

**Research Experiences for Teachers (RET)**  
**Center for Pre-College Programs**  
**New Jersey Institute of Technology**

**LESSON MODULE**

**Polymer structure and function as it relates to distribution and stability**

**MODULE TOPIC:**

Employ the engineering design process in order to design and construct a Jell-o Mold Polymer model with a homogeneous distribution of particles

**RATIONALE:**

The application and use of this module in the classroom promotes a hands-on real-world experience working with polymer models in order to gain a better understanding of the behind the scenes aspect of the engineering process and how teams must work together as a cohesive unit to accomplish a shared goal. The lessons developed in this module are designed to promote a better understand of the engineering design process.

**STANDARD(S) & INDICATOR(S):**

(Note: This section should include all standards listed in the lessons.)

**5.1.8.B2.** Design and conduct investigations incorporating the use of a control.

**5.1.8.A2.** Communicate experimental findings to others.

**5.4.4.C3.** Use the design process to identify a problem, look for ideas, and develop and share solutions with others.

**5.4.6.C1.** Select a technological problem and describe the criteria and constraints that are addressed in solving the problem.

**5.6.12.A6.** Know that many biological, chemical and physical phenomena can be explained by changes in the arrangement of atoms and molecules.

**5.6.12.A7.** Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms.

**OBJECTIVE(S):**

(Note: This section should include all objectives listed in the lessons.)

Students will be able to:

- Understand the structure and function of polymers and their effects on the properties of particle distribution and stability
- Engage in cooperative problem-based learning activities
- Use a molecular model set to construct and evaluate multiple polymer, surfactant, and Active Pharmaceutical Ingredients (API) design models from planning stage to final product
- Employ the engineering design process in order to design and construct a Jell-o Mold Polymer model with a homogeneous distribution of particles

**LIST OF LESSONS:**

Polymer Structure and Function: Stability and Distribution Model Project

Homogeneous Distribution of Active Pharmaceutical Ingredient in Jell-O Mold Polymer Project.

Lesson Plan Template

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**LEARNING EXPERIENCES – INSTRUCTIONAL PLAN SUMMARY:**

Students will engage in cooperative problem-based learning activities involving polymer structure and function

**STUDENT ASSESSMENT:**

Demonstration of acquired skills and knowledge will be through student assignments, which will be accompanied with an assignment specific rubric.

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**LESSON #1**

**LESSON TOPIC:** Polymer Structure and Function: Stability and Distribution Model Project.

**RATIONALE:**

The application and use of this module in the classroom promotes a hands-on real-world experience working with polymer models in order to gain a better understanding of the behind the scenes aspect of the engineering process and how teams must work together as a cohesive unit to accomplish a shared goal. The lessons developed in this module are designed to promote a better understand of the engineering design process.

**STANDARD(S) & INDICATOR(S):**

**5.6.12.A6.** Know that many biological, chemical and physical phenomena can be explained by changes in the arrangement of atoms and molecules.

**5.6.12.A7.** Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms.

**5.1.8.B2.** Design and conduct investigations incorporating the use of a control.

**5.1.8.A2.** Communicate experimental findings to others.

**OBJECTIVE(S):** Students will be able to:

- Relate polymer properties to molecular structure
- Describe the structure and function of polymers and their effects on the properties of particle distribution and stability.
- Construct and test multiple polymer model designs to analyze and understand polymer formation characteristics and their relation to homogeneous distribution of particles
- Produce an organized lab report that compares polymer models and demonstrates interpretation of experimental data.

**MATERIALS:**

1. Standard Molecular Model Set
2. Colored Pencils
3. Plain White Drawing Paper
4. Ruler

**LIST OF HANDOUTS (attach original copies of each handout - teacher & student edition)**

1. What is the Design Process Essay Handout- This provides students with a brief but clear and concise look at what makes up the different aspects of the Engineering Design Process.
2. Stability and Distribution Model Project – This provides the rules and regulations that teams must abide by in order to successfully complete the task.

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

Procedure:

1. Students will watch a clip from *Thinking Big, Building Small* video from TeachersDomain.org
2. Students will read and take notes on What is the Design Process Essay Handout and answer discussion questions provided
3. Students will design and build multiple polymers based on rules and guidelines set out by teacher in Stability and Distribution Model Project – Student Handout included

**HOMEWORK ACTIVITY/EXERCISES/PROBLEMS:**

1. Construct and test polymer model designs to analyze and understand polymer formation characteristics and their relation to homogeneous distribution of particles.
2. Work in cooperative pairs/groups to construct and model polymer-surfactants-API formations based on teacher prepared guidelines
3. Design, evaluate, and reformulate multiple polymers structures using molecular models of differing characteristics in an attempt to optimize polymer stability and API capacity
4. Produce an organized lab report that compares polymer models and demonstrates interpretation of experimental data

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**LESSON #2**

**LESSON TOPIC:** Homogeneous Distribution of Active Pharmaceutical Ingredient in Jell-O Mold Polymer Project.

**RATIONALE:**

The application and use of this module in the classroom promotes a hands-on real-world experience working with polymer models in order to gain a better understanding of the behind the scenes aspect of the engineering process and how teams must work together as a cohesive unit to accomplish a shared goal. The lessons developed in this module are designed to promote a better understand of the engineering design process.

**STANDARD(S) & INDICATOR(S):**

**5.6.12.A7.** Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms.

**5.4.4.C3.** Use the design process to identify a problem, look for ideas, and develop and share solutions with others.

**5.4.6.C1.** Select a technological problem and describe the criteria and constraints that are addressed in solving the problem.

**5.1.8.A2.** Communicate experimental findings to others.

**OBJECTIVE(S):** Students will be able to:

- Describe the structure and function of polymers and their effects on the properties of particle distribution and stability.
- Employ and demonstrate the engineering design process
- Design and construct a Jello Mold Polymer model with a homogeneous distribution of particles
- Prepare a well formulated conclusions paper which describes the design process and analyzes the experimental results.

**MATERIALS:**

3 oz packet Gelatin Dessert

1 cup Boiling Water

1 cup Cold Water

Smarties Candy

Access to Refrigerator

Any Materials that can be found in the local supermarket that you will make your mold out of

**LIST OF HANDOUTS (attach original copies of each handout - teacher & student edition)**

1. Easy-Fit Design Article Handout
2. Homogeneous Distribution of Active Pharmaceutical Ingredient in Jell-O Mold Polymer Project

Lesson Plan Template

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

**Procedure:**

1. Students will watch a clip from *Easy - Fit Design* from TeachersDomain.org
2. Students will read and take notes on Easy-Fit Design Article Handout and answer discussion questions provided
3. Employ the engineering design process to design and construct a Jell-O Mold Polymer model with a homogeneous distribution of particles – Handout included
4. Students will work as a design team whose goal is to design, construct, and produce a Jell-o mold with API equally distributed throughout the mold.
5. Prepare a well formulated conclusions paper which describes the design process and analyzes the experimental results.
6. Student Design Team Jell-O Molds will be graded based on teacher prepared rubric, based on assignment rules, regulation, and limitations.
7. Students will include a written conclusion paragraph based on design process and data analysis.

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