Fall 2020

Discovering Your Inner Scientist through Zoom

An Outreach360 STEM Program

VIRTUAL IMPACT PROGRAM

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Discovering Your Inner Scientist in 12 Weeks

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Route 1:

12 Disciplines – 12 Different Focuses – Continual exploring of new topics

Options (and many more):

Biology	Chemistry	Physics	Mathematics
Marine Biology	Geology	Astronomy	Computer Engineering
Human Biology	Battery Chemistry	Climate Change	Electrical Engineering
Mammalian Biology	Digestive Health	Environmental Science	Computer Science
Plant Biology	Nuclear Energy	Health Science	Medicine

These pre-designed lessons are nearly complete for your classrooms each Saturday. After downloading the files from Google Drive to your individual account, you will need to:

- Review the lesson plan within this document
- Complete the checklist at the beginning of the Google Slides
- Add or remove any content you deem necessary for your class time
- Add your name and the date you present these slides on Slide 2, also add a picture!

Activities made within these templates have been used before over Zoom but are still works in progress. If you find details on how you improved a teaching experience through the virtual format, share this with the other volunteers and the Outreach360 staff (link here) to create the best learning experience possible for the students.

Route 2*:

Less Disciplines – Dive Deeper into each subject and build over time

From the provided lesson plans, each Teacher will have the opportunity to create additional lessons individually. Workshops at the beginning of the 12 Week Virtual Impact Program will provide additional tools for each volunteer to create their own lessons, tailored for their individual classroom. We encourage this for the more confident and independent volunteers who have experience teaching, are studying a STEM subject, or are passionate about either aspect.

*Other options can be considered with advanced notice to the Outreach360 team; however, time is a constant restraint. Please notify Outreach360 Staff in advance if you wish to have the Curriculum Development Team assist you with creating new content.

Templates and educational materials will be provided in your orientation process.

Resources for Teachers:

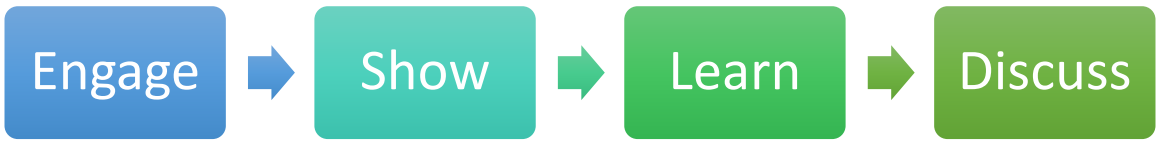
Quizlet, Prezi, GoNoodle, Kahoot!, Khan Academy,

How to access teaching materials in this curriculum:

1. Click on the blue link next to the predesigned lessons in this file → Presentation Found Here
2. Select 'File' and then 'Make a Copy' to save to your Google Drive, or 'Download' to save to your local computer.
3. After the first two steps, tailor your classes by adding or deleting information at will.

Teaching Philosophy

Provide opportunities for individuals with determination to pursue their dreams and goals.



Important Hints for Teaching:

1. Each level of students will be different and be approaching the subject material from various levels of English proficiency. Take time to consider this and pronounce difficult words slowly. Often repeat yourself to ensure student comprehension.
2. Consider the first hint to be the most important, do not rush *anything.*
3. Allow time for discussion and questions. Chances are that other students have the same question but are more hesitant.
4. Use the predesigned lessons to build upon what you know already – add in details that you think would be interesting to talk about or do some research to complement your teaching!

The Three Tier Teaching Method

1. Establish Common Ground
    a. Visit some common pictures, vocabulary that students should be familiar with. Many topics that you will cover with students can and will involve some form of recent event, use this to your advantage.
2. Introduce New Concept(s)
    a. Keep it simple, but the main objective is to add onto previous knowledge – the process we call learning.
3. Tie Everything Together
    a. The best way to learn something is to have a **discussion**. Framing questions about topics to spark conversation can be challenging at first, but with the right technique can be achieved with practice! Keep making open-ended questions to ask students and keep everyone engaged!

Predesigned Lessons:

Lesson #1: Science Introduction (All) **Presentation Found Here**

Opening Activity: Introductions (What is your name? How old are you? What is science?) Have students answer in the chat and then have them read their answers to the class. You should introduce yourself to the class as well if not done first. Typing out their answers as they read can also be effective.

Target Vocabulary: STEM, Scientist, and Microscope

Activity: Types of Science. Create a discussion and divide the class up. Each student should be able to identify a type of science, what is in the object, or identify an aspect of each picture (color, shape, etc). Have each student participate by calling on them and/or asking to provide answers in the chat. You want to increase participation during your first few classes and keep this momentum going.

Discussion: What type of science do you like? You can lead by example or call on individual students for this activity. Note any interests so you can tailor your classes down the road.

Activity: Arranging items in accordance with their size. Add/subtract words and pictures to make this more appropriate to your age group of teaching.

Closing Activity: What tools do scientists use? Using the pictures provided, have the students provide different words, in Spanish or English to describe what a scientist does and how they do it! This activity should end in some sort of excitement for the students. Hopefully they can picture themselves as a scientist in a lab, or in the ocean, or in space!!

