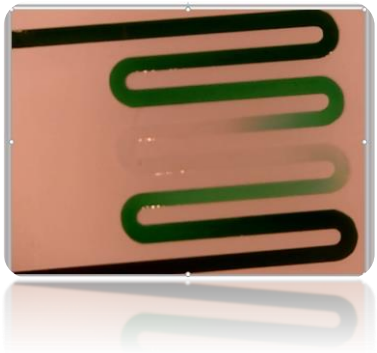
The easy pathway to equivalence- Simple diffusion across a solid medium

Subject Area(s)	Chemistry, Life sciences, physics
Associated Unit	Transport
Lesson Title	Simple diffusion across a medium
Grade Level	High School (10-12 grades)

Image 1

Image file: Diffusion across agarose beds



ADA Description: The image is showing the diffusion of green vegetable dye thought an agarose gel bed. The diffusion chamber is modeling diffusion in the small intestine.

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Lesson #	1 of 1
Lesson Dependency	None
Time Required	240 minutes

Summary

In this activity, the students will learn about the process of simple diffusion and determine some of the factors that affect the rate of diffusion. Thought a series of simple activities, the students will be able to understand and explain Fick's first law of diffusion. They will also have the opportunity to learn about the importance of simple diffusion in biological systems. At the conclusion of the activity, the students will design and develop a model to explain diffusion in a cancerous tumor.

Engineering Connection

- This activity addresses Next Generation Science (NGSS) and Engineering Practice 2: *Developing and Using Models.* The students are given the opportunity to model factors that affect the rate of diffusion through several activities.

- This lesson also aligns with the Next Generation Science and Engineering Practice 5: *Using Mathematics and Computational Thinking.* The students will determine how the rate of diffusion is dependent on the difference between the two gradients, Fick's first law of diffusion. They will determine the diffusion constant for agarose beds of different concentrations.
- Part of the lesson aligns with the Next Generation Science and Engineering Practice: *Construct explanations and designing solutions.* The students will have the opportunity design and construct a model to demonstrate diffusion processes inside a cancerous tumor. They will model the cardiovascular network inside a tumor and how this could be use to deliver anti-tumor drugs.

Engineering Category =

Choose the category that best describes this lesson's amount/depth of explanations engineering content:

1. Relating science and/or math concept(s) to engineering
2. Engineering analysis or partial design
3. Engineering design process

Keywords

- Fick's second law of diffusion
- Concentration gradient
- Kinetic energy
- Simple diffusion
- Random motion

Educational Standards (List 2-4)

Source, year, standard number(s)/letter(s), grade band and text (its unique ID# is optional)

State STEM Standards (required)

ITEEA Standards (required)

NGSS Standards

- HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
- HS-PS2-1. Analyze data to support the claim that Newton's Second Law of Motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
- HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative positions of particles (objects).

CCSS Standards

Systems and System Models

Pre-Requisite Knowledge

Learning Objectives

After this lesson, students should be able to:

- *Demonstrate the principle of diffusion- Fick's Second Law, by utilizing polymers and water-soluble dyes.*
- *Demonstrate the principle of diffusion in biological systems by utilizing model of the small intestine.*

- *Determine the rate of diffusion using time-lapsed photography.*

Introduction / Motivation

Lesson Background & Concepts for Teachers

Image Insert Image # or Figure # here [use Figure # if referenced in text]

Figure 1
Image file: ___?
ADA Description: ___? *(Write as if describing the image to a blind person; do not repeat caption content.)*
Source/Rights: © ___?
Caption: Figure 1. ___?

Vocabulary / Definitions

Word	Definition

Associated Activities

Lesson Closure

Assessment

Pre-Lesson Assessment
Descriptive Title: ___?

Post-Introduction Assessment
Descriptive Title: ___?

Lesson Summary Assessment
Descriptive Title: ___?

Homework
Descriptive Title: ___?

Lesson Extension Activities

Additional Multimedia Support

References

Attachments

Other

Redirect URL

Contributors

Supporting Program

Acknowledgements

Classroom Testing Information