# Teacher's Guide for Oklahoma Medical Research Foundation (OMRF) Discovery Kits

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## Synthetic Worms Experience - Lesson Plan

### Introduction

Welcome to the Oklahoma Medical Research Foundation Discovery Kit! This guide is crafted to help you lead your seventh graders through a scientific journey where they'll witness chemistry in action and learn while having fun.

### OMRF Discovery Kit Components

- 35 Safety Glasses: Safety first! With more glasses than students, you have spares in case of damage or loss.
- 17 Mixing Bowls: Each pair of students will use one bowl to mix their calcium chloride solution.
- 17 Measuring Cups: These will be used to measure the water needed for both solutions.
- 17 Measuring Spoons: These are for accurately measuring the calcium chloride and sodium alginate powders.
- 17 Bottles with Caps: After preparing the sodium alginate solution, each pair of students will use one bottle to mix sodium alginate with water and food coloring, then shake the mixture until it thickens.
- 2 Containers of Calcium Chloride: This chemical should be distributed among the pairs of students to create the solution in which the "worms" will form. The amount provided is sufficient for six class periods with up to 17 groups of two.
- 4 Jars of Sodium Alginate: Like the calcium chloride, this will be distributed among the student pairs and used to create the alginate solution.
- 1 Box of Food Coloring: This can be used by students to color their sodium alginate solution before it reacts with the calcium chloride, allowing for colorful worm creation.
- 3 Boxes of Disposable Gloves: There should be plenty of gloves for all students across six class periods.
- Disposable Stir Sticks: These are for students to stir their calcium chloride solution.

### Safety Reminder

Ensure all students are wearing safety gloves and glasses before starting the experience. Review your classroom safety procedures and the proper disposal of chemicals with your class.

## Teaching Instructions

Have students pair up in groups of two or more. Each GROUP will need:

- 1 OMRF blue measuring cup
- 1 OMRF mixing bowl
- 1 OMRF measuring spoon
- 1 bottle with cap
- 1 stir stick
- Water (at least 2 cups)
- Access to provided calcium chloride, sodium alginate and food coloring

### Proper Cleanup and Disposal

Disposal of Synthetic Worms: After observing and documenting the properties of your synthetic worms, dispose of them by placing them directly into the trash. Ensure that students do not attempt to dispose of them down the sink as they could cause blockages.

Liquid Disposal: The remaining liquid solutions from the experiment, including the water with dissolved calcium chloride and any excess water used, can be safely poured down the sink. Run the tap for a few seconds to ensure all residues are flushed away.

### NGSS Science Correlation

MS-PS1-2. Analyze and Interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

### Science and Engineering Practices

Analyzing and Interpreting Data - Obtaining, Evaluating, and Communicating Information

- After learning about chemical reactions, students engage in an experience to show how synthetic materials are made and how they impact society.

### Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter - Each pure substance has characteristic physical and chemical properties that can be used to identify it.

PS1-B: Chemical Reactions- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.

- Students observe how substances react chemically to create new synthetic materials with different properties than the original substances used to form them.

### Cross-Cutting Concepts

Structure and Function

Influence of Science, Engineering, and Technology on Society and the Natural World

- Students use ideas from the experience to help explain how changes in the properties of materials from chemical reactions can be shaped and used for specific purposes.

# Teacher's Supplemental Information

**What is Calcium Chloride?**

- Calcium chloride ($CaCl_2$) is a white crystalline salt compound, highly soluble in water.
- Common Uses: It's used for de-icing roads, in food preservation, and as a firming agent in canned vegetables.
- Scientific Significance: It serves as a source of calcium ions in a solution, which can lead to interesting reactions, such as the one in our experience.

**Deep Dive into Calcium Chloride:**

- Molecular Makeup: Composed of calcium and chlorine, it's hygroscopic, meaning it attracts moisture from the air.
- Handling Notes: It's important to store it in airtight containers and handle it with gloves as it can irritate the skin.

