

Extracting Excitement: Delectable DNA, Essential Oils, and Bath Bomb Engineering



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Me (Amanda Malefyt)

- **BS in Chemical Engineering, Bioprocess Minor,** Trine University
- **Pfizer Manufacturing Engineer**
- **PhD in Chemical Engineering,** Michigan State University
- **Trine University Professor** (14th years teaching)
- **Member of the AIChE K-12 Executive Committee**
- **Director, AIChE EdDiv**
- **Mom** (a 9 and 11yo)





What is engineering?



Engineers are expert problem solvers who apply their knowledge in programming, physics, math, chemistry, and biology toward making the world a better place!



Types of engineering



Biomedical



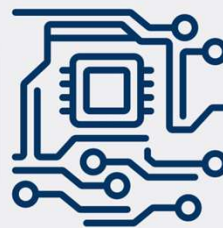
Chemical



Civil



Design



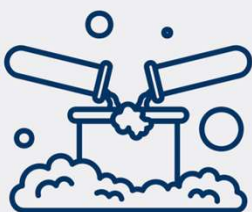
**Computer
Electrical**



**Mechanical
Robotics**



Chemical Engineering



Chemical

Chemical Engineers use chemistry and biology to design and improve processes for making medicines, foods, cosmetics, and fuels.



Average Starting Salary
\$80,000/year
\$38.00/hour



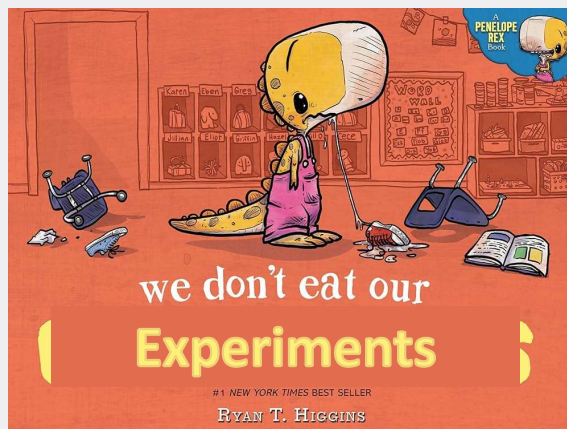
Activities Overview

Safety

- You might find all materials in your kitchen or craft room...
- Messes will be made.
- Some students might be allergic to Epsom salts or certain essential oils (bath bombs).

A one-page overview of each activity is available (electronic or paper)

- Materials List
- Procedure and Tips
- Applications toward Chemical Engineering
- Alignment table for NextGen Science Standards by grade group
- Supplemental Chemical Engineering critical thinking questions





DNA Extraction From Strawberries



Biological Polymers: DNA is a polymer; a giant molecule made of tiny repeating pieces linked like train cars. Chemical engineers use separation techniques to isolate these fragile, long chains from cells to read or safely edit their instructions.

Microscopic Medicine Factories: Chemical engineers can rewrite DNA and insert it into a host cell (a living cell used to grow a product). This transforms the cell into a tiny factory making complex proteins like monoclonal antibodies—"warrior proteins" that fight diseases like cancer.

Green Materials and Sustainability: By designing custom DNA, engineers can reprogram microbes (like bacteria or yeast). Changing their internal instructions trains these organisms to eat industrial waste and recycle it into eco-friendly bioplastics, biofuels, or specialty food ingredients.



Solvent Extraction of Marker Ink



Solvent Extraction (Separation Processes): Extraction means using a specific fluid to selectively dissolve and pull a target chemical out of a solid or liquid mixture. When you brew a hot cup of coffee or tea, you are performing liquid extraction! Chemical engineers use this process to pull essential oils (like lavender, mint, or citrus) out of plant matrices so they can be used to scent consumer products like lotions or bath bombs. **To extract 1 teaspoon of lavender oil, you need almost 2 pounds of plant mass.**

Solvent Selection (Maximizing Yield): Knowing which liquid will dissolve a specific molecule is a core chemical engineering skill. Alcohol successfully dissolves permanent ink while water fails. Process engineers carefully choose solvents that are highly attracted to the exact aromatic molecules they want to capture, which allows them to maximize the pure scent while leaving behind unwanted plant components like green chlorophyll or sticky waxes.

Chromatography (Molecular Separation): Chromatography separates a moving mixture by letting its individual components travel through a material (like liquid climbing up filter paper) at different speeds. As the fluid moves, different ink molecules separate into distinct, visible color bands. Chemical engineers scale this up using large columns to isolate and purify life-saving medicines from complex mixtures of cells, ensuring the final injection is perfectly pure and safe for patients.



Chemical Engineering of Bath Bombs



Chemical Kinetics (Controlling Reaction Speed): Chemical engineers don't just start reactions; they control how fast or slow they happen. By tweaking a chemical recipe, an engineer can design a bath bomb to fizz slowly for a relaxing five minutes or optimize the chemistry inside an automotive air bag so it inflates in a split second during a crash.

Process Scale-up (From Bowls to Factories): Making a few bath bombs in a small kitchen bowl is easy, but a manufacturing engineer must design giant automated mixing plants. They calculate how to blend thousands of pounds of dry powder uniformly without letting the humidity in the room ruin the chemical reaction before the product gets packed into a box.

Product Formulation (Designing the Perfect Mix): Combining active chemical ingredients with filler materials to get a specific texture or shape is called formulation engineering. This is the exact process engineers use to create everyday consumer goods, like crunchy dishwasher pods, smooth cosmetics, or timed-release vitamin tablets that dissolve slowly in your stomach.



Is engineering the path for your students?

