



***The Genetics and Epigenetic Effects
of Diet on Health***

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This curriculum unit is recommended for:
5th Grade Science

Keywords: Epigenetics, Generation, Phenotype, Genotype, Alleles, Genetics, Traits, Inherited Traits, Learned Traits Offspring, Chromosomes, DNA, Heredity.

Teaching Standards: See [Appendix 1](#) for teaching standards for this unit.

Synopsis: This unit is designed to teach 5th grade Genetics. This can also be adapted for a middle school curriculum. My main goal for this unit is to primarily focus on how genes affect overall personality and appearance on an individual level as well as how we can implement changes within the genome by altering the environment through epigenetic mechanisms. In this unit, students will be able to understand some basic vocabulary to help them better understand genetics, learn about genetics at a cellular level specifically looking at the nucleus and the DNA of cells, and then at a broader level, traits and heredity on a more outside perspective. This unit is also designed to explore how human genes are expressed to produce physical traits and characteristics. Students should also know that all traits that are passed down from parent to offspring are not necessarily expressed. They should understand the importance of different alleles in each gene and the importance of dominant and recessive alleles. The discussion on epigenetics will then allow students to explore how gene expression can differ due to the environmental factors rather than solely through inheritance. We will investigate epigenetics through the use of Arabidopsis and the effect of environmental conditions on its growth. The next section of the curriculum unit will focus mainly on epigenetics.

I plan to teach this unit during the coming year to approximately 100 students in 5th grade science.

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Introduction

Throughout my career as a teacher, I have been fortunate enough to have the experience of teaching students with learning disabilities. These experiences have taught me how to manipulate a lesson plan to adapt it in such a way that is easier to understand. My goal is to not lessen the amount of content taught but to make a lesson plan that can explain the material in such a way that is easy to understand. This can be done through starting with more basic concepts and then building up on these topics to reach a level of understanding. When teaching a similar unit to a 5th grade class, we learned how genes are affected through the environment that you are exposed to. These factors can also affect a student's learning ability. This unit really motivated me to learn more about epigenetics and how students were affected due to this. I want to take it upon myself to teach students with these learning disabilities how they have come to develop these problems as well as some steps that they could take to rectify these issues. I do not think that a lack of a stable environment should be a hindrance on a child's learning.

In this unit, students will be able to understand basic concept of genetics and how diet affects our gene expression.

School Demographics

The demographics of our school is very diverse and consists of 75% Hispanic and Latino students, 20% African American students and remaining others. Looking at these data, I am motivated to help these students who are brought up in poverty or other environmental stressors. Poverty brings with it several different stressors, such as poor nutrition, increased prevalence of addiction and the general struggle of trying to get by. These factors have a monumental effect on a child's developing brain. These stressors play a hidden part on student's learning in ways that they are generally unaware of. Through teaching this unit, I hope to shed some light on these areas for these students so that they can take the necessary steps to mold their environment the best that they can to circumvent these factors. These include a change in nutrition intake or a change in the level of undesired activity that lead to these stressors. In addition, I believe this unit serves as a foundation for many other genetics topics that they will learn about in the future.

The Nations Ford Elementary School is committed to social and emotional needs of their students. To determine intervention needs, students receive regular benchmark assessments to establish their level of skill and receive instruction that best meets their individual learning levels. The school monitors the progress of students on a regular basis to ensure that students are making adequate academic growth. Along with academic excellence, our school also offers site based counseling and social skills training to help students from positive relationships. This unit can be used to benefit middle and high school students as well.

As a science lab teacher. I have access to all 800 students in my school. I get access to my students once per week for 45 minutes. My schedule allows for one science instruction once a week for each class.

Rationale

During lunch duty every day, I have a chance to interact with my 5th grade students. Most of the time, I observe that kids do not eat healthy food. A lot of the healthier options found in the cafeteria such as fruits and vegetables are not consumed, and they are generally discarded. If students aren't consuming healthy food that is essential, they are not getting the nutrition that they need to sustain a healthy body. Studies show that children consistently throw away fruit and vegetables without even touching them. Research studies show that more than 50% of apples and 60% of broccoli ended up in trash at Connecticut schools. Children who eat a school lunch are 500% more likely to consume two servings of unhealthy fats in their meal compared to children who bring their own lunches⁰¹.

The primary focus of this unit is on how poor diet can affect a student's ability to learn and how this affects an individual's gene expression. I would also like to focus my curriculum on developing an understanding of genetics and how the genes themselves can influence health and an individual's phenotype. My last part of unit will focus on the link between epigenetics and diet.

Science Standards and Testing:

In North Carolina and across the country, science instruction in K-4 classrooms is often put on the back burner to math and literacy instruction. By the time the students reach fifth grade, they are expected to take and pass a NC Science EOG at the end of the school year. They are then required to go to the level of science classes in middle school. I think a strong foundation attained in Kindergarten is important to the students' success. When people say they do not like science, it is most likely because of a bad experience they have had as a child that has shaped their negative opinion. Hence, it is very important to focus on working with early childhood educators to learn how to create an amazing experience that encourage discovery through play, asking questions, exploration and using creativity to solve simple problems.