Lesson #2: *Marine Biology* (Beginner-Intermediate) **Presentation Found Here**

Opening Activity: Name the smallest and largest animals in the ocean.

Transition: Short YouTube clip with the wide range of animals in the ocean.

Activity: Ask which of the animals from the clip the students knew about already, and which were new to them.

Vocabulary Lesson: Three key words that are related to a STEM topic can be found in a simple google search. For this lesson, the words used are 'marine biology', 'biodiversity', and 'habitat'.

Poll Activity: What percentage of plants live within the ocean rather than on land? (85% of photosynthetic organisms live in the ocean rather than on land!)

Closing Discussion: This can be based around something you know about the ocean or leave this more open to the students. It could be about your favorite sea creature, the predator that eats it, where in the ocean it lives, or anything else! You could also include a famous marine biologist or someone who studies specific habitats (ex: coral reef biologists).

Lesson #3: *Human Biology* (Beginner-Intermediate) **Presentation Found Here**

Opening Activity: Discovering the cell.

Discussion: What types of cells do you have?

Lesson: The role of **cells** related to **tissues** and **organs**. (This can be related to the discussion slide following the lesson. Relate the cells of the body and compare it to the bricks that build a house, a wall can then be compare to a wall of the house, and after multiple walls are built – a house is made!) Students use these visuals to solidify information and using multiple methods (auditory, visual, tactile) will ensure learning is taking place in your virtual classroom.

Lesson: Discussing the roles of the circulatory and immune systems.

Discussion: What are the different ways germs can enter the body?

Discussion: Doctors are scientists, but how do they relate to science? What do they study, what do they work on? Is it important for a doctor to know about the human body? Have the students find a type of doctor as a homework assignment (optional) to talk about during the next class!

Additional information from Khan Academy can help you prepare for your lesson!

Lesson #4: *Geology* (Beginner-Intermediate) **Presentation Found Here**

Opening Activity: How are rocks made?

Activity: With what you answered before, what are different types of rocks? How do you describe the difference? What types of rocks can you name? (English or Spanish)

Lesson: The three types of rocks are; igneous, sedimentary, and metamorphic rock. Each one of these rocks are formed in different manners. **Igneous** rocks are formed from magma, sometimes from volcanic eruptions that allow the molten rock to cool. This can form basalt or granite. **Sedimentary** is formed from pieces of other rock that have settled. This is often considered to be in layers (YouTube Video). **Metamorphic** rock is formed from pressure and heat within the earth. Most of the rock originated from a long time ago when earth was formed. Now it is in a continuous cycle of renewal (image on slide 8).

Interactive Game: This game will introduce the students to the properties of rocks, getting them thinking about observations. Observations are a critical part of thinking like a scientist! The properties explored in this activity are density (compared to water), hardness, fragility, and the quality of being porous.

Students will have the options to answer in the chat, 'raise their hand' virtually, etc. to answer during the four-part activity. The Teacher is then responsible for dragging the image to the appropriate area as well as demonstrating through the online game.

Lesson #5: *Musculoskeletal Anatomy* (Beginner-Intermediate) **Presentation Found Here**

Opening Activity: What parts of your body do you use to move?

Lesson: Bones are the framework for the body. They help you move and protect your organs. Bones are hard on the outside (like you can feel in your body) but soft/spongy on the inside.

Discussion: What happens when you break a bone? Answer: The bone will fix and repair itself. A doctor might put a cast on it to make sure the bone grows straight

Activity: Where is the biggest bone? Answer: in leg (femur). Where is the smallest bone? Answer: in ear (stapes).

Lesson: Muscles help stand, move, sit, or do any sort of motion. There are muscles you can control (like squeezing your bicep in your arm). Other muscles you cannot control.

Discussion: Where are there muscles? Answer: Everywhere! (over 600 muscles underneath the skin)

Activity: flex and extend muscles from video

Lesson: tendons connect muscle and bone

Discussion: What would happen if we did not have bones or muscles? Possible answers listed.

Lesson #5a: Musculoskeletal Anatomy (Intermediate) **Presentation Found Here**

Opening Activity: see beginner

Lesson: Bones are the framework for your body. They help you move and protect organs. Bones are made of spongy (inside) and compact bone tissue (outside) as shown in the picture.

Discussion: Why would you need spongy tissue? Answer: Pores/empty space in the bone allows blood vessels which deliver nutrients to travel through. Bone marrow is also in spongy bones. Some cells begin their life in the bone marrow. Due to the porous nature, spongy bone can also absorb more shock and pressure than compact bone.

Activity: see beginner

Lesson: Muscles help stand, move, sit, or do any sort of motion. You can control voluntary muscles – these are skeletal muscles.

Discuss: What are muscles that cannot be controlled? Answer: cardiac muscles (in the heart create a heartbeat. Smooth muscle is in stomach, blood vessels, bladder, intestines, etc. These help you digest food, urinate, pump blood, etc. Cardiac and smooth muscle are involuntary.

Videos: Flexing/extending. Abduction/Adduction.

