Science Standards and Curriculum for the Gifted and Talented

Grade 7

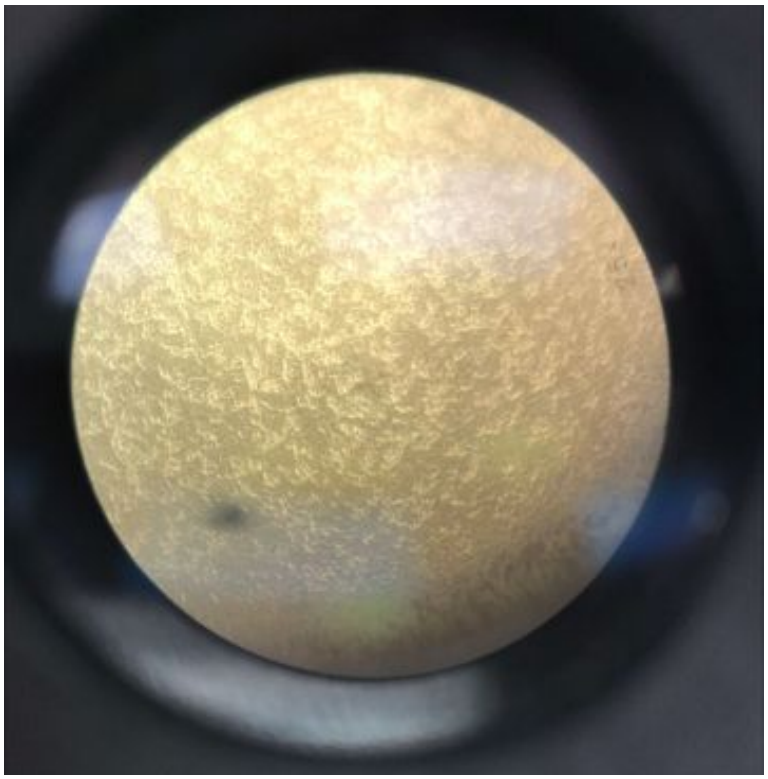
Introduction

While a Common Core Standards and Curriculum exists for all students in the Seventh Grade, no similar standard exists to aid students whose understanding of science - in this case, biology - is deeper and better developed than their peers. For these "talented and gifted" students, an advanced standard is necessary in order to enrich their learning experience and to provide a challenge. Thus, the objective of *Science Standards and Curriculum for the Gifted and Talented* is to provide seventh grade teachers with a comprehensive and encompassing curriculum on biology that can be applied to "talented and gifted" students.

The content of the following will explore concepts also mentioned in the Common Core Standards and Curriculum in much more depth and will also provide "talented and gifted" students with hands-on experiments and opportunities to explore these advanced concepts. Through this curriculum, students will be able to build upon their existing knowledge on biology and build a strong foundation that will aid them in biology courses on the high school level.

This curriculum has been divided into several sections: cell biology, genetics, evolution, earth sciences, structure and function in living systems, and physical sciences. Each section will entail a set of standards that students are expected to understand by the end of the lessons. Each section also includes at least two lesson plans that will help teachers plan their lesson and expand on concepts more thoroughly. Each lesson plan will also include an Experiment/Investigation section that will provide students with a hands on learning experience, which will help them better understand the biological topics. Although these sections parallel those found in the Common Core Standards and Curriculum, the sub-sections found underneath will explore these general sections in more detail. Lesson plans will also include suggested homework and assessment standards that teachers can follow.

Table of Contents



Cells through a microscope.

CELL BIOLOGY

Cells are microscopic units that make up all living organisms; living organisms may be composed of just one or trillions of cells.

a. Students understand how cells function in various living organisms and their structure (organelles, nucleus, shape, etc). They also understand that cells can communicate with each other.
b. Students can differentiate plant cells and animal cells; they can identify characteristics that are unique to plant cells
c. Students understand the difference between eukaryotes and prokaryotes and their cells.
d. Students understand the function of the nucleus in forming our genetic makeup. They also understand the function of DNA and its structure.
e. Students understand the role of ribosomes in DNA translation.
f. Students understand the role of the mitochondria in providing energy for the cell
g. Students understand the basics of how photosynthesis is carried out in the cell, focusing on the role of chloroplasts
h. Students know the main difference between meiosis and mitosis. Mitosis results in two identical daughter cells, whereas meiosis results in two non-identical daughter cells. Furthermore, meiosis separates two homologous chromosomes, which leads to two rounds of genetic separation and cell division.
i. Students know the steps of mitosis and the reason for this process (cells divide through this process to reproduce)
j. Students understand the process of cell differentiation and can pinpoint an example of this in animals. Furthermore, they can link this process to gene expression.

Objective	Teach students that there are different types of cells, dividing them into two categories: plant cells, animal cells. Teach students the difference between prokaryotes and eukaryotes and how their cells differ.
Science Standard	Although cells make up all living organisms, there are different types of cells. Plant cells and animal cells are inherently distinct. a. While animal cells have organelles known as mitochondria, plant cells have organelles known as