Objectives

North Carolina and Charlotte-Mecklenburg Schools use the North Carolina Essential Standards in Science to guide assessment and curriculum planning. I follow these standards closely and help support classroom teachers in achieving their teaching of objectives. Students know some likenesses between parents and children are inherited. Other likenesses are learned from parents or within the community (population/culture). Students know that in order for offspring to resemble their parents there must be a reliable way to transfer genetic information from parent to offspring. Students can be encouraged to keep lists of characteristics that animals and plants acquire from their parents, things that they don't, and things that the students are not sure about either way. This is also the time to start building the notion of a population whose members are alike in many ways but show some variation.

Unit Goals

In this unit students will be introduced to some basic vocabulary words; Genes, Heredity, Mutagens, Epigenetics Chromosomes, Phenotype, Genotype, Nucleus, DNA, Inherited Traits and Acquired Traits, and Generation.

1. Location of DNA, Chromosomes.
2. Traits and Heredity. Inherited and Learned Traits.
3. Environmental factors, how diet that changes human genes make ups and how the genes are expressed to produce physical characteristics (or phenotypes)

Background Knowledge for Teachers:

Vocabulary knowledge this is a brief definition for each words See Appendix 2.

Genes and Heredity

Cells are the basic unit of structure and function of all living things. Tiny biochemical structures inside each cell called genes carry traits from one generation to the next. They have the instructions for making the thousands of chemical building blocks in the body. These building blocks are called proteins. The genes provide the instructions on the makeup of the plant or animal, what it looks like, what it needs to do to survive, and how it will interact with its surrounding environment. The genes are strung together in long strands of material called deoxyribonucleic acid (DNA) and these long stands are called chromosomes. Most living things have pairs of chromosomes (one from each parent) and each organism can have a different number of chromosome pairs. For example, humans have 23 pairs of chromosomes while the fruit fly has 4 pairs. Chromosomes are the structures in the nucleus that hold the information from our parents. There are 46 chromosomes (23 pairs) in all our body cells. Two of those chromosomes (one pair) determine gender of the organism. The other chromosomes carry all the information that makes an organism what it is such as height, eye color, and so on.

Genes are the basic unit of heredity and are subunits contained on the chromosomes. The genes of an individual are determined by their parent. A bacterium that is produced by the splitting of one parent cell into two daughter cells will have the exact same genetic makeup as its one parent cell. A human, on the other hand, has two copies of each gene – one set from their mother and a second set from their father. Different forms of the same gene are called alleles. For example, the gene encoding eye color can have many alleles such as black, blue or brown. For each gene, a human can have two different alleles or two of the same alleles. Alleles can either be dominant or recessive. The most dominant allele of a gene will be expressed regardless of the other alleles. An allele that is hidden by the presence of a dominant factor is called recessive. When two recessive genetic factors are present in offspring a recessive trait can be observed.

The genes are further made up of unique codes of chemical bases comprising of A, T, C and G (Adenine, Thymine, Cytosine and Guanine). These chemical bases are part of the DNA. The words when strung together act as the blueprints” that tells the cells of the body when and how to grow, mature and perform various functions. With age the genes may be affected and may

develop faults and damages due to environmental and endogenous toxins. Heredity is what makes children look like their parents. During reproduction, DNA is replicated and passed from a parent to their offspring. This inheritance of genetic material by offspring influences the appearance and behavior of the offspring. The environment that an organism lives in can also influence how genes are expressed.

Based on the parents of the offspring, one can guess what traits the child may possess. Heredity is what makes children look like their parents. During reproduction, DNA is replicated and passed from a parent to their offspring. This inheritance of genetic material by offspring influences the appearance and behavior of the offspring. The environment that an organism lives in can also influence how genes are expressed. A gene gives only the potential for the development of a trait. How this potential is not only achieved depends partly on the interaction of the gene with other genes, but it also depends partly on the environment. For example, a person may have a genetic predisposition toward being overweight. The person's actual weight, however will depend on the further lifestyle of the individual.

The Central Dogma

DNA is the molecule that holds the genetic information for a cell and an organism. DNA resembles a spiral staircase. Each step on your DNA staircase contains instructions for your body. These instructions are your genes. Genes are made up of four letters in the alphabet: T, A, G and C. These letters are always grouped into three, such as CAG. The letters are then strung together in groups, such as CAG, GGT, ACT and GAT. These strings alongside environmental factors determine our genetic makeup and gene expression.