Lesson: see beginner

Closing discussion: see beginner

Lesson #6: *Chemistry – Matter and Energy* (Intermediate) **Presentation Found Here**

Opening Activity: What is chemistry? Who can do chemistry? Why is chemistry important?

Emphasize that anyone can do chemistry, it is everywhere, and it's used all the time!

Lesson: **Atoms** – the smallest unit of matter. From the Latin root 'Atomos' meaning indivisible.

Activity: What is the smallest thing you can see? Use pictures on next slide to give ideas, then write answers on the following slide to demonstrate the others answers. (Further instruction in notes panel of slide 5)

Lesson: Alchemists, early chemists from the dark ages had different plans for chemistry. They depended on observations to make hypotheses. These hypotheses are the basis for science and rely on the If ____, then ____ statement. The following activity will explore how to use these statements using an example slide, and two activities using the chat and voice functionalities.

Lesson: Modern chemists were interested in taking hypotheses and showing them to be correct or incorrect. This is one of the foundational aspects of science.

Lesson: The atom is the smallest unit of matter. It is made up of different parts and can be defined by the number of those parts available, this refers to the periodic table of elements. Two videos are included in the slides to emphasize the different parts and then start to relate the atom to a molecule, which is just more atoms put together through bonds. Slide 19 shows how the structure of the atom looks like our solar system, but in fact they are two completely different concepts as shown in the first video.

Lesson: Matter and energy. Matter is a tangible object that you can often touch, like a solid, liquid or gas. Energy is often non-tangible (heat, light, radio waves, Bluetooth). These are two fundamental parts of how the universe works and many branches of science extend on one or both topics. Note the two sides of the slide and use this to compare when you talk.

Activity: Sort the objects according to their properties (The sun is both energy and matter!)

Discussion: Depending on the level of the students, have a short lesson on the correlation between states of matter and temperature. The activity that follows this will require them to write one sentence using the words provided on slide 27.

Activity: Have the students write another sentence about a different state of matter.

Discussion: What makes something a liquid? Have the students think and let this set in for a minute because it will be brought up on the next slide's YouTube video.

Closing Discussion: What is quicksand? Is it a solid or a liquid?

As shown in the final slide, quicksand is a non-Newtonian fluid, acting as a solid and a liquid in different circumstances. It is a truly unique property that can be further investigated through the link: http://www.science-explorers.net/blog/its-a-solid-its-a-liquid-its-a-non-newtonian-fluid

Lesson #7: *Climate Change & Weather* (Intermediate) **Presentation Found Here**

Opening Activity: What is the difference between weather and the climate? Weather is short-term, climate is long-term.

Lesson: **Climate Change** refers to changes in the average conditions in an area. When scientists discuss climate change, we are referring to human-caused climate change based on the greenhouse effect. What are some examples of this? (Melting ice caps, sea level rise, increasing temperature.

Activity: How does a greenhouse work? Have you ever been in a greenhouse? How does it feel in comparison to the outside? Explain how greenhouses trap heat.

Lesson: Gases in the atmosphere trap heat like a greenhouse, which helps the earth retain heat from the sun.

Activity: What is in the atmosphere? What gases are normally there? What percentages?

Lesson: When certain types of gases in the atmosphere increase, this causes additional heat to be trapped, increasing the temperature of the globe. These gases come from various places, including methane from cows, burning fuels for power increase the proportion of heat-trapping gases.

Closing Activity: What kind of things would humans need to change to ensure that we contribute less to climate change?

Lesson #7a: Weather (Beginner) **Presentation Found Here**

Opening Activity: Watch video. Discussion questions on the next slide

Lesson: Weather is what the sky and air are like outside. Talk about the weather in the picture or what the weather is like where students are located. Answers for picture: sunny, warm, hot, etc. 5 main parts of weather to introduce. See if students are familiar with any of the topics and what they know about the following: temperature, wind, humidity, precipitation, & cloudiness

Lesson: **Temperature** – refer to picture to discuss how the thermometer works.

Question: Why does Earth get hot and cold? Answer: the sun! When the sun shines on your area, it gets hot. When the sun doesn't shine (like at night, when there are too many clouds in the sky, or during winter) it get cold.

Lesson: **Wind** - movement of air. Application: windmills that generate electricity. **Humidity** – water vapor in air. Pictures can help here... the desert has little water vapor in air and is dry. The jungle has lots of water vapor and is humid. Humidity makes you feel damp, sticky, and have frizzy hair. **Precipitation** – water that falls to earth (shown in picture). Talk about forms of precipitation. **Cloudiness** – made up of water droplets in sky

Activity: Which clouds are rain clouds, and which would be during sun? Answers on next slide. Rain clouds are dark because water droplets clump together to form water drops. Less light can get through which makes them look dark.

Discuss: Talk about forms of extreme/other types of weather: fog, hail, and tornadoes.

Closing activity: What is your favorite type of weather and why?

Lesson #8: *Intermediate Environmental Science* (Water Cycle) **Presentation Found Here**

Opening Activity: How much of the earth is covered in water?

