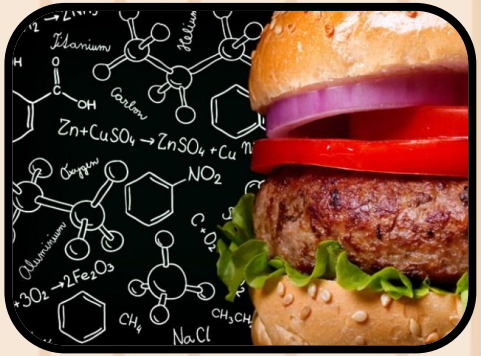
Food Science

Food Chemistry, Ice Cream, Strawberry DNA Extraction, Solar Power Oven

5549
GRYPHON ROBOTICS

Food Engineer

- Health, wellness, safety, waste reduction, water, energy and sustainability are critical topics
- Population growth, aging, “big data,” personalization, sustainability, social responsibility are new challenges.
- Open innovation, and new technologies offer unique vast opportunities.



Food Science

- Explore the use of and design new technology and tools
- The science behind cooking / baking / cutting / cooling / heating
- Why do we add/do _____ to make our food more delicious
- Make food more sustainable for the future
- Food safety and packaging
- Product Development
- Nutrition

Food Chemistry

Food Chemistry – Background

Materials:
- Computer
- Baking (as desired - um...yes please!)

Chemistry and Baking? How are they related?

Baking is simply a form of chemistry. The use of heat, cold, and cutting changes the composition of foods. Even simply slicing an apple sets off chemical reactions that change the color of the apple's flesh. If you heat up sugar to turn it into syrup, you're using a chemical reaction. Once you start learning how these specific processes work, you can use them to your advantage, creating effects in food that make plain dishes fabulous or finding the perfect substitute for someone with a dietary restriction!

Baking Chemistry – Research

The sweet science behind... Cookies

Granulated Sugar: Sugar contributes to the **flavor and texture** of the cookie. It also i**ncreases the cooking speed** of the cookie, it also makes the cookies **spread out more** and rise due to the air pockets it creates. The sugar in a cookie is also what causes the carmalizaton on the bottom of the cookie. Extra sugar creates an extra **crunchy** cookies.

Brown Sugar: Brown sugar is almost the complete opposite of granulated sugar. The brown sugar is what **absorbs moisture** and is very hygroscopic, meaning it retains water very well. Extra brown sugar creates a very **chewy** cookie.

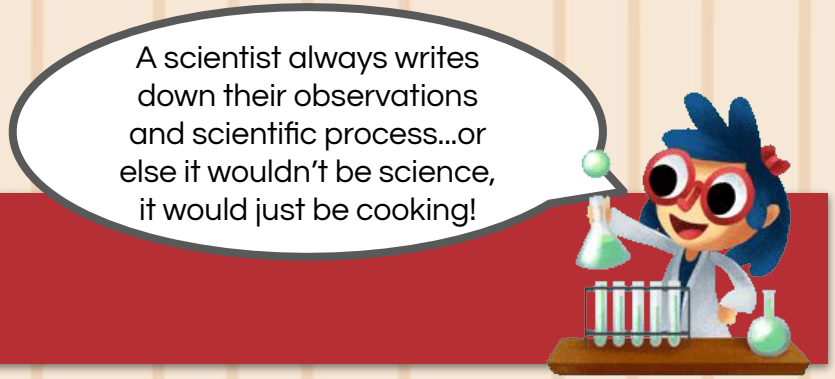
Milk: Milk is what **adds hydration** to the cookies. When the milk is cooked in the cookie, the water inside will evaporate **causing expansion and more of an airy texture**. Extra milk will create a **cakier** cookie.

Baking Chemistry – Research Continued

Baking Soda	Baking Powder
Baking Soda is a base, when this is mixed with an acid (like vinegar or milk) a chemical reaction occurs, this causes the food to rise. ↗ Baking Soda is a stronger base than Baking Powder. Too much Baking Soda and not enough of an acid can leave extra Baking Soda in your food leaving a metallic aftertaste. Yuck! 🤢 Baking Soda is used to help food rise. ↗	Baking Powder actually already contains Baking Soda. 🤯 It's a mixture of Baking Soda (base) and Cream of Tartar (acid). Combining these bases and acids causes two reactions to happen with Baking Powder, meaning its a **double acting substance.** ↗💪↗ 1. When wet - helps rise food ↗ 2. When heated - helps rise food ↗

Learn more here and here!