A DNA molecule² contains a code that can be used by a cell to express certain genes. Specific sections of a DNA molecule provide the information to build specific protein. which can then be used by a cell to express the desired gene. A DNA molecule is a nucleic acid, one of the four molecules of life. It comes in the form of a long, linear molecule referred to as a strand. Each strand of DNA is bonded to a second strand of DNA to form a DNA double helix. In eukaryotic cell's DNA is found in the nucleus as a tightly coiled double helix. DNA molecules are replicated during cell division. When a cell divides, the two new cells contain all the same DNA that the original cell had. A gene is a specific segment of a DNA molecule that holds the information for one specific protein. DNA molecules have a unique code for each gene which codes for their specific protein. Some organisms can have more than 100,000 different genes so they will have 100,000 unique sequences of DNA 'code'. In order to form a protein from this DNA code, a process called transcription occurs. Transcription is the process used to convert small regions of DNA into portable messenger RNAs. RNAs are single stranded versions of DNA that contain an Uracil base pair the messenger RNAs then carry this information to protein making ribosomes. Ribosomes read this information that is contained in the RNA and translates the information into a protein through a process called translation.

Genotype and Phenotype

Human genetics coding could be found by their genotype. It determines which traits or characteristic to show. Organisms with the same genotype do not necessarily look similar. The behavior and appearance change periodically. Meanwhile, organisms that look same do not have the same genotype. The identification of genotype could be only done by the process of biological test and could not be identified through observations. Genotype is our complete heritable genetic identity. It is our unique genome that would be revealed by personal genome sequencing. However, the word genotype can also refer just to a gene or set of genes carried by an individual.

In contrast our phenotype is a description of our actual physical characteristics. This includes our height, eye color, but also overall health, our disease history and even our behavior and general disposition. Both the genotype and phenotype sound similar but has differences. for instance, hair color or type, eye color body shape, and height. It depends on the genotype but also influenced by the factors in the environment.

Inherited and Learned Traits

Inherited traits refer to physical characteristics passed on from parents to offspring (young children). Examples of inherited traits of animals include the coloring of their fur, their eye or ear shape, and the shape of their feet and beaks. Examples of inherited traits in plants include having broad leaves to soak up the sun due to living in the understory of forests, having shallow wide roots to quickly absorb water, or having spines to discourage predators from eating them.

Learned Behaviors refer to actions of an animal. Some behaviors are learned while others are instinctive. A learned behavior is something an animal must learn how to do or learns from experience. Examples of learned behaviors include reading, performing tricks, dancing, and riding a bike.

Gene Expression and Epigenetics

Gene expression is the process by which the instructions in our DNA are converted into a functional product, such as a protein. This is done through a process called transcription. The RNA produced during transcription is then converted into a functional protein through translation. This process of DNA converting to a protein through a RNA intermediate is called the Central Dogma. When the information stored in our DNA is converted into instructions for making proteins or other molecules, it is called gene expression. Gene expression is a tightly regulated process that allows a cell to respond to its changing environment. It acts as both an on/off switch to control when proteins are made and also a volume control that increases or decreases the amount of proteins made³.

Epigenetics is the study of changes in gene activity which are not caused changes in the DNA sequence. Gene expression is one way to understand on the genotype may result in the phenotype. Epigenetics can change the way a cell reads the DNA message in a number of ways by adding tags i.e “methylation or methyl groups to cytosine” These tags are not permanent and can change quite a lot over time due to the varying environmental conditions the organism experiences. There are a number of different types of tags or ways in which the DNA messages are controlled. This is a

very simple way of explaining the reason why some genes can be affected by something in addition to the DNA code itself within a cell. Epigenetics can be used to describe anything other than DNA sequence that influence the development of an organism. New research shows that people also inherit the effect of their parents' lifestyle and exposures as tags on our DNA. This is called epigenetics. These tags affect how the genes in our DNA function⁰⁴.

DNA Methylation

DNA methylation is an epigenetic mechanism used by cells to control gene expression. Several mechanisms exist to control gene expression in eukaryotes, but DNA methylation is a commonly used epigenetic signaling tool that can fix genes in the “off” position. Researchers are currently looking at the links between DNA methylation and human diseases such as lupus, cancer, muscular dystrophy and various congenital defects. Their findings could be significant in aiding the development of therapies and for understanding and preventing conditions that develop during embryonic development because of abnormal methylation of the X chromosome and gene imprinting⁰⁵.

Teaching Strategies

This unit spans 5 to 6 classes and includes four mini lessons, that teach basic vocabulary terms, two hands-on activity, one project and one assessment. This unit will empower students how to take care of our body and how other environmental factors affect our growth of our mental and physical well beings.

Before teaching them, vocabulary students will be introduced to the scientific method. Students will make observations, determine a problem (scientific question), form a hypothesis, collect and record data, conduct an experiment, and analyze data and draw conclusions is the way scientists learn about the world around us. In this unit students will be following steps of the scientific method to explore and inquiry.

The scientific method: At the core of biology and other sciences lies a problem-solving approach called the scientific method. The scientific method has five basic steps.

- 1, Making an observation.
2. Asking a question
3. Forming a hypothesis
4. Making a prediction based on the hypothesis
5. Testing the prediction

The scientific method is used in all sciences including chemistry, physics, geology, and psychology. The scientists in these fields ask different questions and perform different tests. However, they use the same core approach to find answers that are logical and supported by evidence.