Lesson: Explain how much of the earth is covered in water. Talk about where all of that water is stored (lakes, rivers, streams, oceans, glaciers, etc.). Get students thinking about how much of the water on earth is drinkable, and then how much of that water is accessible to us. Then, introduce students to the water cycle.

Question: Where does water go after it rains? Or after you swim, how does it dry?

Lesson: Explain the concept of evaporation. Heat from the sun changes water into a gas called water vapor. You could ask for some more examples of evaporation. Then, explain transpiration, how water moves through plants, then evaporates from their leaves. Explain condensation, the process of water changing from a gas to a liquid, from water vapor back to water. This is how clouds form. You can ask for some more examples of this, as well. Explain precipitation, how water falls back to earth from clouds. You can ask for some examples; I only use rain as an example in the slide. Explain groundwater, water stored under the earth in the soil and around loose rock.

Lesson: Demonstrate how all of the concepts you have just taught work together to make the water cycle. Talk about the flow of water and how it is continuous.

Question: Why is the water cycle important? What would happen if there were no water cycle, or if it were disrupted?

Lesson: The water cycle sustains life. Explain this idea and show how the flow of water makes life possible, not just for us, but for all things.

Question: How do humans impact the water cycle?

Lesson: Discuss how human activities can impact the water cycle. You might talk about damming rivers, or using water for farming. You might even touch on climate change.

Closing Question: Why is it important to know about the water cycle?

Lesson #9: *Intermediate Environmental Science* (Food Chains) **Presentation Found Here**

Lesson #9b: *Beginner* (Food Chains) **Presentation Found Here**

Opening Activity: Provide students with several animals from the same ecosystem and ask them to organize these animals into a diagram showing what eats what. If they can do that, then great, they've made a food chain.

Lesson: Explain the idea of a food chain, that it is made up of different levels called trophic levels that depict the flow of energy within an ecosystem.

Activity: Play the video in the slide from The Lion King that talks about food chains. You can ask students about the importance of food chains after this video.

Lesson: Food chains start with a producer that makes food using the sun's energy. Note that this is the first trophic level. Stop and ask students about the importance of the sun on the next slide. Make sure they understand that the sun is what makes life possible. Talk about consumers next, primary consumers, specifically. They eat producers, and they are in the second trophic level. Then talk about secondary consumers which eat primary consumers. They are in the third trophic level.

Activity: Show the next video from The Lion King and mention apex predators. You can ask the students if they can name any other examples of apex predators.

Lesson: Talk about decomposers, which break down organic material. You can ask some questions here about how Mufasa alludes to decomposers in the video, and why they are an important part of the food chain.

Question: Why are trophic levels important?

Lesson: Every animal serves a specific function within an ecosystem. Trophic levels are important because they show the importance of balance. You can ask questions about what would happen if certain animals disappeared from certain food chains.

Lesson: Talk about sustainability, and use the previous discussion to lead you in. Keep the students thinking about how each animal has an important role to play in food chains, and how if we get too involved, we can disrupt the balance within ecosystems.

Question: On the last slide, think about what happens if an apex predator is removed from an environment. Students probably wouldn't have thought of this in the previous examples, since apex predators don't have any natural predators.

Closing Discussion: Ask students about the food chains that they see at work around them. Why are they so important? Even something as simple as birds keeping the insect population from escalating could be used here.

Lesson #10: *The Cell, Microscopes, and DNA (1.5-2 days)* (Advanced) **Presentation Link Here**

Opening Activity: What defines life? There are 7 characteristics that we are looking for but try to get students to respond through the chat and then talk about it. The next slide shows the 7 characteristics and you can have them think of examples for each.

Guided Activity: What is a cell? The smallest part of a living organism is a cell. Often they are regarded as the 'building block of life' and it is the smallest unit of life as well. The Youtube video is a short song that talks about animal and plant cells, the two main types of eukaryotic cells (living things with many cells). The chart on slide 8 shows the comparison of a cell to many other objects, some of which might have been discussed in prior lessons.

Continuing to explore the cell: Mitochondria – the power plant of the cell, controls most of the energy storage and expense. Nucleus – contains the information within the cell, the brain. Vacuole – very important in plant cells, contains water/liquid to control the balance of a cell

Lesson: (Interactive) Microscopes help a scientist see the smaller parts of the world. Different parts of the microscope help to accomplish this goal → click on link on slide 12 to explore more microscopic images such as the nucleus, golgi, or other stains to visualize parts of a cell.

Discussion: What would the letter 'e' look like under a microscope. Have each student draw this in their notebook. Move the box on slide 14 to show the answer. This phenomenon is caused by the reflective mirrors used within a microscope. It isn't essential to know this, but it is a fun activity to do in person.

Lesson: Within the nucleus, there is DNA. The DNA of a cell contains all of the information that it needs to function. The code is written out and explained in the 'Genetics and DNA lesson' for advanced students. Ask the students on slide 16, what is DNA? Why do we have traits like hair color? Continue with the lesson on slide 17 to explain these questions.

Activity: Using the chat feature, have the students type four traits or characteristics about themselves. Try to get them to talk about heritable traits they can get from their parents like hair color, skin, height, body type, palette, eye color, nose shape, hair texture, etc. Continue this activity into a discussion of everyone in the class's characteristics and how this relates to DNA and their parents. Some traits even can be traced back to grandparents!