	chloroplasts. Chloroplasts play a role in photosynthesis, whereas mitochondria provides energy for the cell. b. Plant cells have cell walls, which is a feature missing in animal cells. Plant cells also have vacuoles, which are missing in animal cells. c. The difference in structures also affects their methods of communication. While animal cells have gap junctions and can communicate through these junctions through cell-cell recognition, plant cells are connected by and communicate through plasmodesmata. Another difference between cells can be found between eukaryotic and prokaryotic organisms. a. Eukaryotic cells contain membrane-bound organelles, whereas prokaryotic cells do not. Eukaryotic cells contain a true nucleus and mitochondria, whereas prokaryotic cells are lacking these. b. Genetic material (DNA or RNA) in prokaryotes are not bound. c. Animals and plants fall under eukaryotic cells, and bacteria fall under prokaryotic cells.
Experiment/Investigation	PROJECT + IN CLASS DISCUSSION - Assign students into different groups - Have half of the groups make a model of a plant cell and the other half make a model of an animal cell. Models should be 3D and can utilize any material the students may choose. Suggested materials include styrofoam balls, clay, construction paper, and pipe cleaners/wires. (The models can be assigned as an at-home project). - Pair each animal cell group with a plant cell group - Have the pairs of groups make a list of differences and similarities between their models - Discuss how these differences allow each group of organisms - plants and animals - survive and adapt to their environment. Include discussion on the role of the different organelles found in animal and plant cells.
Procedures (warmup, guided instruction, “lesson”)	Diagrams are encouraged. a. Start by discussing the concept of different types of cells, depending on the structure of the cell. b. Using diagrams, explain the differences between animal

	and plant cells. c. Point out similarities between animal and plant cells, including the presence of membrane-bound organelles. d. Using point c as a transition, introduce the topic of eukaryotic and prokaryotic cells. e. Explain the differences between eukaryotic and prokaryotic cells, emphasizing the biggest difference: the lack of membrane-bound organelles in prokaryotic cells. Include examples of prokaryotic and eukaryotic cells.
Assessment	Have students complete a venn diagram or chart, listing features of plant cells, features of animal cells, and features found in both. Do another venn diagram for eukaryotic cells and prokaryotic cells. The venn diagrams should be done without the use of textbooks or notes.
Homework	Assign reading of the corresponding chapter in the science textbook the night before the lesson. On the night of the lesson, assign any questions from the chapter in the textbook. If questions don't exist in the textbook, the following may suffice: 1. Explain why plant cells and animal cells have different methods of communication. 2. Explain the biggest difference between prokaryotic and eukaryotic cells. 3. How do the differences between plant and animal cells relate to their different functions? Points to consider and include are photosynthesis (chloroplasts) and the release of energy (mitochondria).

Objective	Teach students the structure and role of DNA and its replication.
Science Standard	Deoxyribonucleic acid, DNA, is a molecule commonly found in cells that contains genetic information that dictates the development and reproduction of living organisms.

	a. DNA is made up of a sugar and phosphate backbone and four types of nitrogen bases - adenine, guanine, cytosine, and thymine. These nitrogen bases pair with each other in a specific way: adenine with thymine and guanine with cytosine. Each base is attached to a sugar molecule and phosphate molecule. b. A base, sugar, and phosphate are called nucleotides. Nucleotides are arranged into two long strands, which twist around each other, giving DNA a double helix shape. c. DNA can replicate itself through a process known as DNA replication. Key concepts to know are: Okazaki fragments, 5' to 3', DNA polymerase, and replication bubble. d. DNA is turned into RNA through a process called transcription. e. RNA is then translated by ribosomes to form polypeptides, or amino acid chains.

Experiment/Investigation	DNA MODEL MADE OF BEADS AND WIRE
	- Materials needed:
	  - Beads in six different colors
	  - Two strands of wire - one thick wire, one thin wire
	  - Key rings
	- Process:
	  - Gather 26 beads of 2 different colors (52 beads in total) and designate one color to be "sugar" and the other to be "phosphate"
	  - Gather 6 beads of 4 different colors (24 in total) and designate each color to a nitrogen base
	  - Obtain 20 inches of thick wire and 20 inches of thin wire and bend both strands in half
	  - Add two sugar beads (one on each side) to the thick wire
	  - Add two phosphate beads to the thick wire (one on each side)
	  - Add an adenine bead and a thymine bead to the middle of the thin wire, where the bend is. Line up the two wires by placing the adenine and

	thymine beads above the sugar and phosphate beads (you can also use cytosine and guanine instead of adenine and thymine) - Slide a sugar bead through the thick AND thin wire on each side. Do the same with two phosphate beads. - Add a cytosine and guanine OR an adenine and thymine bead on each side of the THIN wire. - Slide a sugar bead through the thick AND thin wire on each side. Do the same with two phosphate beads. - Continue repeating the process until all beads have been used - Twist the ends of the thin wire and add a keyring to the other end of the wire - Twist the thin and thick wires together (you may need pliers) - Use wire cutters to cut off the twisted end, leaving an inch and a half of wire. Use pliers to tuck the ends into the bead so that they don't poke you
Procedures (warmup, guided instruction, "lesson")	The use of 3D models or picture diagrams is highly encouraged, if not necessary. a. Start off by reviewing simple information about cells in living organisms and review the nucleus. b. Explain the concept of DNA, including its structure and role in living organisms. Use 3D models or diagrams if possible. c. Utilize drawings to explain DNA replication and the importance of the 5' to 3' direction. d. Explain RNA and how DNA is turned into RNA through transcription. e. Finally, go through the role of the ribosome in turning genetic information, RNA, into polypeptides through translation. f. Review the entire process of replication, transcription, and translation. You may want to divide up these topics into two or three days to ensure that students are fully understanding the DIFFERENCES between the processes.
Assessment	Using a diagram of a DNA strand, have students fill in the

	proper labels of nitrogen base, nucleotide, phosphate molecule, and sugar molecule.
Homework	Assign reading of the corresponding chapter in the science textbook the night BEFORE the lesson. Assign any questions from the chapter in the textbook the night of the lesson. If no questions exist, here are some questions that may suffice: 1. Why are Okazaki fragments necessary in DNA replication? 2. What is the role of a ribosome in a cell? How does it work with DNA? 3. Explain the structure of a DNA molecule. Identify key concepts, such as nitrogen bases and nucleotides. 4. Explain the difference between DNA replication, transcription, and translation.