A major component of literacy is vocabulary, or the words employed by the language of in a field of knowledge. Understanding words and concepts is important for young students as they are confronted with great deal of new terminology in the passages they read, especially in content areas such as science. Science is a discipline that relies heavily on students' ability to understand new terms and concepts. A strong focus on vocabulary helps students understand and communicate using appropriate terminology and the incorporation of imagery makes learning fun. To keep this in mind my first goal is to make my students to understand all the vocabulary words, which are going to help students to understand this unit. The Frayer Model is a simple graphic organizer for building student's vocabulary. The technique requires students to define target vocabulary and apply their knowledge by generating example and non- examples, giving characteristics, and/or drawing a picture to illustrate the meaning of the word. This information is placed on a chart that is divided into four sections to provide a visual representation for students

Instructional Implementation

This unit will take about four weeks, one (45 minute) class per day

Day 1: Teaching Vocabulary

Dorothy Frayer and her colleagues at the University of West Virginia came up with vocabulary-based teaching strategies known as "the Frayer Model" (Figure 1, see also Appendix 3) used by thousands of educators. This approach to word study relies on teaching strategies that analyze words rather than having students memorize definitions. Somewhat like concept circles, the Frayer Model uses a graphical organizer that asks students to describe words by much more than a memorized definition. In a perfect world, vocabulary is learned in context. The phrases and sentences around the unknown word define the meaning. If that is not enough, students use affixes -- prefixes, suffixes, and roots -- to decode meaning. Somewhat like concept circles, the Frayer Model uses a graphical organizer that asks students to describe words by much more than a memorized definition. Students must define the term and then describe essential characteristics, provide examples and provide non-examples. Because the Frayer Model teaching strategies dig deeply into understanding the word, it promotes critical thinking and a familiarity with unfamiliar vocabulary. It draws on a student's prior knowledge to build connections among new concepts.

Goal: Students will identify unfamiliar concepts and create a visual reference for concepts and vocabulary. Epigenetics, Generation, Phenotype, Genotype, Alleles, Genetics, Traits, Inherited Traits, Learned Traits Offspring, Chromosomes, DNA, Heredity. A lesson Plan and Frayer Model Graphic Organizer are provided in Appendix 2.

Activity: Frayer Model for Learning Vocabulary

Teacher Input

We will begin the first lesson by introducing the important vocabulary words. Reading, writing, and other communication in science requires the use of unique vocabulary. I feel that part of the battle of learning is developing the needed vocabulary so that students can understand the skill that is being taught. Part of disciplinary literacy instruction in science is educating students so that they are able to communicate like scientists, which means they need to use the language of science. In my day-to-day science lessons, I always introduce a new lesson with its vocabulary. I will start by introducing all the vocabulary words from the unit the teacher will provide copies of the Frayer Model Graphic Organizer to students and explain the process. Next, display the Frayer Graphic Organizer and explain each of the sections. Use one common vocabulary word to demonstrate the various components on the form. Once the students finish their graphic organizer, they will share their work with the whole class.

The students will have a chance to explore each vocabulary word through Discovery Education Animation Explore Activity where one can type each word and observe live action of each word with explanations. At times animation of each word it is very helpful especially for ESL and EC students (see Appendix 2).

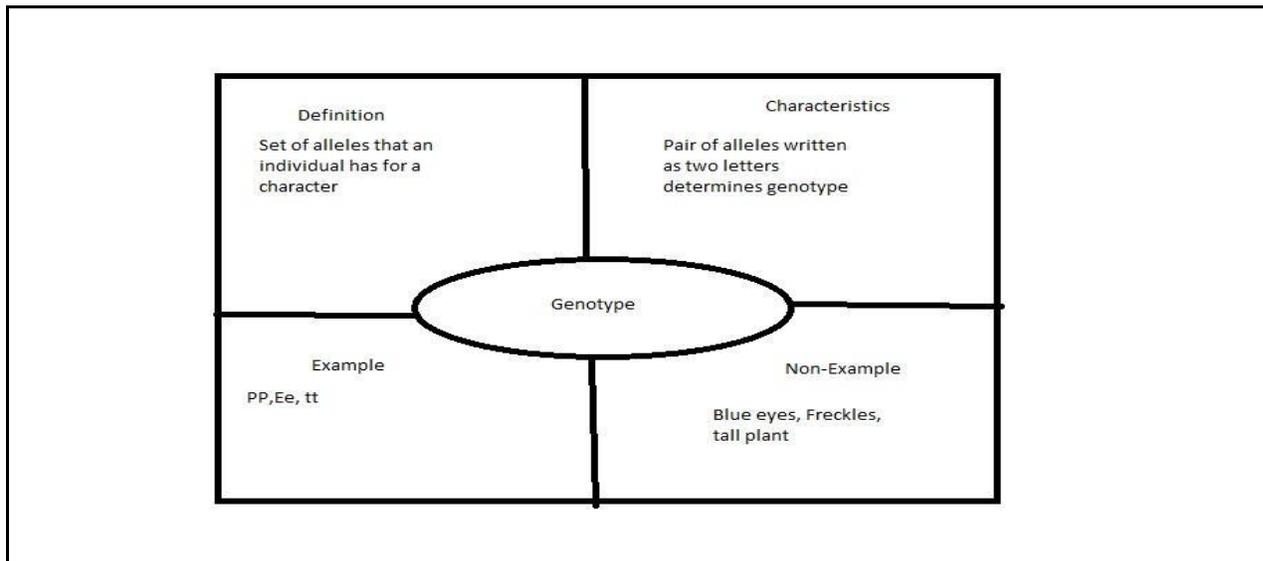


Fig 1: Frayer Model Example: Genotype

Day 2: DNA: The molecule and its organization

Teaching locations of DNA and Chromosomes.