Baking Chemistry – Your Turn!



Test out your own cookies / baking!
Parent supervision required.

Think back in what you just learned about cooking/baking. What substitutes could you make to a batch of cookies? More milk? Less sugar? Different types of sugar? Baking powder vs baking soda… both?!

Form a question and hypothesis and get working! You can make a copy of this EDD as a template. Make sure that you have different levels of IV, for example an extra tablespoon of sugar, and than in another batch I would have two tablespoons of sugar...etc

If you can't actually make the cookies still try to come up with an experiment and than do some research to see if you were right!

You don't have to make multiple batches, try dividing the batter into smaller parts and than adding things in smaller quantities

Chemistry – Bonus

The sweet science behind... Rock Candy

Create Your Own Rock Candy

*Note: This will take several days (3-7 days)

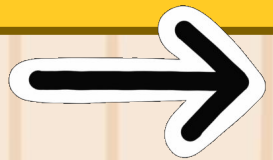
Follow along with the instruction on this website OR on the video.

Ice Cream

Ice Cream – Research

Materials:

- Gallon and Quart size plastic bag
- ½ cup milk
- ¼ tsp vanilla
- 1 tbsp sugar
- ⅓ cup salt
- 3 cups ice



Most ice cream has only **five major parts**: ice crystals, fat, sweeteners, air, and other solids. These five parts are "emulsified" or combined together to create ice cream.

Ice Crystals	The Fats	The Sweeteners	Air	Other Solids
The ice crystals create the ice part of ice cream and is the main part of the ice cream.	The fats, often milk or cream, stabilizes the basses and creates the richness of the ice cream.	The sweeteners, the sugars, improves the texture of the mixture and adds sweetness.	Air is very vital to ice cream making, it is responsible for the consistency of the ice cream, as well as the texture and volume of the ice cream.	Other solids refers to anything non-fat milk solids and any flavourings and mix ins. These add to the flavour and texture of the ice cream.

Ice Cream – Create

Materials:

- Gallon and Quart size plastic bag
- ½ cup milk
- ¼ tsp vanilla
- 1 tbsp sugar
- ⅓ cup salt
- 3 cups ice

1) Add the sugar, milk, cream and vanilla into the quart bag
2) Put the ice in the gallon bag
3) *Record the the temp. Of the ice
4) Add the salt to the bag with ice
5) Seal the quart sized bag and place it into the gallon sized bag, seal the gallon bag
6) Shake the bags vigorously for 5-15 minutes
   a) Pro-tip: use gloves or wrap the bag in a cloth
7) Eat your Ice Cream!

Ice Cream – Brain Freeze → Reflection

Think about this while you eat your ice cream masterpiece!

- How does the ice cream freeze that quickly?? (look here)
- What would you improve about this process?
- How does a non-dairy act in place of the dairy?? (look here)

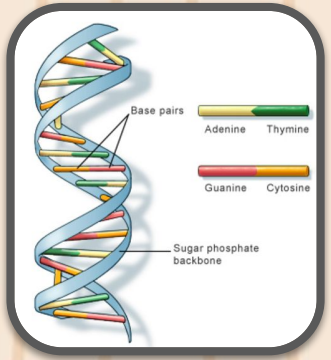
Strawberry Extraction & GMO

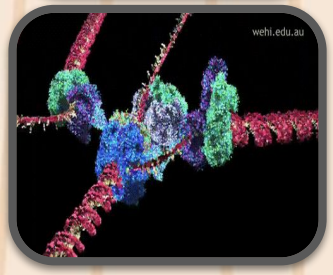
DNA – Research

Materials:

- Plastic ziplock bag
- Strawberries
- straw/stick/coffee stirrer/ tweezer
- 2 tsp dish detergent
- ½ cup water
- 2 cups
- 1 coffee filter or fine mesh strainer
- 2½ cup cold rubbing alcohol (need parent)

