Investigating Genetic Traits

A lesson plan arranged by:

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Submitted in partial fulfillment of the requirements of EDI 432 – Secondary Science Practicum

Grand Valley State University

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INTRODUCTORY INFORMATION

- Grade: 9th (32 Students/Class)
- Class: STEM Biology (Innovation Central High School)
- Time Allotted: 2 days (55 minutes/day)

OUTLINE OF LESSON

- Day 1: Engage, Explore, Explain
- Day 2: Explain, Elaborate/Extend, Evaluate

STANDARDS

High-School Content Expectations

- L4.p2A Explain that the traits of an individual are influenced by both the environment and the genetics of the individual. Acquired traits are not inherited; only genetic traits are inherited.
- B4.1c Differentiate between dominant, recessive, codominant, polygenic, and sex-linked traits.

Next Generation Science Standards

- *This lesson does not apply to any Next Generation Science Standards.*

Standard Connections to Lesson

The HSCE standards that will be addressed in this lesson are L4.p2A and B4.1c. L4.p2A will be addressed in the explain activity. Students will learn about the difference between acquired traits and inherited traits. They will be shown a trait and be asked to identify if it is an acquired trait or an inherited trait. In this portion of the lesson, we will also discuss how the environment can influence traits. The B4.1c standard will be addressed throughout the entire lesson. Students will first discover that some traits are more common than others through PTC taste test. They will analyze the results and they will start to develop ideas as to why a larger percent of the classroom population were PTC tasters vs. Non-tasters. Afterwards, we will begin to discuss what dominant and recessive traits are in the explain portion of the lesson and students will learn how to differentiate between the two. After the explain portion, students will apply the knowledge they learned from the explain activity and complete a dominant and recessive traits worksheet.

NATURE OF SCIENCE (NOS)

Science produces, demands, and relies on empirical evidence.

This NOS concept will be addressed in my lesson during the explore activity. Students will be completed a PTC genetic taste test to determine if they have the ability to taste the chemical PTC or not. As a class, we will collect data from each student and create a graph comparing PTC tasters to non-tasters. We will discuss what we see from the data and students will have to use the evidence collected to develop a conclusion. Overall, through this activity, students will be collecting and using evidence to write a Claim, Evidence, Reasoning (CER) conclusion. Through this explore activity, I hope to have studnets focus on making conclusions from the evidence in regards to traits being more prevalent than others and creating a discussion leading into dominant and recessive traits. Through this, I also hope to focus on showing students that science relies on empirical evidence because they cannot write a conclusion without scientific evidence.

OBJECTIVIES

1. Students will be use evidence collected as a class to develop a conclusion about the ability to taste PTC as a dominant or recessive trait.
2. Students will be able to explain the difference between the terms dominant and recessive traits.
3. Students will be able to explain the difference between phenotype and genotype.
4. Students will be able identify homozygous dominant, homozygous recessive, and heterozygous dominant.
5. Students will be able to devise the phenotype and genotype of an organism.
6. Students will be able explain how the environment can influence traits.
7. Students will able to identify acquired and inherited characteristics.

REQUISITE KNOWLEDGE

Students will have had an introductory lesson to heredity and genetics. Students will have discussed where their traits come from and know the difference between DNA, chromosomes, and genes. Students will also have learned about Gregor Mendel and his pea plant experiments. They will have been introduced to his three laws, (1) Law of Dominance, (2) Law of Segregation, (3) Law of Independent Assortment.

SAFETY CONSIDERATIONS AND PRECAUTIONS

There are minimal safety concerns in this lesson. Students will be tasting PTC genetic taste testing strips. These are harmless, but students should not chew or swallow the testing strips. The teacher needs to make sure that students understand that.