To ensure students have a clear understanding of their new vocabulary words, the teacher will review the lesson from Day 1 to refresh the students' memory of the topic. This will lead to a better understanding of the material by solidifying the knowledge they acquired during the previous week.

Goals: Students will understand that cells contain DNA. DNA is a physical structure that can be seen. They will prepare a solution containing strawberry DNA and then observe first hand that DNA is in the food that we eat. Activity procedure and recording data sheet are provided in Appendix 3

Teacher Input

In this lesson, students learn about DNA, the building block of genetic material. DNA contains all the genetics information for an organism's traits and metabolic processes. The condensed form of DNA is called chromosomes. A main function of DNA is that it controls the production of proteins. In eukaryotes, DNA is located in the nucleus. Have you ever wondered how scientists extract DNA from an organism? All living organisms have DNA, which is short for deoxyribonucleic acid; it is basically the blueprint for everything that happens inside an organism's cells. Overall, DNA tells an organism how to develop and function, and is so important that this complex compound is found in virtually every one of its cells.

Activity

Students will be able to extract DNA from strawberries and look under microscope. With the Strawberry DNA experiment, students will extract, isolate, and observe the DNA of a strawberry in a matter of minutes. It sounds impossible, but thanks to special characteristics of strawberries, it's actually very possible. Strawberries are the perfect choice for a DNA extraction for two reasons: They yield way more DNA than other fruits and also, they are octoploid, meaning that they have eight copies of each type of DNA chromosomes. In this activity students will extract DNA from strawberries under teacher guidance from household chemicals such as dish soap, rubbing alcohol, strawberry etc. Students will be following steps of the scientific method and they will make their prediction, recording result and making conclusion. To extract the DNA, each component of the extraction mixture plays a part. Soap helps to dissolve cell membranes. Salt is added to release the DNA strands by breaking up protein chains that hold nucleic acids together. Finally, DNA is not soluble in isopropyl alcohol, especially when the alcohol is ice cold.

Lab Analysis Questions

1. What purpose is served by the Dawn dishwashing detergent?
2. Describe what the DNA looks like with your naked eye.
3. Where did the DNA first appear?
4. What might have happened if the alcohol was poured too fast and it did not form a layer on top of the water?
5. There is about 6 feet of DNA contained in each of your cells. How is it possible for so much DNA to fit inside the small space of a cell?

Students will complete lab analysis questions and teacher will have a brief discussion with students.

Day 3: DNA Isolation

Goals: Students will be able to determine if all living organisms have DNA and also recognize that DNA is a molecule located in the cell's nucleus and holds genetic information that makes each of us unique and special.

Material needed: Strawberry, dishwashing soap, salt, rubbing alcohol,

Teacher Input

Mini lesson: Teacher will start Day 3 lesson by reviewing all the vocabulary words from previous lesson. Traits are observable characteristics that are passed down from parent to child. The characteristics of an organism can be described in terms of a combination of traits. Some traits are inherited, and others result from interactions with the environment. Traits are physical characteristics you inherit from your parents. In this investigation, they will take an inventory of their observable traits and compare these to the observable traits of their classmates. They will then take inventory of students and teachers in school. Finally, they will determine the frequency of each trait in school's population and will make a prediction about how many classmates will have the same form of traits as me.

Then they will calculate frequency of each form of the trait for class using this formula: $(\text{No. of students with form of trait} \div \text{Total number of students in class}) \times 100$. Finally they will make a bar graph and compare frequencies for each form of each trait

Day 4: Trait Inheritance

Goals: Students will be able to understand that traits are observable characteristics that are passed down from parent to child and an equal number of traits are passed on from each parent.

Activity:

I listed two activities depending on your time you can finish one or two or both. For details see Appendix 4 where traits survey sheets and generations of traits resource are available

1. Traits Survey: Students will move around the classroom and complete class traits survey sheet.
2. Generations of Traits:

In this hands-on activity students track and record the passage of colored pom-pom “traits” through three generations of gingerbread people. Students observe that traits are passed from parents to offspring, and that siblings each receive a different combination of traits from their parents.

Day 5: Epigenetics and the Environment

Environmental agents including nutrition, chemicals and physical factors such as temperature, can alter gene expression by affecting the epigenetic state of the genome. Foods that mediate epigenetics changes in gene expression via methylation. It has recently been discovered that some foods such as rice, cabbage, wheat, and potatoes are the source of miRNA circulating in the blood and serum of humans.