Lesson: Explain how DNA controls everything on a cellular level and can lead into changes at the level of organs and people. https://kidshealth.org/en/kids/what-is-gene.html a good resource to help you form a background on this topic from your last biology class.

Discussion: How can a cell work to help you? Example provided is the muscle cell for organs to move around and work for the body.

Lesson # 11a: *Microbiology* (Advanced) **Presentation Found Here**

Opening Activity: What's the smallest thing that you can see with your eyes?

Lesson: Microorganisms are the smallest organisms on the planet. Define what things fit into the category (bacteria, viruses, fungi, etc).

Discussion: Do you know of any other names for microorganisms? Hint: they make you sick

Discussion: What are some sicknesses that bacteria or viruses cause? (cold, flu, sore throat, etc).

Lesson: Some example microbes and their structure and size relative to other things.

Debate/Discussion: Are microbes good or bad? How would you categorize them?

Lesson: Microbes do important things in the world! Talk about some of the roles microbes play (decomposition, oxygen production, etc).

Lesson: Microbes can live in extreme environments! Deep sea thermal vents, arctic, etc

Question: When you are healthy, do you have any bacteria on you? (See what they think about this, can do a zoom poll of yes or no)

Lesson: The answer is YES! There are many, many microbes that live in you and on you. They do a lot of things to keep you healthy.

Lesson: Describe how many microbes live on you. (Use some sort of comparison that they would be able to understand to contextualize the number

Lesson: What do microbes do in your body? Explain: metabolism, immune system priming, etc.

Discussion: Re-visit the "are microbes good or bad" question to see how they feel now. The feelings should have shifted.

Lesson # 11b: *Microbiology* (Intermediate) **Presentation Found Here**

Lesson #12: Physics (Intermediate) **Presentation Found Here**

Opening Activity: Have the students discuss how the pictures relate to physics. What could they represent? The next slide contains a list of possible answers that relate to the pictures.

Lesson: Definition of physics & physicist. Ask the students if they have heard of a few famous physicists and what about them.

Discuss: Discuss what the students know about laws. Scientific laws are different from legal laws; they describe how the world works. Laws are always true and there's been many experiments done to prove them.

Video: Newton's Law of Gravity (only about the first 1:52 are relevant). Discuss what they learned in the video and why gravity is a law.

Lesson: Newton's Laws of Motion. Only laws 1 & 3 are being discussed today.

Interactive simulation: Law 1: Objects in motion stay in motion unless acted upon by an outside force. Objects at rest will stay at rest unless acted upon by an outside force. Once you click the link, another page will open. From there, click the play button. For this lesson, the 'motion' simulation was the best. To begin, students can choose what object (from the bottom) to be on top of the skateboard. Note: before any motion occurs, this is an example of "objects at rest stay at rest." To move the skateboard, apply force. Note: once motion is occurring, this is an example of" objects in motion stay in motion." You can turn on the speed from the box in the upper right to prove that the object is not slowing down.

Lesson: Law #3. Use the pictures to describe the law. Ex. Rocket moves up as flames shoot down, a person pushes into the other and the other pushes back, the air is let out so the balloon travels upwards.

Conclusion: Real life application: what are some ways physics impacts your life? Ex. While driving in a car, while kicking a ball, keeping you on the ground, etc.

Lesson #13: *Human Anatomy - Cells, Tissues, and Organ Systems* (Advanced) **Presentation Found Here**

Opening: Introduction to the different types of cells. Stem cells are the beginning of all cells and are made in bone marrow (inside bones). We get red and white blood cells from this area and it is one of the most important processes that we have within our body to continue to grow!

Discussion: What types of cells do you have in your body? Answers: skin, muscle, brain, liver, kidney, lung, heart/cardiac, bone, and pancreas.

Lesson: Have the students guess in the chat what slide 5 is. This is an image of red blood cells traveling through the blood stream. The circulatory system is responsible for transporting oxygen from the lungs to the rest of the body. Oxygen is used to convert glucose (food) into energy. Veins and arteries are the main transporters of blood to and from the lungs.

Lesson: Have the students guess what slide 7 is. These are immune cells. The immune system is responsible for protecting the body against viruses and bacteria. The lymph nodes produce immune cells to transport through the body in lymph.

Discussion: What are the different ways germs can get inside your body? Answers are seen in the pictures on slide 9 (mouth, nose, eyes, cuts on hand or body, etc.). Continue discussion and try to come up with ways to protect yourself from germs. Answers – gloves, mask, glasses, washing hands, staying physically distant from those who are sick etc.). The immune system is like a detective who is searching for germs to get rid of! Fun fact: a sneeze can travel over 2 meters. Video lesson on how a vaccine works from the CDC.

Lesson: Have the students guess what slide 13 contains. These are skeletal/bone cells that form the skeletal system. The main role of the skeletal system is to provide support and protection for the body and its organs. Discuss what would happen without this support.