SCIENTIFIC BACKGROUND

Heredity is the passing of traits from parents to offspring. Each offspring has an unique set of traits. Traits are characteristics that an organism has. For instance, there are physical traits which are the characteristics of how one looks (height, eye color, hair color). There are also behavioral traits, which are characteristics of how one acts. Additionally, traits can also be something that cannot be seen, such as blood type. A trait can also be something you can do, such as playing soccer or volleyball. These traits can be acquired or inherited. Acquired traits are traits that are not acquired from genes. Therefore, they cannot be passed on to the next generation. For instance, an acquired trait could be skills acquired through playing a sport. Inherited traits are traits that are passed on from generation to generation. For example, a child can inherit blue eyes from his or her parents. Inherited traits can either be dominant or recessive and are determined by the set of alleles present for a particular gene. Dominant traits often mask recessive genes and thereby prevent the recessive gene from being shown in the phenotype of the individual. In genetics, in determining the genotype of an individual, dominant alleles are expressed using capital letters, while recessive alleles are expressed using lower case letters. Recessive traits sometimes determine what the offspring will look like. When an individual has two recessive alleles for a particular gene, then the recessive trait will be shown. Yet, if there is only one recessive allele and one dominant allele, the dominant allele will be displayed. Moreover, if an individual has two dominant allele then the individual will also display the dominant trait. It is important to remember, that each individual has two alleles that make up a particular gene that codes for a specific trait. On the next page there is a list of important vocabulary terms for this lesson.

SCIENTIFIC BACKGROUND VOCABULARY

Terms	
Gene	A segment of DNA on the chromosome that codes for a particular trait.
Allele	Different forms of a gene or the different possibilities for the same trait.
Phenotype	An individual's physical appearance resulting from gene make-up
Genotype	Combination of genes an organism
Dominant Allele	Produces the same phenotype whether its paired allele is identical or different
Recessive Allele	Produces its characteristic phenotype only when its paired allele is identical
Homozygous	Having identical pairs of genes for any given pair of hereditary characteristics
Heterozygous	Having dissimilar pairs of genes for any hereditary characteristic

MISCONCEPTIONS

The language used in a genetics unit can often be trouble for many students. In this lesson, students will learn about dominant and recessive traits. There are many misconceptions in relation to dominant traits due to prior ideals about the term "dominance". Therefore, it is important to be aware of student misconceptions when teaching this unit and to address these misconceptions. Some misconceptions students may have regarding this lesson are listed below.

1. A dominant trait is 'stronger' and 'overpowers' the recessive trait (Allchin, 2005).
2. A dominant trait is more likely to be inherited (Allchin, 2005).
3. A dominant trait is more prevalent in the population (Allchin, 2005).
4. 'Wild type' traits are inherently dominant, while mutants are recessive (Allchin, 2005).
5. Male or masculine traits are dominant (Allchin, 2005).

DIFFERENTIANTION

Differentiation in this lesson includes multiple instructional techniques that incorporate both multiple intelligences and universal design techniques. In this lesson, students will watch a short video clip. This aims to generate student interest and applies to visual learners. In the explore portion of the lesson, students will explore dominant traits via PTC taste test. This activity will benefit kinesthetic learners, as well as, interpersonal learners because the activity allows the students to work in groups and move around. This section of the lesson will also apply to logical/mathematical learners because we will be graphing data collected from the PTC taste test. In the explain section there will be a lecture with integrated class discussion which will provide students the opportunity to answer questions and apply the knowledge they are building through the lesson. Verbal linguist students are often students who love to talk and therefore by asking questions in the presentation it will be beneficial to those students. Also, in the explain section students will complete a vocabulary assignment. This vocabulary assignment will help students become familiar and understand the vocabulary related to this lesson. The vocabulary assignment is a graphic organizer and will be beneficial to all learners, especially since many of my students struggle with vocabulary. The elaborate section asks students to apply what they learned in the other sections of the lesson. In this activity, students can work alone or in pairs, thus benefitting both intrapersonal and interpersonal learners. Overall, this lesson provides differentiation via multiple intelligences and universal design.

5E LESSON

BELL RINGER ACTIVITY/PRE-ENGAGE (5 minutes)
Each day when students enter the classroom prepared to learn. The teacher will greet the students as they enter. The students will retrieve their organized binders from the designated locations. Once the classroom bell rings, the teacher will begin the day by welcoming the students to class, stating the daily objectives, and discussing the agenda. After this is complete, the teacher will instruct the students to complete warm-up activity if applicable.

