List of Past Modules

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| **Module Name** | **Module Topic**  | **Brief Description of Module** |
| Racing with Interchangeable Parts | Measurements & Precision, Quality Control, Defining a System | Students are challenged to recreate a tire that is missing from a Lego racecar using measurements that they take. Students must first measure all of the dimensions of the tire that they need to recreate. Then the model car and tire will be taken away, and the students will work with Crayola Model Magic clay to recreate the missing tire entirely based on their measurements. The students will then test the fit of their newly created part in the racecar, testing the size and movability of the racecar with their new tire by rolling it down a ramp and (optionally) measuring its dimensions with a caliper. The importance of interchangeable parts, precise measurements, geometric shapes & dimensions, and spatial fit will be emphasized in this module. |
| Super Slime | fluid dynamics, physical properties | Many students are familiar with silly putty and other slime products, however very few understand the science and chemistry that goes into making these products. This activity seeks to educate students on the reaction that creates slime as well as show how the physical properties of the slime change when different proportions of reactants are used. This activity addresses a wide range of topics including physical properties, polymers, and non-Newtonian fluids, as well as introduces students to the Engineering Design Process.  |
| Surface Tension | Physics, Engineering | In this 50-minute module, we introduce the concept of surface tension to students through three simple experiments: In the first experiment, students attempt to place as many drops of clean water as they can on a penny and learn that it is something called surface tension holding the blob of water together. In the second experiment, students use soap to weaken the surface tension of milk and observe the induced flow patterns traced by streaks of food coloring. In the third part, students apply the knowledge gained from the first two parts and repeat the first experiment using soapy water. Students will also practice aspects of the scientific method in this lesson. |
| Investigating Fluid Flow Using PlayDoh | Fluid Dynamics/Momentum Transport | This module uses PlayDoh extrusion to generate and visualize the parabolic profile for flow of fluids through a tube. Participants make predictions on the pattern of the flow profile, collect data and calculate velocities. Follow-up questions allow those leading the module to debrief on what the participants observed.  |
| Bears, Beets, Paper Chromatography | paper chromatography, mass transfer | This activity will introduce 9th-12th grade students to liquid chromatography and the mass transfer principles behind it. Featuring a murder mystery theme from "The Office", students will put on their detective hats to determine who left the ransom note. By performing chromatography in various ink samples from around the office, the students will try to match the correct marker to the culprit who left the ransom note and save Angela.  |
| Lighting | Lighting characterization and costs emphasizing power and energy consumption | The Lighting module introduces the concepts of energy and power through a study of light bulbs power consumption. Students determine the power consumption of different light bulb types and compare to the values indicated on the original packaging. Energy consumption is calculated by assuming an average daily usage and energy cost calculated based on current electricity rates. Other aspects of light bulb use are evaluated including: 1) luminosity, 2) dimmability, 3) lifetime, and other factors such as bulb hazards and color. Total cost of illumination is calculated from electricity (operating) and bulb (capital) cost for a five-year time frame. Students decide which bulb they recommend for purchase and write a paragraph supporting their conclusion. |
| Milk that turns into paint | Milk that turns into paint | Make an important adhesive with pigment (paint) based on milk casein, using separation techniques and the functions of conventional materials |
| Liquid Layers  | Physical properties  | In this module, the interactions between liquids of different densities are shown by placing multiple liquids in a test tube. Each liquid will "isolate" itself from the others, thus showing clear boundaries between different-density liquids! Additionally, solid materials of different weight (paperclip, bottle cap, etc.) will be dropped into the test tube to see how the heavier materials will sink into the liquids with higher densities.  |
| Adsorption: cleaning water with carbon  | Mass transfer (adsorption) | Activated carbon filter to visually demonstrate adsorption by filtering out dye and other “contaminants”  |
| Alternative Cleaner Fuels | Thermodynamics  | We will create a lemon battery and the material used for it is 4-6 lemons, zinc and copper electrodes, wires, LED, alligator clamps, tape, voltmeter. In the end we will present how lemon battery is a cleaner option for alternate fuel and hence on larger scale other alternate fuel options can be used as well like hydro-power, nuclear reactors and solar energy.  |
| Fun with Fluorescence | Material science | This module allows students to learn about two physical phenomena: fluorescence and crosslinking polymers. Students will have the opportunity to add sodium alginate to calcium chloride to produce a cross-linked polymer, calcium alginate; this is unique because students can take two liquids and make an insoluble gel. Furthermore, one of the sodium alginate solutions contains liquid highlighter dye, so students can observe fluorescence by placing those with highlighter dye under a black light. In particular, this module covers concepts of chemical bonding and the absorption of light as it relates to fluoresce. In additional, this concept of fluorescence will be connected to chemical engineering research that uses a similar scheme to enhance understanding of materials, biologics, catalysts, etc.  |
