List of Past Modules

|  |  |  |
| --- | --- | --- |
| **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. |