**What is Sodium Alginate?**

- Sodium alginate ($NaC_6H_7O_6$) is a natural polysaccharide extracted from brown seaweed.
- Common Uses: It acts as a thickener in food, an ingredient in dental molds, and is used for wound dressings due to its absorbent properties.
- Scientific Significance: In the presence of calcium ions, sodium alginate can form gel-like structures – the basis for our synthetic worms.

**Deep Dive into Sodium Alginate:**

- Molecular Makeup: It's a long-chain carbohydrate, which makes it capable of creating gels when reacting with calcium ions.
- Handling Notes: Sodium alginate is safe to handle.

**What is an Exothermic Reaction?**

- Definition: An exothermic reaction is a chemical reaction that releases energy by light or heat.
- Real-World Example: Combustion in a fireplace or the warmth felt when quicklime (calcium oxide) is added to water. The dissolving of calcium chloride in water is exothermic, causing the water to feel warm.

**Deep Dive into Exothermic Reactions:**

- Energy Insights: These reactions often occur spontaneously and can be harnessed for various applications, such as in self-heating cans and heat packs.
- Teaching Tip: Illustrate this concept with everyday examples, such as rust forming on iron or baking bread in the oven.

**What is the Transformation of Natural Materials into Synthetic Ones?**

- Definition: This process involves creating synthetic materials, like plastics and nylon, from natural resources. These man-made materials often have enhanced properties compared to their natural counterparts.
- Real-World Example: Synthetic fabrics in clothing are more durable and easier to maintain than natural fabrics like cotton. Plastics, used in various products, are made from petroleum.

**Deep Dive into the Transformation:**

- Durability and Cost Insights: Synthetic materials are more long-lasting and often cheaper to produce than natural ones.
- Environmental Impact Insights: The production and disposal of these materials can harm the environment, causing pollution and waste issues.

# Teacher's Supplemental Information

## Optional Extension Guide for Turning the Experience into an Experiment

This extended experiment is an optional addition for educators who wish to challenge advanced classes or expand the lesson further. While not required, it offers an excellent opportunity to deepen students' understanding of and engagement with scientific concepts.

By extending a simple classroom experience into a more comprehensive experiment, this approach reinforces the learned concepts and encourages critical thinking and hands-on exploration. It's designed to enhance the learning experience by challenging students in a practical, interactive way.

## Extension Plan for the Experiment

To enhance the learning experience around the transformation of natural materials into synthetic ones, we propose the following extensions to the initial activity:

### Comparative Analysis with Different Salts

Setup: Use three beakers, each with a different naturally-occurring salt.
Beakers:

- #1: 30 g of Calcium Chloride ($CaCl_2$)
- #2: 30 g of Sodium Chloride (NaCl)
- #3: 30 g of Magnesium Chloride ($MgCl_2$)

Constant: Keep the sodium alginate constant at 0.5 g in each beaker.
Objective: Observe and compare how sodium alginate reacts with different salts.

### Concentration Variation of Calcium Chloride

Setup: Use three beakers with varying concentrations of calcium chloride.
Beakers:

- #1: 15 g $CaCl_2$
- #2: 30 g $CaCl_2$
- #3: 45 g $CaCl_2$

Constant: Keep the sodium alginate constant at 0.5 g in each beaker.
Objective: Study how different concentrations of $CaCl_2$ affect the reaction with sodium alginate.

### Concentration Variation of Sodium Alginate

Setup: Use three beakers with different amounts of sodium alginate.
Beakers:

- #1: 0.5 g sodium alginate
- #2: 1.0 g sodium alginate
- #3: 1.5 g sodium alginate

Constant: Keep the calcium chloride constant at 30 g $CaCl_2$ in each beaker.
Objective: Investigate how changing the amount of sodium alginate influences its reaction with a constant concentration of calcium chloride.

By conducting these experiments, students can delve deeper into the science of material transformation, understanding not just the 'what' but also the 'how' and 'why' behind these processes. This hands-on approach also helps in developing their analytical and observational skills.