GENETICS

A cell contains DNA, which provides genetic instructions that specify a living organism's traits. These traits are impacted by environmental influences.

a. Students understand that DNA is the genetic material that can be found in chromosomes in cells.
b. Students understand the different methods of reproduction, both sexual and asexual.
c. Students understand that through sexual reproduction, the offspring inherits half their genes from each parent and can link this to meiosis.
d. Students understand that genes are expressed by DNA and is coded for by a distinct sequence of nucleotides.
e. Students understand the concept of alleles; genes have alternative forms, and the expression of an allele determines the organism's phenotype, or physical characteristics. Students also understand the differences between a dominant and recessive allele (which one is expressed).
f. Students can set up and solve a Punnett square.

Objective	Teach students about different methods of reproduction (both asexual and sexual).
Science Standard	Living organisms reproduce in different ways. Two different classifications of types of reproduction are sexual and asexual. a. Asexual reproduction is when an offspring develops from one parent (one organism) and inherits the genes of that parent only. No fusion of two cells occurs, and the number of chromosomes usually does not change. b. Types of asexual reproduction includes budding, binary fission, fragmentation, and vegetative fragmentation. c. Bacteria, hydras, sponges, and some plants reproduce asexually. d. Sexual reproduction is when an offspring develops from two parents (two organisms) and inherits genes from both parents. Two gametes, reproductive cells, fuse together. The number of chromosomes in one gamete is half of the number of chromosomes in the offspring cell that results from the fusion of two gametes. Meiosis is involved in sexual reproduction. e. Organisms would prefer asexual reproduction because of its efficiency.

Experiment/Investigation	OBSERVING VEGETATIVE PROPAGATION
	- Materials:
	  - One bulb of onion per group
	  - One rhizome of ginger per group
	  - Two pots of soil
	- Procedure:
	  - Have students observe the bulb of onion and rhizome of ginger. Then, have the students draw and label the bulb and rhizome.
	  - Then, have students break off pieces of the rhizome so that each piece has a number of bulbs on it.
	  - Bury each piece of rhizome in one pot. The pieces should be 3-4 centimeters deep in the soil.
	  - Bury the bulb of onion about 3-4 centimeters deep in the other pot of soil.
	  - After 10-15 days, have students dig out the onion and pieces of rhizome.
	  - Have the students observe and draw and label what they see.
	- Discussion:
	  - Discuss the practicalities of using vegetative propagation to reproduce: what are the positives? What are the negatives? Why would a plant prefer asexual reproduction?

Procedures (warmup, guided instruction, "lesson")	a. Because asexual and sexual reproduction is a dense concept, a review of meiosis and mitosis may be necessary. b. Explain what asexual reproduction is and the different types of it that can be observed. c. Explain what sexual reproduction is, incorporating discussion of meiosis. d. Compare and contrast asexual reproduction and sexual reproduction on the microscopic or cellular level. Again, discussion of meiosis should be incorporated. e. Discuss how the two different types of reproduction affect the offspring in terms of number of chromosome and expression of genes. f. Discuss why some organisms may prefer asexual reproduction (discussion of the benefits of sexual reproduction will come in the next lesson plan).
Assessment	Have students pick a type of asexual reproduction to write about. They may also draw a diagram to aid their writing. Then,

	have students explain the difference between asexual reproduction and sexual reproduction either through a venn diagram, a chart, or a short paragraph.
Homework	Assign reading of the corresponding chapter the night before the lesson. On the night of the lesson, have students complete questions from the chapter in the textbook. If no problems are provided by the textbook, the following may suffice: 1. Explain through words or pictures meiosis. 2. Explain, on a cellular level, the difference between asexual and sexual reproduction.

Objective	Teach students how to complete a Punnett square and its applications
Science Standard	A Punnett square, also referred to as Mendelian inheritance, is a tool that can be used to predict the appearance of a certain trait in an offspring. a. One gene can have two or more variations, which are termed as alleles. An allele can be either recessive or dominant, in which a dominant allele is expressed as the trait. b. Dominant alleles are usually denoted by a capital letter, and recessive alleles are denoted by the corresponding lowercase letter. c. Monohybrid cross involves one type of gene and physical characteristic (phenotype). d. Dihybrid cross involves two types of genes and physical characteristics (phenotypes). A dihybrid cross is needed when two alleles for different characteristics are on the same chromosome. e. Link the concept of alleles and gene expression back to sexual reproduction: living organisms may prefer sexual reproduction because of the greater genetic diversity it results in.
Experiment/Inve	FAMILY TIES (PUNNETT SQUARE PROBLEM)