| Thermoelectric Human Power | Conservation and Transfer of Energy | This module uses Peltier devices to teach students principles of the conservation and transfer of energy. The students place their hands on one side of the Peltier devices while the other side lies stationary on a cold surface, ice or ice water. The Peltier devices generate electrical energy from this difference in temperature using N and P type semiconductors. This generated electrical energy can be used to light an LED to give students a visual idea of the presence of electrical energy, or a voltmeter can be used to detect a voltage across a known resistance to calculate the quantifiable amount of electrical power generated from the Peltier devices. |
| Thinking Like a ChemE: Building a Humanitarian Filter  | Separations | “Thinking Like a ChemE: Building a Humanitarian Filter” is a workshop activity that allows students grades 3-8 to think critically while using very basic separation principles to make a water filter from common everyday objects. As background, we ask students to think about the real life application of this exercise: the example we give the students is the victims of Hurricane Maria in Puerto Rico who may need a cost efficient water filter from materials they already have. Students are divided into teams of 5-7, plus 1 or 2 supervising volunteers per team, depending on the classroom size or preferences of the teacher or demonstrator. They are given “dirty water”, and their goal is to create a filter that will remove undesirable particles from the water to achieve clear water with a pH close to 7. |
| Hydrophilic vs Hydrophobic | Physical Properties, Hydrophilic vs Hydrophobic | After the demonstrations and activity students will know about the properties of hydrophilic and hydrophobic materials. To introduce the concepts, a demonstration of will be used, a “lava lamp” made with cooking oil, water, and alka seltzer. The topic of density will also be explored in the demonstration. After the demonstrations students will be able to participate in a hands on activity where they will take home their own art made using hydrophobic and hydrophilic everyday items.  |
| Building Block Air Quality Sensor | Air Quality | Poor air quality is a problem that affects the health of many communities, and measuring air quality can be extraordinarily important to people with health problems. In this module you will build a simple air quality sensor with some standard electronic components and building blocks (e.g. legos) |
| It's Crystal Clear, This Rocks! | Crystallization | We teach kids about crystallization by making rock candy with them. |
| Strawberry DNA Extraction | Biochemical engineering | Students will learn about the basics of chemistry involving DNA and extraction solutions. |
| Magic Yeast | Biochemistry | The process of yeast metabolism is demonstrated to students from sixth to eighth grades, students are expected to be able to understand and explain by their knowledge acquired in this 20-30 minutes module this process, its phases, and its relevance for chemical engineering at the end of this module. This will be done through an easy and accessible experiment that allows participants to learn about the different conditions needed for metabolism as yeast breaks sugar (hexose) down. Additionally, they will be able to identify some of the optimal process conditions and relevance in the global industry. |
| Putting a Stop to Viruses! | Biochemistry of soap interactions with different viral structures | Kids will learn about what viruses are, different types, and how chemical engineers and themselves can put a stop to viruses. They will be able to have a fun, interactive experiment that can be down at home with little to no mess! |
| Cooking Up Plastics | Biodegradable plastics from food | The purpose of this module is to introduce students to the science of polymers and consider how we can design products for a smaller environmental impact. This experiment enables students to create their own biodegradable plastics with materials in their own kitchens. Students will polymerize milk proteins and starches from corn to create and mold their own plastics. Both plastics are formed when the compound is exposed to heat and an acid, which results in polymer chains forming. When the soft plastic is kneaded together, the polymer chains form a large network. Students will get the opportunity to test out the biodegradability of the two plastics. |
| Exploring Bioproducts: Glue for Piñatas | Bioproducts, Renewable sources, Chemistry | This module introduces students to bioproducts. Students learn about different examples of bioproducts made from different plants. Students also get to use a bioproduct. Students watch a demonstration of making “engrudo” (wheat paste), which is made from starch and hot water and involves the chemical reaction of gelatinization. The “engrudo” is a bioproduct and a starch glue. Starch glues have been used throughout history and still used today, primarily in the packaging industry. Students use the “engrudo” to make a piñata. Students will not only learn about new science vocabulary and processes but also about history and culture involving bioproducts. |
| Invisible Ink from Lemon Juice | Chemical Reactions | In this module, we introduce the concept of oxidation reaction and its applications using a fun experiment on making and testing homemade invisible ink. |
| Air Quality Data Visualization | Data Analysis, Environmental Engineering | This module seeks to excite students about their potential as citizen scientists by encouraging the employment of their data analysis and visualization skills to interpret real-life air quality data into meaningful connections to the world around them. |
