Grades 5-6: All About DNA

What is Biology? What is DNA? What is synthetic biology? What is iGEM? DNA extraction activity.
Duration: 1 hour.

This workshop and activity aims to introduce the topics of DNA--What is it? Why is it important to study it?--synthetic biology, and iGEM. The workshop will be concluded with a DNA extraction activity, after which students will be able to take home their DNA sample home as a souvenir in the form of a necklace.

PART ZERO: INTRODUCTION

Time allocated: 1 minute

Hi everyone! We're from the UW iGEM Team (we'll tell you all about that later). And, today, we want to talk to you about what we do. *Introduce team members.*

PART ONE: WHAT IS BIOLOGY?

Time allocated: 3 minutes

Does anyone know what Biology is?

Biology is the study of living things--this means we biologists study how living things work and why they do what they do so they can stay alive.

Can anyone give us a few examples of what "living things" are?

We try to figure out what's inside living things and how they work. There are many different specific things biologists study and since living things are so complicated, a lot of biologists focus on one part of what makes a living thing--so, there are lots of different kinds of biology: biology that focuses on studying *really* small living things, for example... or biology that focuses on studying plants or animals.

Along the way, one thing we did figure out was that *all* living things have something called "DNA" inside all their cells! Every single one of them!

Who can tell us what a "cell" is?

Livings things are all made of "cells" -- billions and billions of cells -- and are, in fact, considered living things themselves. Depending on how they are made and how they're put together, cells make up all our organs and all the parts that make us go!

So, what determines how cells work?

PART TWO: WHAT IS DNA?

Time allocated: 12 minutes

Have you guys learned about DNA in school yet? Can you tell us what you know?

You can think of DNA as a "recipe" for all living things. The reason we need to breathe, the reason we can see, the reason we have five fingers and two hands... is because the

instructions for making all of those parts are in the DNA in all of our cells. When we were all still inside our Moms, the DNA instructed our newly developing cells what parts they needed to build and how they were supposed to put it together.

So, depending on what the DNA inside each of our cells says, they do different things... like become skin cells--that's right: our skin is made of skin cells that die and fall off--or become brain cells, and combined altogether, they make all our organs that make us what we are.

In fact, the reason we all look a little bit like both our parents is because our DNA is made up of a combination of Mom and Dad's DNA! *Isn't that cool?!*

Can anyone tell us what an enzyme is?
Enzymes are what we call "proteins" -- they start chemical reactions inside living things and are important for pretty much everything that makes sure we're alive! So, they do things like help make sure we get what we need from the food we eat, they make sure that we get what we need from the air we breathe, and they make sure that the cell does what the DNA is telling it to do.

Okay, what's a protein?

Just like how DNA and enzymes are inside every single one of our cells and make sure we work, proteins are, too! If DNA contains the instructions, proteins are what read these instructions and carry them out. An enzyme (which is a protein, if you remember) called "polymerase" reads the instructions and through a series of complicated reactions "decodes" the information and makes new proteins that do very specific things in our cells... like help make energy from the food we eat so we can keep moving!

PART THREE: WHAT IS SYNTHETIC BIOLOGY?

Time allocated: 5 minutes

Has anyone heard of something called "synthetic biology" before?

So, like we mentioned before, there are many different *kinds* of biology. One kind of biology deals with studying DNA and how it works. Now, when we want to find out how, say, a wrist watch works... we would open it up and find out what's inside and what the parts are made of... and then, once we know how things fit... we try to put it together again and see if we can make it work!

Since DNA dictates exactly how a cell should work, we can try to change the DNA up a bit so that a cell does something *we* want it to do. That's called "genetic engineering". We can do lots of awesome things with this, like make rice that has more nutrients in it so that people who don't have access to a lot of food in the poor parts of the world can avoid malnutrition... or we can do weird things like make different coloured vegetables.