ENGAGE (5 minutes)		
I. Overview and Objectives	The lesson will begin by having students watch a 2-minute video clip from YouTube. This video will highlight different traits. There is no objective specifically for this portion of the 5E. The goal of the engage section of this lesson is to generate student interest for the lesson.	
II. Materials and Set-Up	**Materials** ▪ Computer ▪ Projector w/Whiteboard or Smart Board ▪ Internet Access ▪ Video Links: ▪ http://www.youtube.com/watch?v=9SdCoNpDzqw	**Set-Up** Make sure that the computer, projector and internet are working properly prior to the beginning of class.
III. Procedure **PowerPoint (SLIDES1-2)**	Once the warm-up activity is completed, follow this procedure. 1. Explain to the student that they are going to watch a short video clip. 2. Go to http://www.youtube.com/watch?v=9SdCoNpDzqw. 3. Allow the video to load and press the play button. 4. Ask the students to reflect on the video clip and pose the following question: "What does that video illustrate?" "Why are we so different from each other?" 5. Call on 2-3 students to share their answers. 6. After the students share, transition to Explore Activity by stating that we will be looking at a specific trait in today's activity.	
IV. Assessment	The assessment for this portion of the lesson will be observation. The teacher will assess student engagement based on their willingness and effort to share their thoughts about the video.	

EXPLORE (40 minutes)	
V. Overview and Objectives	Students will use PTC genetic traits taste testing strips to explore dominant and recessive traits. Students will collect evidence in terms of the number of individuals who have the ability to taste and the number of individuals who lack the ability to taste. As a class, the students will analyze the data, make observations comparing the PTC tasters to the non-tasters, and create a graph illustrating the collected data. To conclude this portion of the 5E students will write a conclusion using Claim, Evidence, and Reasoning format. ✓ Objective: Students will be use evidence collected as a class to develop a conclusion about the ability to taste PTC as a dominant or recessive trait.

<table>
<tr>
<td>VI. Materials and Set-Up</td>
<td>Materials
▪ Computer
▪ Projector w/Whiteboard or Smart Board
▪ PowerPoint Program
▪ “Investigating Genetic Traits PowerPoint Presentation”
▪ Genetic Traits Taste Testing Strips (PTC) (1 strip per student)
▪ 1 Plastic Sandwich Bags (For every two students)
▪ Sticky Notes (1 per student)
▪ “CER Conclusion Exit Ticket”
▪ Wintergreen Mints

Notes:
– Plastic bags, mints, and sticky notes can be purchases from Meijer’s or Walmart.
– PTC Stripes can be purchases from www.fishersci.com (Catalog No. S85287A – Pack of 100 $4.20)

Fisher Scientific</td>
<td>Set-Up
The day before the lesson, be sure to complete the following tasks.
1. Place two PTC taste-testing strips into a plastic sandwich bag. (One bag will be disrupted for every two students).
2. Copy “CER Conclusion Exit Tickets” (1 per student)
3. Make sure computer and SmartBoard are working properly.</td>
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<tr>
<td>VII. Procedure