stigation	a) Suppose there is a gene for long arms (L) and short arms (l). The father of the family is homozygous dominant, whereas the mother is heterozygous for this gene. Draw a punnett square and summarize the data found. What is the possibility that the offspring will have long arms? What is the possibility that the offspring will have short arms? b) Now suppose that the father is homozygous recessive and the mother is heterozygous. Do a punnett square. Compare the results to those found in part a.
Procedures (warmup, guided instruction, "lesson")	a. Start by explaining the concept of alleles, making sure that students understand the difference between an allele and a gene. Also explain, in depth, the difference between a dominant and a recessive allele. b. Explain the idea of a Punnett square and what it is used for. c. Explain what a monohybrid cross is. Expand upon your explanation by solving a problem with a monohybrid cross for the students. Do several monohybrid cross problems together with the class. d. Explain what a dihybrid cross is. Expand upon your explanation by doing several dihybrid crosses with the class. e. Identify and explain the ratios (3:1 for a monohybrid cross and 9:3:3:1 for a dihybrid cross). f. Go back to the sexual and asexual reproduction concept. Link the idea of genetic diversity to this section, explaining why organisms may prefer sexual reproduction.
Assessment	Have students come up with a Punnett square problem of their own and solve it, explaining the outcome and identifying all recessive and dominant alleles.
Homework	Assign reading of the chapter the night before the lesson. Assign a worksheet on monohybrid and dihybrid crosses. Instead of just writing down a number answer, have students EXPLAIN, in writing, what their results mean. Questions to assign (or use questions from their textbook): 1. What is the difference between a gene and allele? 2. Why would some organisms prefer sexual reproduction? Be sure to mention alleles and gene expression in your answer.

EVOLUTION

The various and diverse species inhabiting Earth today have gradually developed and come into existence through a process known as biological evolution.

a. Students understand that genetic variation (from the lesson on genes) and environmental factors influence evolution.
b. Students can identify and explain at least three causes of evolution of a population, including but not limited to natural selection, gene flow, genetic drift, mutations, and nonrandom mating.
    i. Students understand Charles Darwin's concept of natural selection; they understand that variation already exists in a population, and species evolve when one of these variations is prefered over others due to environmental factors or other influences.
c. Students can pinpoint at least five evidence for evolution, including but not limited to fossils, comparative anatomy, geology, comparative embryology, and molecular biology.
d. Students understand taxonomy and how to read phylogenetic trees. Students can also construct a simple diagram, paralleling the structure of a phylogenetic tree, separating living organisms into groups based on shared characteristics.
e. Students understand that the extinction of a species occurs when the species' characteristics are not suited for and do not adapt to suit the changes in the environment.

Objective	Teach students different phenomena that occur to cause evolution of a population.
Science Standard	Causes of evolution include natural selection, nonrandom mating, genetic drift, mutations, and gene flow. a. Natural selection occurs when variations already existing in a population get filtered out because one variation is superior over the others. Individuals who are already better adapted to the environment are able to survive and reproduce (have offspring) more successfully, thus passing on those "superior" genes. b. Nonrandom mating occurs when individuals choose their mates for a specific reason, such as color of feathers. c. Genetic drift is a change in the gene pool due to chance and is unpredictable. One example is the founder effect. In the founder effect, a small population breaks away

	from a larger population to live in a new area. This small population may have alleles rarely found in the larger population. As the small population breaks away and reproduces within itself, the rare alleles will become more prominent. d. Mutations are changes in genetic material and is the BASIS for evolutionary change. Variations in a population occur due to mutations in DNA. e. Gene flow is when alleles move in or out of a population. For example, pollen from one area can be carried by the wind to another area, influencing the genetic makeup of the new area.

Experiment/Investigation	SEEING EVOLUTION
	The Evolution of Bacteria on a "Mega-Plate" Petri Dish by Harvard Medical School is a great way to show students evolution occurring before their very eyes. (video can be found on YouTube). After the video, discuss what happened in the video, making sure to include the following questions:
	- What did the researchers use to filter out bacteria that had evolved (bacteria that had mutations)?
	- At the end of the experiment, what bacteria remained in the middle of the mega petri dish?
	- What real world applications or concerns can be concluded from this video?
	
	ORGANIZE IT OUT
	In order to ensure students don't confuse one cause of evolution with another, divide students into groups and carry out the following activity.
	- Materials:
	  - Markers and pens
	  - Poster Paper
	- Procedure:
	  - Divide students into groups, assigning each group a different cause of evolution. For example, one group may be nonrandom mating and another group may be natural selection.
	  - Have each group design a poster for their cause of evolution. The poster should include a definition and scenario. Pictures or diagrams are also encouraged.
	  - Have each group do a presentation. After each presentation, the other groups should explain

	why their cause differs from the cause presented.
Procedures (warmup, guided instruction, "lesson")	a. Start by opening up a discussion on evolution and make sure that students understand key vocabulary, which includes population, evolution, and species. b. Touch back upon genes, alleles, and the expression of genes. c. Discuss Charles Darwin's contribution to biology and his theory of natural selection. d. Explain how natural selection is not the only means by which evolution occurs. Explain other causes of evolution of a population.
Assessment	Have students define two or three causes of evolution. A scenario should also be included to help demonstrate and clarify their definition.
Homework	Have students read the corresponding chapter in their textbook the night before the lesson. Assign questions from the chapter in the textbook the night of the lesson. If no questions are provided, the following may suffice: 1. Explain why mutations and natural selection are linked. Which one comes first? 2. Make up a situation that illustrates nonrandom mating. Then, make up a situation that illustrates genetic drift. 3. Does evolution through natural selection occur quickly or slowly? Explain.

Objective	Teach students how to read and construct a basic phylogenetic tree.
Science Standard	A phylogenetic tree is a diagram that illustrates evolutionary relationships between several organisms. Understanding a phylogenetic tree also involves understanding of taxonomy. a. Taxonomy is the branch of science involved with the classification of organisms based on shared characteristics. The modern system gradually breaks down organisms into: kingdom, phylum, class, order, family, genus, and species.

	b. The tips of a phylogenetic tree represent groups of species that have descended from a common ancestor. c. The nodes on the phylogenetic tree represent points at which two lineages diverge and therefore represent common ancestors. d. An outgroup usually exists, which is used as a point of reference, and is not an organism of interest. The outgroup organism usually shares no common characteristics with the other organisms. e. The organisms of interests (mentioned in point c), are referred to as the ingroup.