Lesson: Have the students say where they think the cells on slide 17 belong. They are nervous system cells that can be found in the brain and other parts of the nervous system. An image of the brain shows how scientists organize the different functions of the brain. The two discussion questions will help the students decide what some foundational functions we use the brain for, but also ranking the most important functions of the brain. It will be difficult to choose but having them pick just one will help them realize how much the brain actually does (thinking, breathing, talking, moving, walking, chewing, seeing, hearing, smelling, etc.). The following activity should be prepared by the teacher ahead of time so that they understand all the different functions of the brain. Having the answers written down, the teacher will be able to quiz and walk through where these functions are divided in the brain. The different areas have some difficult names to pronounce, so speak slowly. These different parts are still components of the nervous system.

Closing Discussion: In the chat or using microphones, have the students talk about what type of doctor they would like to be. Who they would want to help or what disease they would like to get rid of? Help the students see the potential they could have as a medical doctor!

Lesson #14: *Nuclear Energy* (Advanced)* **Presentation Found Here**

*Watch videos and do your homework before this lesson – it is quite advanced in theory!

Opening Activity: What are the pictures shown on slide 3? These are pictures of Godzilla. A popular movie throughout the late 20th century. It is depicted as mass chaos and destruction, as nuclear energy is also depicted out to be in movies and in media.

Lesson: What is nuclear energy and why do we use it? Using uranium, we can produce energy from the atoms either through fission or fusion, the splitting or putting together of these tiny building blocks of matter. Seven nuclear reactors are present in Latin America out of 450 in the entire world. The video found on slide 6 shows a brief introduction to how nuclear energy works, you can provide commentary over the background music.

Discussion: What are ways that you know how to get energy? Examples might include, trees/wood, solar energy, hydroelectric water stations, wind turbines, geothermal, coal, gas, fossil fuels, etc.

Lesson Cont'd: Continue to explore the ways energy is harnessed from uranium.

Poll: What country do you think has the most nuclear power? Answer: United States

Lesson: Nuclear accidents like Chernobyl and Fukushima have shown the dangers behind using this type of energy, but there are also a great number of benefits. It is one of the densest types of energy known to man, is a lot cleaner than other types of fossil fuels and gas used for cars and heat, and it is relatively safe outside these two accidents. It is the lowest ranked danger out of energy production. Fun fact: uranium is 4 million times denser with energy per kg than coal.

Lesson Cont'd: Retiring nuclear power plants have been considered and already done in the past for many reactors in the United States. In three videos, explore nuclear energy's pros and cons.

Closing Discussion: Ask the students to respond to the videos and answer their feelings towards uranium, nuclear energy, and its use around the world. Climate change and waste are two big factors to consider for nuclear energy as well.

Lesson #15: *Genetics and Traits* (Advanced) **Presentation Found Here**

Opening activity: Video that introduces students to traits and characteristics.

Discussion: Have students list three traits about themselves and then have them list a trait about a family member in the chat. The next part of the discussion will try and relate these topics to DNA, a way that traits can be handed down from a parent to a child. Familiarize yourself with this topic well enough to be able to field their questions and sort them into a chart.

Lesson: Gregor Mendel was the leading example of **geneticists**, a scientist who studies genes, the biological basis of *inheritance*. He examined the cross-pollination or breeding of the garden pea to yield a varying number of traits. By breeding them and then self-pollinated the second generation to create a model pattern for inheritance that would form the basis of modern genetics. He established **alleles,** which are the linkages of DNA to traits. To understand these linkages, it is best to understand the central dogma of biology.

Lesson Cont'd: DNA is what exists in your cells, it is passed down from your parents and you are born with it. RNA is what a cell is told to make, so it begins to make it. Protein is the end product, it is usually functionable and used somewhere in the body. The example provided in the slides shows the process of making a car and how it compares to the central dogma, try to understand it through these means rather than the definitions. DNA is like the blueprint or instructions on how to build. RNA is the part where stuff is getting built, many parts of the cell are required to help in this process to make the final product. Protein is the fully functioning car that has everything with it. These proteins end up making many of the processes within the body happen.

Discussion: To check for understanding, have the students write in the chat about how a protein eventually ends up as a trait in the body. Good examples are hair color, skin, height, fingernails growing etc.

Lesson: The slides following include some different ways that proteins eventually end up as genes within different organisms. Eyes are a very good example of this. Students with glasses can be called on to see if their parents have glasses/eyesight troubles too! The diagram displays the differences in eye structure due to a mutation in the DNA. In flies the eye is even absent! Another example of genes affecting appearance is the Cocalico cat and regular cats.

Discussion: Fur is also different with different types of bears. Have the students participate in a discussion through the chat or by talking out loud about how bears in different regions have different fur – linking this to both their surroundings (adaptions) as well as DNA.

Closing Discussion: Have the students revisit the topic of traits passed down from parents.

Optional Homework: After talking about phenotypes and genotypes, the students are tasked with seeking out a unique phenotype produced by genes/DNA. Talk about the results of their search in the next class you have with them. Be sure to bring some interesting ones of your own!

Lesson #16: *Mammalian Biology* (Intermediate) **Presentation Found Here**

Opening Activity: Talk about what the animals have in common. What makes animals alike or different? The animals are all mammals! Mammals have many traits that are similar, but today we will talk about 4 main ones.