PowerPoint (SLIDES 3-8)</td>
<td colspan="2">1. Hand out plastic sandwich bags containing two PTC testing strips to each table. *Note: Each student will need a PTC testing strip, so accommodate if students are not arranged at tables in groups of two.
2. The teacher will then explain to the students the task they are going to complete using the PTC strips. The following dialogue can be used.
i. Teacher: “These paper strips have small amounts of the chemical PTC spotted onto them. Small amounts of PTC are harmless to humans.
ii. Teacher: “Remove one strip from the vial and place it on your tongue. Hold it there for a few seconds. Allow it to get wet, but do not chew it or swallow it. Discard the paper into the plastic sandwich bag that is now empty (after removal of PTC strips) on your table.”
iii. Teacher: “Once you have discarded your paper, you may retrieve a piece of candy and a sticky note from the designated location. And upon returning to your seat, write down on the sticky note what the paper tasted like.”
3. Once the students have written on their sticky notes, students will put sticky notes on the SmartBoard in the designated columns (Bitter or Tasteless) that match the description they wrote down.
4. Next, the class will discuss what they observe from analyzing the amount of sticky notes in each column and create a graph illustrating PTC Tasters vs. Non PTC Tasters.</td>
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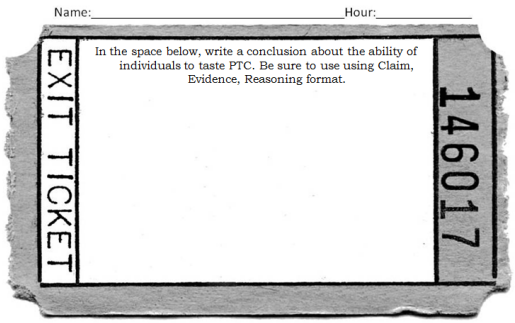
PowerPoint (SLIDES 3-8)	5. After graphing, the teacher will pose the following questions and students will respond. The teacher will continue discussing after student responses (see below). ▪ Teacher: What does the graph tell us? ▪ Student(s): Some people can taste PTC, some can't. More people can taste it than can't. ▪ Teacher: Yes. We vary in our ability to taste PTC. Why do you think some people taste PTC and other people can't? What could account for this variation? ▪ Student(s): An inherited difference, they got it from their parents, people who can't taste PTC have dulled their tastebuds with spicy foods. ▪ Teacher: This variation in our ability to taste PTC is based on our genes (genetic makeup). We do get our ability to taste PTC from our parents. The ability to taste PTC is considered a dominant trait, while the inability to taste PTC is a recessive trait, which we will discuss the different between shortly. ▪ Additional Dialogue: If students wonder why we even have the PTC tasting trait. This can be discussed now or after more genetic traits have been introduced. Scientists don't know for sure why humans have a PTC tasting trait, but they do have some ideas. If you have already covered evolution and natural selection in your classroom, students will understand that the PTC tasting trait may have been helpful long ago when humans were hunter-gatherers. What if a person put a poisonous leaf or root in his mouth? Would it help him survive if it tasted bitter to him and prompted him to spit it out? 6. Have students write a conclusion using Claim, Evidence, Reasoning (CER) technique regarding PTC tasters & Non-tasters. Be sure to discuss CER method of writing conclusions before having students write their conclusions. 7. Collect conclusions, and then transition to the explain section of the 5E lesson discussing traits being dominant or recessive.
VIII. Assessment	The teacher will assess students on their ability to develop conclusions using evidence (data) collected as a class on the number of students who were PTC tasters and the number of students who were non-tasters. Each student will be required to write down a conclusion on an Exit Ticket using Claim, Evidence, and Reasoning technique.  Name:_____Hour:_____ EXIT TICKET In the space below, write a conclusion about the ability of individuals to taste PTC. Be sure to use using Claim, Evidence, Reasoning format. 146017

<table>
<tr><th colspan="3">EXPLAIN (40 minutes)</th></tr>
<tr><td>I. Overview and Objectives</td><td colspan="2">The “Explain” portion of the lesson will be an interactive PowerPoint lecture about Genetic Traits. It will cover the topics of Dominant vs. Recessive, Phenotype vs. Genotype, and Homozygous vs. Heterozygous. Students will participate through class discussion about the PowerPoint and practice questions embedded in the presentation. Students will complete a vocabulary exercise to help them in understanding the language of the content.
✓ <u>Objective:</u> Students will be able to explain the difference between the terms dominant and recessive traits.
✓ <u>Objective:</u> Students will be able to explain the difference between phenotype and genotype.
✓ <u>Objective:</u> Students will be able identify the notation for homozygous dominant, homozygous recessive, and heterozygous dominant.
✓ <u>Objective:</u> Students will be able to devise the phenotype and genotype of an organism.
✓ <u>Objective:</u> Students will be able explain how the environment can influence our traits.
✓ <u>Objective:</u> Students will able to identify acquired characteristics and inherited characteristics.</td></tr>
<tr><td>II. Materials and Set-Up</td><td>Materials
▪ Computer
▪ Projector w/Whiteboard or SmartBoard
▪ PowerPoint Program
▪ “Investigating Genetic Traits” PowerPoint Presentation
▪ “Genetic Traits Vocabulary” handout</td><td>Set-Up
▪ Make sure that the computer, projector and internet are working properly prior to the beginning of class.</td></tr>
<tr><td>III. Procedure

