Grade school - target 6th-8th grade

Some folks need medication to help regulate their mood. Many of these medications are taken by mouth, which can lead to highs and lows since it takes time for them to work. This project aimed to solve this problem by creating a patch which delivers the drug through the skin at a steady rate. The patch consists of a hydrogel made of high acyl gellan gum to provide structure, aloe vera to moisturize the skin, and valproic acid to help stabilize someone's mood. High acyl gellan gum is a polymer, which just means a molecule composed of many parts. When the polymer is cross-linked through heat, linkers come and connect the molecule creating a web of linkages (think of a spider web). These linkages create a gel which can hold the drug and moisturizer into the gel patch. The linkages are 3D, going in all directions, which is why the medicine can release slowly into the skin. The person would only need to change the patch once per day. This project focuses on creating this gel patch from start to finish, exploring all of the steps that go into making a product and bringing it to market.

General Public - Target adults/non-engineering majors

Many adults take a form of medication whether it be for health, lifestyle, or treatment. A problem that can occur is missing a day's dose and the withdrawal affecting their daily tasks. To address this issue, a transdermal hydrogel patch was developed to provide a method to continuously deliver a drug and maintain effective drug levels, working similar to a nicotine patch. This hydrogel patch utilizes a structure composed of a high acyl gellan gum matrix. This matrix consists of the test drug for delivery, valproic acid (used to treat bipolar disorder), as it is a lipophilic drug meaning it can pass through the skin, aloe vera, and polydopamine adhesive.

To test if our product works, we conducted three tests: strength, adhesive, and drug delivery. The strength test was conducted to determine the amount of high acyl gellan gum to add to the gel matrix. The adhesive test was conducted to determine how long we need to leave the gels in the adhesive solution to achieve our desired stickiness. Finally, the drug release rate test was conducted to determine how much of the valproic acid was needed to achieve the target release rate.

Our plan is to sell 9 cm * 5 cm patches at a unit cost of $25, which contains 4 patches. The patches are designed to last 24 hours, and still meets one of the original goals of maintaining a drug concentration in the body to not have highs and lows of the drug effects. Another goal that we were trying to achieve was environmental friendliness, and we were able to achieve that due to the fact that the hydrogel is made mostly of water and will cause minimal harm to the surrounding environment as it easily degrades.

Technical Project Description

We decided to explore the idea of transdermal drug delivery, specifically with the mood stabilizing drug valproate. Due to the oscillatory blood levels associated with ingested extended release pills, we figured that having a constant diffusion rate across the skin for long periods of time would work better. In addition to drug delivery, we also chose to go with a new type of adhesive known as polymerized dopamine film. PDA is created from the acidic polymerization of dopamine hydrochloride. The valproate release rate was modeled using diffusivity constants from researched literature, while the actual experiment was carried out with a precursor to valproate (as it is a regulated prescription drug). The patch was made of high-acyl gellan gum, as well as aloe and an antimicrobial agent. The expected use time for each patch is 1 day, due to the amount of valproate that can be loaded into the patch.