Lesson: #1. A mammal has a vertebrate. Discuss if humans have vertebrate. Try to think of animals that do not have vertebrate. Answers: Yes, humans have vertebrate (students can feel their own spine) and some animals without backbones are listed. Note: a snake might be a common answer, but snakes DO have backbones.

Lesson: #2. Warm-blooded animals can control their body temperature. Humans are an example of a warm-blooded animals. Discuss how humans control their temperature in the cold and in the warm. Answers: by sweating or shivering

Lesson: #3 Mammals have hair. With many animals, this is obvious. Other animals might have different functions for hair or might only have hair at a young age. For example, whales have little hairs where whiskers would be. #4 Mammals produce milk – refer to pictures.

Poll: What is the biggest mammal? Answer: B. Whale. The picture shows a comparison between the size of a whale and of a person.

Online Activity: Mammals of the World link. The point of this activity is that mammals live all over the world and in many different environments. If students are interested in a mammal, you can click to learn more.

Activity: Group the animals by mammal or not. Mammals: koala, lion, squirrel. Not mammals: birds, turtle, fish. You can talk about why 'not mammals' aren't mammals – ex. Birds have feathers, not hair, turtles and fish don't have hair, fish and turtles are cold-blooded, etc.

Conclusion: Talk about the animals/human pictured and why they fit the 4 characteristics mentioned today. (vertebrate, warm-blooded, hair, produce milk)

Lesson #17: *Engineering* (Intermediate/Advanced) **Presentation Found Here**

Opening Activity: Discussion about engineers, civil engineers mostly study for building bridges and buildings. Mechanical engineers study metals and electronics. Chemical engineers study chemical compounds to use as materials for anything. Biomedical engineers focus on improving materials for the health care field. You can read about more types of engineers here; most have a college degree.

Discussion: Use the first slide on the materials discussion to write student answers. This will bridge into the next part where the lesson will explore different alloys and metals.

Lesson: Alloys represent some of the best building materials in the world. By rising the temperature to a liquid state for two metals and mixing them, you can create an alloy. The different types are outlined and shown in this video. The statement of 2+2=5 is a common way to think about how the addition of two metals can create an even stronger material than imagined. Using the concept of adding two things together to create something new is an invention.

Lesson Continued: Adding together a shopping cart and a briefcase, the idea for a suitcase with wheels became more practical. Adding a bell to a clock made an alarm clock to wake up in the morning. These are great examples of useful inventions.

Activity: Guess the invention after seeing two objects. Have the students guess before revealing.

Closing Discussion: Using the three random objects, have the students come up with examples that they could invent or create something! Try making additional activities like this on your own.

Lesson #18a: *Computer Science #1* (Hardware) (Intermediate) **Presentation Found Here**

Opening Activity: What is a computer made of? What parts define it? A computer is an electronic device that is capable of storing and processing data according to instructions called parameters. People use computers to type documents, send emails, browse the web, and much more.

Lesson: Two main features of a computer involve input and output. Inputs include devices like a mouse, keyboard, webcam, or drawing tablet. Outputs include devices like a monitor, printer, or speaker. Inputs and outputs are the same as an equation where you add two numbers together to provide an answer, sometimes they are a bit more intricate.

Discussion: Examples of inputs and outputs in life; including school, food, and science examples.

Lesson: The physical components of the computer. Watch the videos within the slides to know how to identify each part of a computer. Knowing the components that make up a computer make it less of a mystery and more of a reality to each of the students. Even though there are many additional parts within the computer, this will provide the glimpse into how it functions.

Closing discussion: The map of computer science shows all the different applications of computer science. Look into what a computer scientist does here and use this as a talking point.

Lesson #18b: *Computer Science #2* (Software)* (Advanced) **Presentation Found Here**

Opening Activity: Video and introduction to computer programs.

Discussion: What programs do you use? E.g. facebook, twitter, zoom, messages, camera, etc.

Lesson: Computer programming is an intensive way to learn how computer works. All software is made of code by a computer scientist, and is responsible for how our phones and all technology works. A function is an instruction for a computer to use to create something new. Investigate the “hello world” function with the class and all the different things that can go wrong. If you need additional understanding, use this video. You can input this video into your lesson if you want.

Lesson: Have the students respond in the chat to type the following: >>>print(“hello world”).

As the students will soon notice, nothing happened. This is because they are not using a programming environment like in slide 5. Typing into a different program like Zoom will not generate the same results. Explain the difference between input and output. Highlight the importance of using a function and ‘syntax’. Syntax is the grammar of programming and is the way everything is organized. Using periods and commas but in a whole different way. Quotation marks, parentheses, and colons are all important parts of this. Other symbols can be incorporated when needed for the computer to understand.

*A bit of additional prep may be needed for the teacher. Many intro videos can be found on YouTube if you are still confused about this information provided.

Lesson #19a*: Astronomy (*Beginner*)* **Presentation found here**

Opening Activity: What do you see when you look up to the sky at night/in the morning? Name one thing that you know that exists in space. E.g. Sun, moon, stars, planets...