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You can think of synthetic biology as a more efficient and new way to do genetic engineering--back then, in order to do anything with DNA, scientists needed to figure out the code from scratch... and trust me, DNA code is long and really hard to read. Synthetic biology is a way of doing things--scientists share the code that they've figured out with other scientists so that blocks of code that make cells do certain things already exist and other scientists can use those blocks of code without having to write the code from scratch! This lets them concentrate on adding new and more awesome things to the code. It saves a lot of time and money.

If you could, what cool things would you make?

PART FOUR: iGEM

Time allocated: 4 minutes

If you guys remember, we're from an iGEM team... and, believe it or not, making cool things like that is what we do! Unfortunately, we don't quite know how to make things as complicated as [insert some of the more fantastical student suggestions here] yet because we still have a lot to learn about how DNA instructs our cells to do things... maybe when you guys grow up, you'll be able to help figure it out!

Some of the cool things other iGEM teams have done in the past are:

- Things!

PART FIVE: DNA EXTRACTION ACTIVITY

Time allocated: 30 minutes

Now, we're going to do something extra cool. Who'd be interested in *seeing* their DNA?

Today, we'll extract your DNA and put it inside one of these tubes to make a necklace so you can show it off to your parents. *Start distributing materials.*

Procedure

Source: http://learn.genetics.utah.edu/content/labs/extraction/

Step one:

Have each student obtain a cup with Gatorade (a saline solution). Tell students to swish the drink around in their mouth for at least one minute and chew a little bit on their cheeks. The drink should then be spat back into the cup.

The cells inside your mouth come loose really easily and so we'll be collecting those cells and we'll be pulling out the DNA from them.

Step two:

Students should then add the detergent to a test tube. Make sure they are wearing gloves on the hand that they're using to hold the test tube. Then, tell them to pour the solution containing their cell cheeks into the test tube until it is half full.

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We're adding the detergent because the cell is surrounded by a protective skin called a "cell membrane" and DNA is inside *another* protective shell called a "nucleus" -- we need to break those down to get at the DNA and detergent does the job! See, the shell is made of fat molecules and soap is really good at breaking those down. Once broken down, the DNA seeps out.

Step three:
*Next, students should add a pinch of meat tenderizer to the test tube. With their gloved thumb (or palm), they need to cover the top of the test tube. Show them how to gently invert the test tube five times to mix the solution together. We'll let it sit for **10 minutes**.*

So, does anyone know what meat tenderizer is?

Did you guys know that if we stretched out the DNA that is inside a single cell, it would stretch out to be 3 metres long! Now, in order for the DNA to fit inside a single cell, it coils itself around certain proteins--they're called "histones". Now, we can't really see the DNA if they're that tightly coiled up, that's why we're using the meat tenderizer.

Actually, meat tenderizer is just another enzyme... in particular, something called a "protease". *Can anyone guess what this enzyme does?* … It breaks down proteins! That's how meat tenderizer works--the enzymes break down the tough fibres in meat that make it hard to chew, thus making it softer and easier to eat. In this case, we're using the proteins to break down the histones so that the DNA can uncoil.

While we're waiting, does anyone else have any questions about anything?

Step four:
*Using a pipette, slowly add cold rubbing alcohol into the test tube; let the alcohol run down the side of the test tube so it forms a layer on top of the soapy liquid. Keep going until there's about 2cm of alcohol in the tube. Now, we'll let it sit for **10 minutes**.*

We add the cold alcohol to make the DNA come out. We're making it harder for the DNA to dissolve in the liquid, that way we can see it! All the other parts of the cells will be left in the liquid. So, while we're waiting for the DNA to start appearing, *who wants to talk about the different parts of the cell?*

Step five:
DNA should now be visible in the test tube. Using the pipette, suck up the DNA from the test tube and transfer it to the PCR tube. Pipette the DNA into the test tube and fill the test tube the rest of the way up with alcohol. Turn these into a necklace using the string!