Experiment/Investigation	3D MODEL
	- Materials:
	  - Whatever the students decide to use
	- Procedure:
	  - Select 10 animals for students to include in a phylogenetic tree.
	  - Alone or in groups, have students construct a 3D phylogenetic tree, incorporating all of the animals provided.
	  - During their presentation, have students explain the characteristics of each animal that caused them to classify the animals the way they did.
	
	GOING DIGITAL
	Have students explore building their own phylogenetic tree online, through PBS's activity, found in the following link: http://www.pbs.org/wgbh/nova/labs/lab/evolution/research#/chooser

Procedures (warmup, guided instruction, "lesson")	a. Before starting a discussion, present students with a group of animals of various species. Include plants, mammals, fungi, reptiles, and birds. Have students classify them into no more than three groups, with explanations on why they classified the animals as they did. Be sure that they answer the following questions:
	  i. What characteristics do the animals in your groups share?
	  ii. What method did you use for classifying the animals?
	b. Explain taxonomy and the modern system used.
	c. Explain what a phylogenetic tree is and how it works.
	d. Design a phylogenetic tree together with the class.
	e. Have a discussion, linking phylogenetic trees to

	evolution and Darwin's theory of natural selection.
Assessment	Have students create a phylogenetic tree from the the problem presented before your discussion (point a in "procedures" section). The students don't have to follow the three groups that they classified the animals into.
Homework	Assign reading from the chapter in the textbook the night before the lesson. Assign two to three problems in which organisms and their characteristics are listed and students are to design a phylogenetic tree based on the information.

EARTH SCIENCES

As mentioned in the previous section, geology is one evidence of evolution on Earth. Observations and findings from rocks allows us to learn more about evolution of life.

a. Students understand that Earth's slow processes are similar to those that occurred in the past. The changes made by the processes in the past throughout the present have accumulated, forming long-lasting changes in Earth's geologic structure.
b. Students understand that Earth has been affected by major events, including volcanic eruptions, asteroids, and earthquakes.
c. Students can explain the rock cycle, encompassing the formation of new sediment and rocks.
d. Students can read and interpret rock layers and can identify which layer is the oldest and which is the youngest.
e. Students understand that geologic evidence indicates that Earth is about 4.6 billion years old and that life has been around for more than 3 billion years.
f. Students understand that environmental and population changes on Earth can be understood through fossils.
g. Students understand that the movement of Earth's plates and climate changes have affected the distribution of life on Earth.
h. Students can pinpoint and explain major developments and extinctions of plant and animal organisms by using fossils as evidence.
i. Students understand how organisms and their environments impact each other. Students know the basics of ecology, which includes understanding the food chain, symbiosis, and what entails a population.
j. Students understand that Earth can be divided into biomes. They know the different types of biomes, the animals that inhabit each biome, and how they are differentiated.
k. Students understand how people have affected and changed their environment, thus affecting Earth and organisms living on it.

Objective	Teach students the various biomes that can be found on Earth, their distinguishing characteristics, and the animals that inhabit each biome.
Science Standard	Biomes are regions of the Earth and are categorized by the amount of precipitation and the temperature in the area.

	a. Tropical Rain Forest i. Characteristics of a tropical rain forest include abundant rainfall and high humidity. ii. It contains the most diversity of species than any other biome. b. Desert i. Characteristics include less than 10 inches of rainfall per year and extreme temperature fluctuations in a 24 hour period. ii. Plants that can be found, including cacti, sagebrush, and mesquite, have adapted to the limited amount of rain. iii. Rodents, snakes, and lizards can be found in deserts. c. Deciduous Forest i. This forest is characterized by trees that drop their leaves in the winter ii. Species live on the ground, the low branches, and the treetops iii. Squirrels, deer, foxes, and bears can be found d. Taiga i. Taigas are found in northern regions and are inhabited by evergreen forests. ii. This is the largest terrestrial biome. iii. It is characterized by heavy snowfall and very cold winters. iv. Moose, black bear, lynx, and elk can be found here. e. Tundra i. Tundras are located in the northern parts of North America, Europe, and Asia. ii. A distinguishing feature is permafrost. Due to permafrost and little rain, it is referred to as the frozen desert. iii. Flies, reindeer, caribou, Arctic foxes, and polar bears can be found here.
Experiment/Investigation	MAKE A BIOME - Materials: - Shoe box (per group/student) - Scissors - Any other material students choose to use - Procedure:

	- Assign each student (or group) a biome - Have students take the lid off the shoe box. Only the box (without the lid) will be used. - Turn the box on its side, length-wise - Create a background that depicts the assigned biome on the inside of the shoebox (the wall farthest from the student) - Design and decorate the space in front of the background with animals and plants corresponding to the assigned biome. - Display the biomes around the classroom and have students walk around, guessing which biome each shoebox is representing.
Procedures (warmup, guided instruction, "lesson")	a. Introduce the concept of biomes b. Explain the various biomes and their distinguishing features. A chart, organizing the information, should be presented. c. Show pictures as you go through each biome. d. Hold a discussion on the various adaptations organisms have made to survive in their biome. Have students incorporate concepts learned in the genetics section.
Assessment	Present a picture of a biome to the class and have them conclude which biome the picture is of. Have them include one feature of the biome that is characteristic of that biome.
Homework	Assign reading of the corresponding chapter the night before the lesson. The night of the lesson, have students draw three biomes with short explanations underneath.