Study of Epigenetics in *Arabidopsis thaliana*: In this activity students will be able to explore observe epigenetics effect during seed germination process. We will be using *Arabidopsis thaliana* seeds for this lab. *Arabidopsis thaliana* is a small flowering plant that is widely used as a model organism in plant biology. It is a member of the mustard family and it offers important advantages to basic genetics and molecular biology. It can easily grow in the laboratory, ability to self-fertilization.



Fig 2 Adult *Arabidopsis thaliana* plant⁰⁶



Fig 3 Diagram of the germination of *Arabidopsis thaliana* seeds⁰⁷

Goals: To observe growth of plant in different environment (Epigenetics effect)

Mini lesson: In this lab students will start with *Arabidopsis thaliana* seeds and observe its germination. See Appendix 5 for procedure and lab sheet. Students will record results in observation sheet and analyze the data. Observation data sheets are provided.

Lab Analysis Questions

1. Why did one type of plant grow better than the other?
2. How does this show epigenetic changes?
3. Which one grew the best?
4. Did epigenetic work here?
5. What are some ways to improve this lab?

Assessment

Day 5: Review and Assessment (See Appendix 6)

Students will be assessed both formally and informally. Informal assessments will be exit tickets and lab data sheets. The exit tickets and finished lab sheets help determine the level of understanding and the adjustments that need to be made prior to proceeding to the next concept. Students will be assessed with the lab report and discussion sheets. At the end of this unit students will do a unit test.

Appendix 1

North Carolina Essential Standards:

5.L.3.1 Students know that the life processes and species characteristics that define a population will be transmitted from parent to offspring. Students also know that these processes and characteristics cover a broad range of structures, functions and behaviors that can vary substantially from individual to individual.

5.L.3.2 Students know some likenesses between parents and children are inherited. Other likenesses are learned from parents or within the community (population/culture). Students know that in order for offspring to resemble their parents there must be a reliable way to transfer genetic information from parent to offspring. Students can be encouraged to keep lists of characteristics that animals and plants acquire from their parents, things that they don't, and things that the students are not sure about either way. This is also the time to start building the notion of a population whose members are alike in many ways but show some variation.

Appendix 2

Day 1

Vocabulary Knowledge

Gene: The set of information that controls a trait; code in the DNA.

Alleles; The different forms of a gene.

Heredity; The passing of traits from parents to offspring.

Trait: A characteristic that an organism can pass to offspring through genes.

Dominant: An allele whose trait always shows up in the organism when it is present.

Recessive: Trait of an organism that can be masked by the dominant form of a trait

Genotype: Refers to the genetic makeup of an organism;

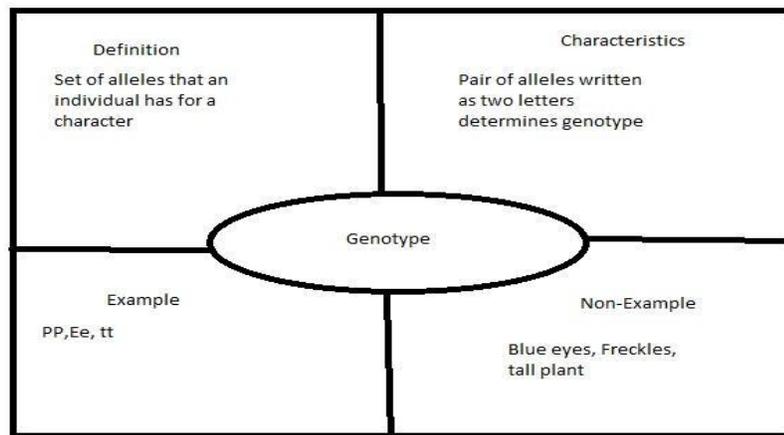
Phenotype: Observed expression of an organism (ex. blue eyes)

Chromosome: a threadlike strand of DNA that carries genes

DNA (Deoxyribonucleic acid) A long linear polymer found in the nucleus of a cell and formed from nucleotides and shaped like a double helix; associated with the transmission of genetic information

Epigenetics: the study of heritable changes in gene expression ,that do not involve changes to the underlying DNA sequence

Activity 1: Frayer Model: [Frayer Model Activity](#)



Activity 2 Discovery Education Vocabulary Animations {08}

[Traits](#)

[Genetics Traits](#)

[Inherited genetic traits](#)

Appendix 3

Activity 1: Extraction of DNA from strawberries

DNA is found in the nucleus of our cells and it carries our genetic code. Normal human DNA are considered diploid, meaning they have two copies of each chromosome. Strawberries are an excellent source of DNA because they are octoploid, meaning they have eight copies of each chromosome! In this lab, you will be working with a partner to break open strawberry cells and separate the DNA using a chemical procedure.

Lab Expectations:

- Students will use all classroom safety practices during the lab.
- Students will NOT eat the lab. If you do, you will go straight to the office and will receive a zero for today's lab.
- Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.
- Keep your hands to yourself and focus on your own lab.