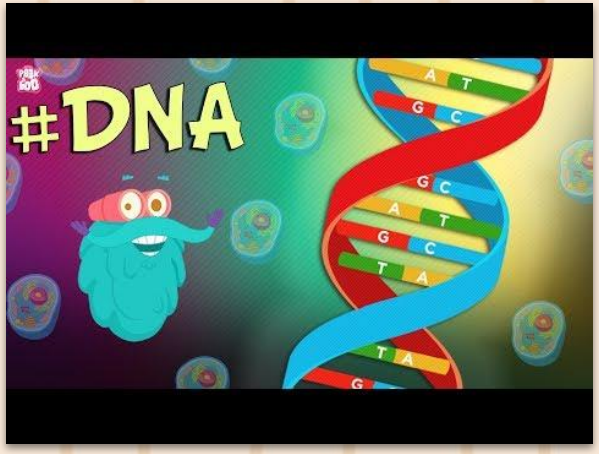
What is DNA (Deoxyribonucleic Acid)?





DNA is what makes up the hereditary information, or genes, in an organism. Most of the DNA is stored in the cell nucleus but a small amount called mitochondrial DNA is stored in the mitochondria of the cell.

DNA is made up of only four chemical bases: adenine (A), guanine (G), cytosine (C) ,and thymine (T). The order of these bases determined the information of the person. These bases can form together in pairs to create the structure of the DNA, which is shaped in a double helix. These pairs attach onto a sugar-phosphate backbone.



GMO – Research

Learn More

Genetically Modified Organisms

People have been altering the DNA of plants and animals for many years using traditional breeding techniques. Artificial selection for specific, desired traits has resulted in a variety of different organisms, ranging from sweet corn to hairless cats. But this artificial selection, in which organisms that exhibit specific traits are chosen to breed subsequent generations, has been limited to naturally occurring variations.

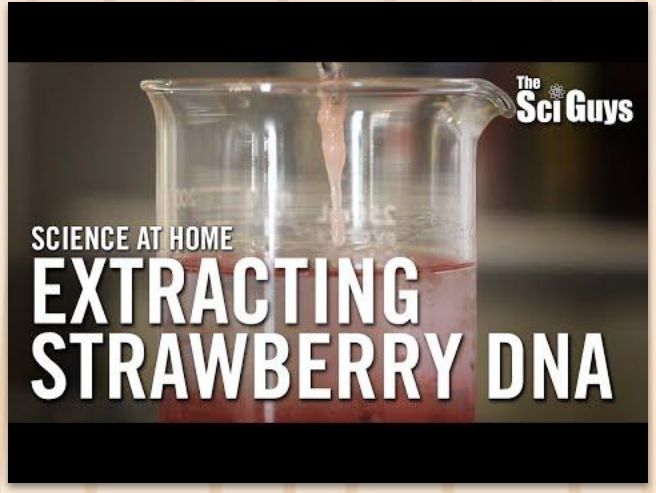
In recent decades, however, advances in the field of genetic engineering have allowed for precise control over the genetic changes introduced into an organism. Today, we can incorporate new genes from one species into a completely unrelated species through genetic engineering, optimizing agricultural performance or facilitating the production of valuable pharmaceutical substances. Crop plants, farm animals, and soil bacteria are some of the more prominent examples of organisms that have been subject to genetic engineering.

DNA – Create

Materials:

- Plastic ziplock bag
- Strawberries
- straw/stick/coffee stirrer/ tweezer
- 2 tsp dish detergent
- ½ cup water
- 2 cups
- 1 coffee filter or fine mesh strainer
- 2½ cup cold rubbing alcohol (need parent)

Extract (get out) DNA From Strawberries



1. Pull of green leaves on the strawberry
2. Put the strawberries in the plastic bags and mash them for about 2 minutes. Completely crush them to break open the cells.
3. In the plastic cup, mix together the detergent, salt, and water, this will be your DNA extraction liquid.
4. Add 2 teaspoons of this liquid to the bag with the strawberries
5. Reseal the bag and smash for another minute, try to avoid soap bubbles
6. Place the coffee filter inside the other plastic cup, pour the bag over the filter, squeeze the remaining liquid into the cup.
7. Pour an equal amount of cold rubbing alcohol down the side of the cup, don't stir this.
8. Watch the substance develop a white cloudy substance, that's the DNA.
9. Tilt the cup and pick out the DNA with the straw/stick. **SO COOL!**

DNA Extraction – Reflection

While you play with your strawberry DNA goo….