Activity: What is the shape of Earth and why do you think so? (provide pictures)

Lesson: Gravity is what keeps us on the ground and what makes an apple fall from a tree! Gravity is a force by which planets like Earth draw objects to their center. That's you can stand and land on ground when you jump! The force of gravity is why Earth has a spherical shape. Objects with more mass have more gravity. Earth's gravity comes from its mass.

Activity: What can you tell about/do you know of "planets"? Can you name any one of them?

Lesson: Key words: celestial, orbit, planet (To the question "what is a planet?") This sounds like a simple question yet it doesn't have a very simple answer! According to scientists, a planet is a celestial (positioned in sky, outer space) body that has the following three features: (1) It must orbit a star (ex: Earth orbits the Sun.) (2) It must be massive enough to have a big gravity so it can gain a spherical shape and (3) It must be big enough so that its gravity can clear objects with similar size near its orbit around size.

Activity: Have you ever heard of mnemonic devices? Give an example and introduce the mnemonic for planets of our solar system.

Optional Homework: Draw your favorite planet tonight! Use a lot of colors!

Lesson #19b*: Astronomy 2 (Intermediate)* **Presentation found here**

Opening Activity: Let's review the mnemonic device from our last class! Ask students to see if anyone can remember the mnemonic along with the names of the planets. (Allow to use notes)

Lesson: Let's study 4 planets closest to the Sun. Mercury is the closest planet to the Sun and the smallest planet in the solar system. Venus is the hottest planet of our solar system due to greenhouse gases and it is as big as Earth.

Activity: Let's watch a video about how greenhouse gases work.

Lesson (cont'd): Let's study 4 planets closest to the Sun. Earth is the only planet of our solar system with liquid water on its surface, perfect place for life!

Discussion question: What percentage of Earth is covered by water? Mars has seasons, volcanoes, polar ice caps. Scientists are working on determining the past and future potential of life.

Cool Down Activity: (Exploring planets) Allow for students to pick which planet they want to have a closer look at. https://spaceplace.nasa.gov/solar-system-explorer/en/#/review/solar-system-explorer/game.swf

Lesson #20: *Environmental Science* (Air Currents) (Intermediate) **Presentation Found Here**

Opening Activity: What is the weather like where you live? Is it windy a lot? Is it windy now?

Lesson: First, explain how air moves. Hot air rises, cool air sinks. Hot air is less dense, and cool air is denser, and the air that is denser sinks.

Question: Why is some air hot and some cold?

Lesson: Uneven heating of the earth's surface leads to uneven heating of the air. Different environments absorb sunlight differently. This is most clearly demonstrated at the beach. During the day, the sand is hot in the sun, but the ocean is cool. The air over the sand rises because it is hot, and the cool air over the water rushes in to take its place. The flow of air is cyclical in this model, and this type of current is called a convection current. You can use the diagram on the slide as a visual representation.

Question: How will this air current change at night?

Lesson: The air current will reverse at night. The sand will lose its heat after the sun goes down, and will be cool very quickly. But the water will retain more of the warmth. The air rises over the water because it is warmer and the cool air from over the beach rushes in to takes its place. This is the same example, only in reverse. There is a diagram in the slides to use as a visual aid.

Question: Why are air currents important?

Lesson: Air currents help predict the weather, they influence the ocean's currents, and they can help produce energy. This part of the presentation focuses on how students can apply their knowledge of wind energy to the real world. Discuss turbines, how we use them to harness the wind's energy, power generators and create electricity. Explain that turbines use renewable sources of energy, that can be replenished and that we will never run out of.

Closing Discussion: What is so great about renewable energy? Why is it important to know about air currents?

Lesson #21: *Plants, General* (Advanced) **Presentation Found Here**

Lesson: A brief overview of plants and their evolutionary age.

Activity: A discussion on the basic plant anatomy.

Lesson: An explanation on the functions of plant organs, followed by definitions of meristems and their functions. This is followed by the description of the four largest groups of plants, moss, ferns, conifers, and flowering plants. There are examples of each with detail on the evolutionary age and the plant anatomy features discussed in the previous slides.

Activity: The ferns and conifer slides have questions for the students, the answers can be found in the speaker notes. After the slide on flowering plants, there are 6 slides asking the student what type of plant is pictured. The students should be able to recall the four types of plants from the previous slides.

Lesson #22: Extremophiles (Advanced) **Presentation Found Here**

Opening activity: A discussion on the habitats of living organisms

Lesson: The definition of an extremophile, and the type of environment they live in, as well as the definition of micro-organisms.

Activity: Identify and discuss some dangerous conditions for most organisms on Earth?

Lesson: The definitions of thermophiles, followed by information on the environment. Then, the definition of halophilic, followed by an explanation of the environment. Psychrophiles is defined next, as well as the types of microorganisms that live in that environment. Next, endoliths are described, followed by an organism called Dunaliella, an algae discovered in the driest place on Earth. Last, the water bears also known as Tardigrades are discussed, and their extreme tolerance to heat and cold.

Activity: A discussion question on why organisms would want to colonize such extreme environments.