Materials:

- 1 Strawberry
- 1 Ziploc Bag
- Dawn dish soap
- Salt
- Water
- 1 Coffee Filter
- Rubbing Alcohol
- 1 Plastic Cup
- 1 Toothpick

Procedure:

- Place one strawberry in a Ziploc bag. Press the air out and seal it
- Carefully squish the strawberry for two minutes until it has turned into mush
- Add a few squirts of Dawn dishwashing soap, a small pinch of salt, and a half a cup of water
- Mash again for one minute
- Filter through a coffee filter into a plastic cup. Make sure nothing falls out of the filter!
- When done filtering, throw out the filter and what is in it. Keep what is left over in the plastic cup
- Slowly pour about 150ml of cold rubbing alcohol into a clear cup
- You should see the DNA rise up out of the solution and float to the top. Spool the DNA on your wooden toothpick to examine it
- Clean up your lab area up with a paper towel. When you are finished drawing your DNA, throw out everything.

Data/Results:

Draw a picture of what your strawberry DNA looks like below!

Was this picture like your pre-lab drawing or explanation of what DNA looks like?

If your answer was "No" what was different about your drawing?

Conclusion Questions:

1. Where is DNA found inside of a cell?

2. What the function/job of DNA?

3. What is the purpose of soap in this lab?

4. What is the purpose of the alcohol?

5. Do strawberries have more or less chromosomes than a human? Explain.

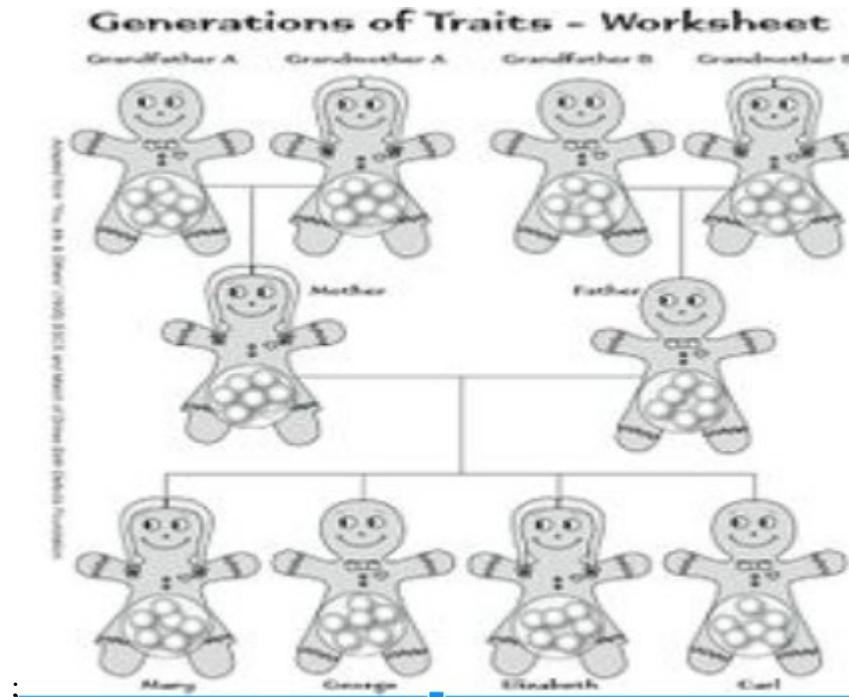
Communicate With Your Partner:

1. Why might we not use this process to see the chromosomes in human cells?

2. Since strawberries have DNA, when you eat other foods, such as fruits, veggies or meat, are you also eating the food's DNA?

Appendix 4

1. [Generations of Traits](#)



2. Human Traits Survey Labs: In this investigation, students will take an inventory of their observable traits and compare these to the observable traits of their classmates.

<http://www2.mbusd.org/staff/pware/labs/HumanTraits.pdf>

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Appendix 5: Seed Germination

In this activity students will follow this procedure with the help of their teachers.

Data Procedure Sheet:

Name:	Date:
Control Group (No treatment)- Grow this batch with regular conditions and no treatment)	
Treatment Group 1 (Salt Water)- Grow this batch with regular conditions EXCEPT using salt water	
Treatment Group 2 (High Temperature)- Grow this batch with regular conditions EXCEPT at a higher temperature	
Treatment Group 3 (Dark)- Grow this batch with regular conditions EXCEPT in the dark without light	

Data Observation Table After their lab students will observe and record results.

An electronic version of this data sheet can be found here:

https://drive.google.com/open?id=1pg_2WZHIpYHRxytrQDW0lkijbefB6dNI

Salt Water

Control	
Treatment Group 1	

High Temperature

Control	
Treatment Group 2	

Dark

Control	
Treatment Group 3	

Appendix 6

1. Review Bingo Game

https://learn.genetics.utah.edu/content/basics/activities/pdfs/Traits%20Bingo_Public.pdf

2. Formal unit Assessment: After finishing this unit students will attempt unit test.

<https://drive.google.com/open?id=1re8nrXSOR7hb3FT03X7tvOfTTViBn1j5>

Teacher Resources:

This site has all the necessary resource for teachers

<http://elementaryscience.cmswiki.wikispaces.net/Elem%20SA%205th%20Grade>

CMS Science Wiki:

<http://elementaryscience.cmswiki.wikispaces.net/home>

North Carolina Essential Standards Resource Guide

<http://www.nsta.org/about/positions/elementary.aspx>

<http://elementaryscience.cmswiki.wikispaces.net/file/view/2017%20Revised%205th%20Grade%20Science%20Resource%20Guide-1.pdf/617064765/2017%20Revised%205th%20Grade%20Science%20Resource%20Guide-1.pdf>

Flocabulary <https://www.flocabulary.com/unit/inherited-acquired-traits/>

Reading Materials for Teachers

[DNA Methylation in Mammals](#): DNA methylation is essential to healthy mammalian development and function.