- What observations can you make about your Strawberry DNA?
- A human cannot see a single piece of thread 100 ft away. However, if you take a bunch of thread and wind it up to make a rope you can see it much easier. How is this analogy similar to your DNA extraction?
- Why might scientist need to look at / study DNA? (23 ways DNA changed the world)

Solar Power Oven

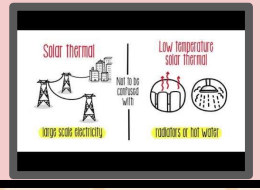
Solar Power – Research

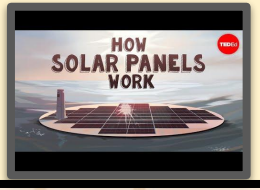
Materials:

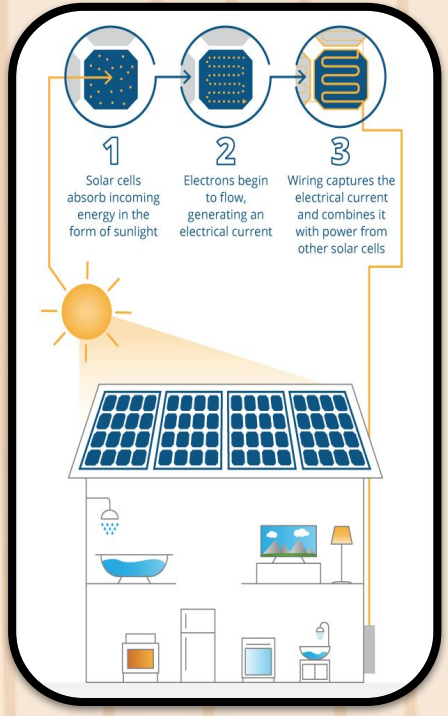
- Cardboard box
- Box knife or scissors
- Adult supervision!!
- Aluminum foil
- Clear tape
- Plastic wrap or a freezer bag
- Black paper
- Newspapers
- Ruler or wooden spoon
- Thermometer

We can use the sun's energy in two different ways. We can capture the energy from the sun through solar THERMAL (what we will be doing for our DIY oven) and solar PHOTOVOLTAICS (like solar panels).

Solar Thermal - Convert the sun's energy and turn it into heat	**Solar Photovoltaics** - Convert the sun's energy and turn it into electricity
Read THIS Watch	Read THIS Watch







Oven– Research

How do standard electric ovens work??

Thermal Radiation- The energy source is electricity. Electricity passes as a current through the inner, coiled wires of the elements.

Convection - Similar to thermal radiation ovens but a circulating fan adds air. This fan distributes the directed radiation from the heating elements around the oven, thereby delivering a more even spread of heat and a faster, more balanced cooking environment as a result.

Oven Coils Turn On and Off to Maintain Temperature

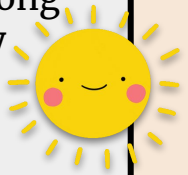
Fan

Solar Power / Oven – Research Continued

Thermal Insulation: Materials that keep heat trapped inside the oven which allows to heat to build.

Camping Competition → Cast Iron Dutch Oven

Cast iron is slow to heat up, so it's also slow to cool down. It is a good regulator of heat and an excellent thermal insulator.Because cast iron pans typically weigh much more and are thicker than the same size pan in another material, they tend to store more energy when heated. This combination of high heat capacity and weight means that cast iron takes a long time to get hot. Once hot, however, a cast iron pan usually contains more thermal energy than other pans at the same temperature.



Your Camping Prototype for a Solar Thermal Oven

- In order for your oven to reach interior temperatures high enough for cooking, the walls and the bottom of the box must have good insulation (heat retention) value. It may also be useful to look at light weight options, better for camping. Good insulating materials include: aluminum foil (radiant reflector), feathers (down feathers are best), rockwool, cellulose, rice hulls, wool, straw, and crumpled newspaper.

Solar Power – Create

Materials:

- Cardboard box
- Box knife or scissors
- Adult supervision!!
- Aluminum foil
- Clear tape
- Plastic wrap or a freezer bag
- Black paper
- Newspapers
- Ruler or wooden spoon
- Thermometer

Make and Test Out Your Own Solar Thermal Oven Prototype!

Follow along with the instructions in the video or use this website for help!

Can you beat 160 degrees?