Objective	Teach students the various ways people have impacted Earth and the consequences that have followed.
Science Standard	As people inhabit Earth, they have made permanent changes in Earth's environments, which have impacted people and other organisms living here. a. Eutrophication of Lakes

	i. Humans have disrupted freshwater ecosystems, causing eutrophication. As runoff from sewage and manure reach lakes, algae and other plants grow without restraint. ii. As the algae and plants die, organic material accumulates on the bottom of the lake, making the lake more shallow. iii. Detrivores use up oxygen as they decompose dead organic matter from the runoff. This lowers the oxygen level, killing fish and other organisms. b. Global Warming i. The atmosphere, made up of carbon dioxide and water vapor, absorbs and retains a large portion of light and heat from the sun. This is known as the greenhouse effect. ii. As people release more and more carbon dioxide to the atmosphere, the atmosphere retains more and more heat, raising the temperature on Earth. This is known as global warming. iii. Global warming has the greatest impact in the far north, affecting the lives of organisms like polar bears.
Experiment/Investigation	GLOBAL WARMING IN A JAR - Materials: - 3 large jars and 1 smaller jar that fits inside the larger jars - Laboratory thermometers - Marker - Anti-fog solution - Timer or clock - Clear plastic wrap - Rubber bands - Paper and pencil/pen - Procedure: - Cut out cardboard strips that are a bit wider than the thermometers. Tape one strip to the back of each thermometer. - Label one jar as “A”, another as “B”, and the last one as “C” - Place a thermometer in Jar A and leave it uncovered

	- In Jar B, spray anti-fog solution before placing a thermometer in it and sealing the top opening with the clear plastic wrap and a rubber band - In Jar C, spray anti-fog solution - Fill the smaller jar with water, making sure that the water is room temperature. Put the water-filled smaller jar into Jar C. - Put a thermometer in Jar C, next to the smaller jar. Put a thermometer in the smaller jar with water. - Seal Jar C, like you did for Jar B. - Make sure the sun hits the cardboard box taped to each thermometer. - Read and record each thermometer - For the first 30 minutes, check the thermometers in 5 minute intervals. After 30 minutes, check on them in 15 minute intervals. - Jar A represents what Earth's atmosphere without the greenhouse effect. Jar B represents Earth's atmosphere with the greenhouse effect, and Jar C represents Earth's atmosphere next to a large body of water, like an ocean. - Hold a discussion with the class, regarding the observed measurements. Apply the results to the real world.
Procedures (warmup, guided instruction, "lesson")	a. Open up a discussion on global warming, followed by a clear explanation of the steps that lead to global warming. b. Ask students if they can think of any other ways humans have impacted Earth. c. Introduce the concept of eutrophication and follow it with an explanation. Diagrams depicting the steps should be shown. d. Have students draw a simple diagram, depicting the process of eutrophication. Have them do the same for global warming.
Assessment	Have students label the two diagrams they drew.
Homework	Assign reading of the corresponding chapter the night before the lesson. On the night of the lesson, assign the questions from the chapter. If no questions are provided, use the following: 1. Explain eutrophication of lakes through a step-by-step process.

	2. Explain global warming. 3. What is one way people may reduce the impacts of eutrophication and global warming? 4. In what other ways have human impacted Earth? Are there any positive ways humans have impacted Earth?

STRUCTURE AND FUNCTION IN LIVING SYSTEMS

Structure and function are interrelated with each other. This phenomenon can be observed in the anatomy and physiology of plants and animals.

a. Students understand that levels of organization exist in plants and animals. These levels are the following (in order according to individual size): cells, tissues, organs, organ systems, and whole organism.
b. Students understand the different functions of organs, tissues, and cells and their contribution to organ systems. They also understand that the failure of one of these levels can result in changes to the entire system.
c. Students understand the primary goal of the nervous system and how it functions. Students also know the structure and functionality of a neuron.
d. Students understand the structural function of bones and muscles and how they interact. Students also know the role of the nervous system in the function of bones and muscles.
e. Students understand the role of sperm and eggs in reproduction and also know the reproductive organs of both males and females; this includes the placenta, the umbilicus, the testes, and the ovaries). They also understand how sexual activity may lead to pregnancy.
f. Students understand how plants reproduce and know the processes by which flowering plants produce pollen, ovules, seeds, and fruit.
g. Students understand how the eye and ear function, including how the two send information to the brain. This should incorporate understanding of ganglion cells, bipolar cells, rods and cones, hammer, anvil, stirrup, and the cochlea.

Objective	Teach students how neurons function to form the nervous system.
Science Standard	The nervous system is a network of nerve cells (neurons) that travel throughout the body, transmitting nerve impulses and information. a. The nervous system is divided into two main systems - the central nervous system (CNS) and the peripheral nervous system (PNS). The CNS consists of the brain and spinal cord, while the PNS consists of all the nerves not included in the CNS. b. The PNS is then further divided into the sensory and motor systems, where the sensory system conveys

	information from sensory receptors and the motor system conveys information from muscles. c. The motor system of the PNS is then divided into the somatic system, which controls voluntary muscles, and the autonomic system, which controls involuntary muscles. d. A neuron, a specialized cell that transmits nerve impulses, consists of a cell body, dendrites, and an axon. Dendrites receive incoming messages from other cells, and axons transmit an impulse from the cell body to another cell. The cell body contains the nucleus. e. A neuron communicates with another neuron by releasing neurotransmitters, a chemical that is released into the synapse (gap between two neurons) and transmitted to the dendrites of the next neuron, stimulating it.