[DNA Methyltransferases](#) DNA methyltransferases represent the key enzymes in such modification of the DNA, which is involved in gene transcription control, maintenance of genome stability and parental imprinting.

[DNA Methylation in Bacteria](#) The process of DNA methylation, one of the essential mechanisms in mammalian development and function, also plays an important role in the virulence and survival of bacteria.

www.learn.genetics.utah.edu): This website has all the resource you need to teach your students about genetics.

Books for Teachers

The Epigenetics Revolution: How Modern Biology Is Rewriting Our Understanding of Genetics, Disease, and Inheritance

The Gene; An Intimate History By Siddhartha Mukherjee

Art Notebook to accompany Genetics: From Genes to Genomes 2nd Edition

Nutrition and Epigenetics (Oxidative Stress and Disease Book 35) 1st Edition

Genetics Isn't Everything: How to Make Your 'G-e-n-e-s' Fit You by Katherine .S Egan

Students Resources

Reading Resource

Parents and offspring reading passage for students

https://gtm-media.discoveryeducation.com/videos/DSC/data/Similarities-of-Parents-and-Offspring_G3_W_D_W_CD.p

The Practical Guide to the Genetic Family History Book by Robin Bennett

Videos

Brainpop videos and activities are very good resource for students. This website has 4-5 minutes video and also has quizzes. <https://www.brainpop.com/science/cellularlifeandgenetics/heredity/>

This website has science games, Diagrams and activities.

<https://www.neok12.com/Genetics.htm>

This website is very helpful for deep understanding in this content.

<https://www.khanacademy.org/science/high-school-biology/hs-classical-genetics/hs-introduction-to-heredity/v/introduction-to-heredity>

Bibliography

"Crystal Lombardo." August 30, 2017. Accessed October 21, 2018.

<https://vittana.org/27-unhealthy-school-lunches-statistics.->

This website is recommended for unhealthy school lunch statistics.

Genetic Science Learning Center. "Learn.Genetics." Learn.Genetics. August 7, 2018. Accessed November 28, 2018. <https://learn.genetics.utah.edu/>.

This resource is in teacher's background knowledge on basic concepts of genetics and epigenetics.

"University Of Washington." UW Homepage. Accessed October 21, 2018.

<http://www.washington.edu/>.

This website explains how DNA, Genes and Chromosomes are the building blocks of inheritance.

"Epigenetics: Fundamentals, History, and Examples." What Is Epigenetics? Accessed October 21, 2018. <https://www.whatisepigenetics.com/fundamentals->

This website has basic concept of epigenetics fundamentals.

"What Is DNA Methylation?" Robertson, Sally. News-Medical.net. August 23, 2018. Accessed November 11, 2018. [https://www.news-medical.net/life-sciences/What-is-DNA-](https://www.news-medical.net/life-sciences/What-is-DNA-Methylation.aspx)

[Methylation.aspx](https://www.news-medical.net/life-sciences/What-is-DNA-Methylation.aspx).

This site gives you the basic knowledge of DNA Methylation.

Fig 1 "Arabidopsis Thaliana." Wikipedia. November 04, 2018. Accessed November 11, 2018.

https://en.wikipedia.org/wiki/Arabidopsis_thaliana-

This site only has Arabdopsis Thaliana image.

Fig 2

[https://upload.wikimedia.org/wikipedia/commons/a/af/Different_stages_of_seed_germination\(Arabidopsis_thaliana\).jpg](https://upload.wikimedia.org/wikipedia/commons/a/af/Different_stages_of_seed_germination(Arabidopsis_thaliana).jpg).

Discovery Education Vocabulary Animation Sign in | Discovery Education. Accessed November 12, 2018.

<https://app.discoveryeducation.com/learn/signin?next=https://app.discoveryeducation.com/learn/player/0c51e5ce-9195-42f0-b3a7-2a84be99b6c1>.

This DE site has animation for each vocabulary words which are used in this curriculum unit.

Endnotes:

- ¹Lombardo, Unhealthy school lunches statistics, 2
- ².Learn genetics, A DNA molecule, 5
- ³.Gene Expression and Epigenetics, 7
- ⁴.Epigenetics Fundamentals, 7
- ⁵.Robertson, DNA methylation, 8
- ⁶.Arabidopsis thaliana plant, 13
- ⁷.Arabidopsis thaliana seeds germination, 13
- ⁸.Discovery education vocabulary animations, 16