| Potato Power! | Electrochemistry/circuits | Students will learn about electrochemistry, renewable energy, and circuits through an interactive lab in which they can build a potato circuit. Students will be able to get hands on circuits experience exposing them to basic electrochemistry and physics, and will learn how easy it is power simple electronics. Students will also learn about the theory of how batteries and specifically a potato battery work. |
| Racing boats: The science of surfactants | Engineering, physics, properties of liquids | The present module deals with the analysis of surface tension, as it varies with two surfactants; liquid soap and detergent and with the increase of temperature. Therefore, first the experiment will be performed in water at room temperature and then in warm water. The experiment consists of moving a boat (of disposable plate material), by the action of the surfactant's force with the water molecule. |
| Fluid Dynamics: Measuring Viscosity with Timed Marble Drop through Liquids | Fluid dynamics, physical properties | Students will be introduced to the concept of viscosity by dropping marbles into graduated cylinders filled with liquids of varying viscosities, and they will time the marble as it falls through the liquid. The viscosity of the liquid is inversely proportional to the velocity of the marble and will allow students to visually see the difference in the liquid's viscosity and mathematically calculate it with skeleton note equations. |
| Heron's Fountain at Home | Fluid Mechanics | The objective of this module is to introduce students of grades 9th to 12th to the fundamentals of fluid mechanics through a Do-it-yourself module based on the popular theory of Heron’s Fountain. Interactive handouts have been developed whose aim is to guide students to understand the concepts involved through engaging questions which are followed by a step-wise procedure to construct the model at home. |
| Insulation Challenge | Material properties, heat transfer, conduction | Students use everyday materials to design an insulation system around a cup containing ice. The objective is to melt the least amount of ice possible in a 20 minute time frame. |
| pH-un With Food | Physical Properties | The module walks the audience through the science behind the pH scale while using a red cabbage concentrate as a pH indicator. The presenters will describe the differences between acids and bases such as taste (sour for acids, bitter for bases), texture (soapy for bases), chemical structure (-H or –OH presence), approximately 5 minutes. Afterward, students will be presented with safe, household solutions such as vinegar, coffee, and lemon juice for acids and dish soap, egg whites, and baking soda solution for bases. Then, with the new information, they can then make guesses on whether the solutions are acidic or basic. This can then be verified with the pH indicator. Additionally, questions can be posed like, “How can you make a pH 7 solution from a pH 10 and pH 4 solution?” to increase experimentation, approximately 10 minutes. |
| Phase Changes and Making Food | Physical properties, unit operations | An easy method to observe freezing-point depression when creating ice-cream at home. |
| Saving Lives with Centrifugation | Physics (Centrifugation) | Students will be creating their own centrifuge in order to investigate the behaviors of particles under centrifugal force and how this is used in the field of blood donations and processing. Our goal is to promote blood donations, especially during the current shortage, by demystifying the procedure itself and explaining the fascinating phenomena that occur while processing blood. By creating their own centrifuge, students will be able to apply engineering principles to ensure their product works properly, and then can explore the laws of physics through the utilization of it. |
| Polymer Bouncy Balls | Polymers and Elasticity | In this lab we evaluate a polymer chemical reaction and the entanglement of these polymers that form an elastic compound that can be molded into a bouncy ball toy. Students will analyze the effect of temperature on the elasticity, or ‘bounciness’, of the ball. |
| Digestive System as a Chemical Plant | Process design | The interactive part is when the students have to complete the block diagram with the equipment and devices, as if it were a puzzle. |
| Dew and bubble point: understanding mixtures | Process simulation, physical properties | It is an interactive module in which no physical materials are needed, students will be able to relate the concepts of bubble and dew point using a simulation of evaporation of a water-ethanol mixture. |
| Science with Marshmallows | Thermal/kinetic energy and phase transitions | While marshmallows are a sweet treat, they are also great for displaying scientific principles in daily life experiences. The main components that are found in marshmallows are sugar, gelatin, water, and air. The sugar gives the marshmallow its sweet taste, and the gelatin gives the marshmallow its squishy and bouncy texture. Water and air also help form the correct consistency of the marshmallow. If you have eaten marshmallows at room temperature and after the marshmallow has been heated, you will notice a significant difference in texture, size, and consistency. This experiment will take students through the process of discovering why this is. |
| Colorful Chalk Chemistry | Transport Phenomena, Unit Operations, Physical Properties | The presenters will make a video detailing the process of making sidewalk chalk. The process consists of mixing Plaster of Paris with food coloring and water, and pouring this mixture into a mold. The audience will learn about exothermic chemical reactions, and be exposed to the basics of chemistry. |