Experiment/Investigation	TESTING YOUR REFLEX
	- Materials:
	  - Ruler (one per group)
	  - Stopwatch (one per group)
	  - Pencil and paper
	- Procedure:
	  - Assign each student a partner (group them into groups of 2 students)
	  - Have each student draw a T-table in their notebook. Label one column “distance” and the other column “time”.
	  - Have Student A rest one of their arms on the table so that their hand is dangling off the table.
	  - Have Student B hold the ruler by the 0cm mark and dangle the ruler above Student A’s hand. (The ruler should NOT be touching the hand.)
	  - Have Student B drop the ruler. Student A is to catch the ruler as fast as possible. When Student B drops the ruler, he/she should start the stopwatch and end it when Student A catches the ruler.
	  - Record the time on the stopwatch AND the centimeter mark or inch mark at which Student A’s hand is on.
	  - Repeat this two more times.
	  - Students A and B switch places and repeat.

	- When the experiment is over, hold a discussion with the students on what the results indicate. (The results indicate how fast the students' brains respond).
Procedures (warmup, guided instruction, "lesson")	Prepare diagrams of a neuron. A tree or chart of the division of the nervous system may be necessary to help students better understand and differentiate the various systems. a. Start off with a discussion of the nervous system and the different divisions within it. Set up a tree or chart to help visually organize the information. b. Move on to the neuron. Explain what a neuron is and present diagrams for kids to visually see and understand the structure of a neuron. c. Explain the various structures found in a neuron - dendrites, cell body, and axon - and explain their functions. d. Animations of a neuron in action should be presented for students to have a visual explanation. e. Have students draw a diagram of a neuron in their notebooks. f. After the experiment, have students explain what happened to produce the measurements recorded, using information on global warming (information can be found in "standards" section).
Assessment	Using the diagram of a neuron, have the students label the dendrites, the cell body, and the axon. Have the students write a short description of the function of each part of a neuron.
Homework	Assign reading of the corresponding chapter the night before the lesson. Assign the questions in the chapter the night of the lesson. If now questions are provided, the following may suffice: 1. Using a chart or tree diagram, divide the nervous system into its various subsystems. Then, explain what each system entails. 2. What are neurotransmitters? Why are they important? 3. How might the structure of a neuron help carry out its function?

Objective	Teach students how the eye functions and how the nervous system delivers information from the eyes to the brain.
Science Standard	The nervous system detects external and internal signs. One external sign it detects is information from the eyes, allowing the brain to process and respond to visual cues. a. The eye consists of several layers. Starting from outermost to innermost, the layers are: cornea, iris, pupil, lens, vitreous gel, and retina. b. The cornea is the clear covering that protects the eye. The iris is the colored part of the eye and controls the size of the pupil, depending on the light intensity of one's surroundings. The pupil is the small opening in the middle of the iris where the light enters the eye. The lens focuses light on the retina. c. Light that hits the retina is absorbed by photoreceptors in the neurons of the eye. d. Rods and cones are two types of photoreceptors. Cones provide color vision, and rods provide black and white vision. e. The light absorbed by the neurons initiate an impulse to be sent to the optic nerve. The impulses first travel to bipolar cells. From there, they travel to ganglion cells and then to the optic nerve. f. From the optic nerve, the impulses travel to the brain, where the message is interpreted. g. There are no photoreceptors on the optic nerve. Thus, light that hits the optic nerve is NOT absorbed, giving this spot the name, the blind spot.

Experiment/Investigation	THE BLIND SPOT
	- Materials:
	  - This link: https://faculty.washington.edu/chudler/chvision.html
	- Procedure:
	  - On their individual computers or on the board, have students look at the link provided above
	  - Go through each activity
	  - Each activity will have students experience the blind spot first hand
	  - Engage the class in a discussion of what's happening. Questions to include are: why can

	you not see the image at certain points? Where is the light hitting?
Procedures (warmup, guided instruction, "lesson")	Diagrams of the eye may be necessary for this lesson. a. Start by presenting a diagram of the eye and explaining each layer. b. Refresh students on "neurons" before explaining how neurons in the eye work. Explain photoreceptors as structures found in neurons and explain their function. Incorporate discussion of rods and cones. c. Explain that impulses travel to the optic nerve, where they are then taken to the brain. Explain that the impulses travel through bipolar and ganglion cells. d. Show students an animation of light entering the eye and being absorbed and taken to the brain. e. Have students draw a diagram of the eye.
Assessment	Have students label the diagram of the eye they drew and explain what each part's function is.
Homework	Assign reading of the corresponding chapter the night before the lesson. On the night of the lesson, assign the questions in the chapter. If no questions exist, the following may suffice: 1. What are rods and cones? What are their differences? 2. Explain the path light takes to reach the brain. You may draw a diagram to aid your explanation. 3. What is the blind spot?

PHYSICAL SCIENCES

Students understand basic physical principles that explain biological structures and functions.

a. Students understand that visible light makes up only a portion of the electromagnetic spectrum and can identify the other waves that make up the spectrum.
b. Students understand that in order to see an object, the eye must detect light scattered by the object.
c. Students understand that light travels in straight lines if the medium through which it travels doesn't change. They also understand that shadows are formed when light encounters an object that doesn't let light through.
d. Students understand that different colors are produced by different wavelengths of light and that the color white is a mixture of many colors. Students also know that the color black is formed when an object absorbs all the light, not reflecting any light back.
e. Students understand that light can be reflected, refracted, transmitted, and absorbed by matter.
f. Students know how lenses are used in a magnifying glass, the eye, a camera, a telescope, and a microscope.
g. Students know that the angle of reflection is equal to the angle of incidence and can draw a simple diagram, depicting the angle of reflection, the angle of incidence, and the normal line.
h. Students know the various types of synovial joints found in the body: hinge, ball-and-socket, sliding, pivot, saddle, and planar.
i. Students understand how the musculoskeletal system works and can compare it to levers found on mechanical structures.
j. Students understand that blood is pumped through the body by the contractions of the heart, which produces blood pressure. Students can trace the path of blood through the body and know the functions of the different parts of the heart.

Objective	Teach students about the different parts of the heart and the role it plays in getting blood to circulate through the body.
Science Standard	The heart plays a crucial role in the circulatory system, pumping blood by contracting. a. Arteries carry blood away from the heart under immense pressures. Veins carry blood back to the heart under little pressure (blood pressure is lowest in the veins).

	Capillaries allow nutrients and wastes to diffuse between cells and blood. b. Blood pressure is related to the force and rate of the heartbeat. It is created by the contractions of the heart as it pumps blood throughout the body. Normal, resting blood pressure in adults is 120/80. c. The heart has four chambers and four valves (one for each chamber). d. Blood enters the heart through the vena cava and into the right atrium. From there, it enters the right ventricle before entering the pulmonary artery. It then travels to the lungs before traveling to the pulmonary vein and then into the left atrium. From there, it travels to the left ventricle before exiting the heart through the aorta. From there, it travels to all the cells in the body. e. Backflow of blood is prevented by the valves in the heart.

Experiment/Investigation	MAKE A HEART
	- Materials:
	  - Large balloon
	  - Wide mouth jar
	  - 2 flexible drinking straws
	  - Scissors
	  - Water
	  - Tape
	  - Wooden skewer
	  - Large pan or sink
	- Procedure:
	  - Fill the jar half full with water
	  - Cut the neck of the balloon off. Set the neck aside
	  - Stretch the balloon over the mouth of the jar. Pull it down tightly - the flatter the balloon is, the better.
	  - Using the skewer, poke two holes in the flattened balloon, one inch apart from each other.
	  - Put a straw through each of the holes. Make sure that the straws fit securely and that no air can get around the straws.
	  - Slide the uncut end of the balloon neck onto one of the straws and tape it.
	  - Set the jar in a large pan or sink. Bend the straws

	downward and gently press down into the center of the flattened balloon. - Observe what happens. - This depicts what happens in one chamber and its valve.
Procedures (warmup, guided instruction, "lesson")	a. Present a diagram of the circulatory system of the human body to the class. Locate the capillaries, veins and arteries and explain their distinct functions. Use this simple way of remembering: **A**rteries carry blood **A**way. b. Present a diagram of the human heart to the class. Explain that the heart pumps blood by contracting. c. Using the diagram, illustrate the path blood takes through the heart. d. Explain the significance of blood stopping at the lungs (to pick up oxygen) e. Have the class draw a diagram of the heart and label the four chambers, the pulmonary artery, and the aorta.
Assessment	Have students draw arrows in their heart diagram, illustrating the flow of blood through the heart.
Homework	Assign reading of the corresponding chapter the night before the lesson. Assign questions from the chapter the night of the lesson. If no questions are provided, the following may suffice: 1. Why is it important for blood to pump throughout the body? 2. Explain the path blood takes when entering, traveling through, and exiting the heart. 3. What is blood pressure? Why do doctors read blood pressure of a patient?

Objective	Teach students the types of synovial joints found in a human body.
Science Standard	There are six types of synovial joints. Synovial joints are joints that allow movement. Where the bones meet to form a synovial joint, articular cartilage can be found, covering the bones. The function and structure of the six types of synovial joints can also be found in the real world, in many machines. a. Hinge joints

	i. They act like the hinges of a door. ii. They allow for flexion and extension. iii. One bone remains still while the other moves. iv. Elbows and knees are hinge joints. b. Ball and socket joint i. This joint allows for the greatest range of motion. ii. Shoulder and hip joints and ball and socket joints. iii. A bone with a spherical head fits into the cup-like socket of the other bone. c. Pivot joint i. Pivot joints allow for rotation. ii. The neck and the joint between the radius and the ulna are pivot joints that allow for rotation. d. Condyloid joint i. Bones that have an oval projection are called condyloid bones. They fit into the hollow space of the bone next to it. ii. Condyloid joints are made up of small bones and are prone to injury. iii. It permits all movement except for rotation. iv. Examples are the wrists and small finger bones. e. Saddle joint i. One of the bones is shaped like a saddle, while the bone connecting to it is like a rider on the saddle. ii. An example is the joint for the thumb. f. Planar joint i. A planar joint allows for gliding movement. ii. This joint is found where bones meet at a flat surface. iii. This joint can be found between the tarsal bones in the foot.
Experiment/Investigation	REAL WORLD APPLICATION - Materials: - Poster paper (1 per student) - Markers, pens, pencils - Procedure: - Have students find these joints in the real-world (example: trash can lids, door hinges, etc.) - (Not all joints will have a real-world equivalent) - Through photographs or drawn pictures, have students make a poster board comparing and

	contrasting real-world joints to anatomical synovial joints - If students wish to put in animations or short clips, a Power Point Presentation may be made instead of a poster board
Procedures (warmup, guided instruction, "lesson")	a. Explain what a synovial joint is. b. Go through each joint, explaining where they can be found in the real world (not all the joints will have a real-world equivalent) c. While going through each joint, provide animations that will help students visualize the function of each joint
Assessment	Read short descriptions of the different types of joints and have students write down or discuss which type of joint it is.
Homework	Assign reading of the corresponding chapter the night before the lesson. The night of the lesson, assign the questions from the chapter. If no questions exist, the following may suffice: 1. Describe three types of synovial joints. You may include pictures or diagrams to aid your descriptions. 2. How do the different types of joints help a person move and function? 3. Are there any limitations to the types of joints?