PowerPoint (SLIDES 9-35)</td><td colspan="2">1. Open PowerPoint program and select the file labeled “Understanding Genetic Traits PowerPoint Presentation”
2. Begin presentation. Allow students to ask questions during the presentation and pose questions to them as well.
3. Once presentation is complete, hand out “Dominant & Recessive Vocabulary” handout
4. Explain the task the students are to complete with the vocabulary handout.
5. Proceed to Elaborate/Extend section.</td></tr>
<tr><td>IV. Assessment</td><td colspan="2">The teacher will assess student understanding through observation and participation in PowerPoint presentation. In addition, the PowerPoint presentation will contain embedding “Checkpoints”. These checkpoints will allow the teacher to assess student understanding of content taught. After the presentation, students will also complete a vocabulary exercise. The following terms will be addressed in the exercise: dominant, recessive, gene, allele, homozygous, heterozygous, phenotype, and genotype.</td></tr>
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ELABORATE/EXTEND (15 minutes)			
I.	**Overview and Objectives**	In this portion of the lesson, students will complete a worksheet where they will apply what they have learned about recessive and dominant alleles and determine the phenotype and genotype in a particular case. ✓ Objective: Students will be able to identify homozygous and heterozygous traits, as well as dominant and recessive traits. ✓ Objective: Students will be able to practice writing genotypes and phenotypes. ✓ Objective: Students will be able to label a set of alleles as homozygous dominant, homozygous recessive, and heterozygous dominant.	
II.	**Materials and Set-Up**	Materials ▪ "Genetics Practice Problems Set #1" handout ▪ Genotype and Phenotype Quiz	Set-Up ▪ Make copies of the handout. Be sure to have a copy for every student.
III.	**Procedure**	1. Explain to the students that they will be practicing identifying dominant and recessive traits, homozygous and heterozygous traits, and phenotypes and genotypes. 2. Hand out worksheet and allow the students to begin working. 3. While, the students are working the teacher will observe the students and assist when needed.	
IV.	**Assessment**	Students will be assessed via a Quiz. After completing the practice worksheet, students will take a quiz to determine their level of understanding of the content.	

EVALUATE	
Location of Assessment	**Description of Assessment**
Engage (Page 4)	In this section of the 5E lesson, the teacher will evaluate student engagement based on observation. After showing the video clip the teacher will ask questions and assess student engagement based on their willingness and effort to share their thoughts about the video.
Explore (Page 4-6)	Students will be evaluated in this section of the 5E lesson plan via participation in the explore activity. As a class we will collect data, graph the data, and discuss what the graph is illustrating. The teacher will make observations about student responses. This section also has an assessment for NOS (see below).
Explain (Page 7)	Students are evaluated in this section of the 5E lesson plan via checkpoints in the PowerPoint Presentation. During the presentation students will be asked to take out a sheet of paper and answer some questions that will help the teacher check for understanding. The teacher will collect the student's answers at the end of the presentation to analyze and assess student understanding of content taught. If additional instruction is needed, the teacher will plan to make accommodations within the unit.
Elaborate/Extend (Page 8)	Students are evaluated in this section of the 5E lesson by completion of their Genetics Practice Problems Set #1 and by taking a quiz.
NOS Assessment	Science produces, demands, and relies on empirical evidence. The assessment for this NOS concept will be a exit ticket that students have to use to write a conclusion using evidence collected from the explore activity. Students will be required to write their conclusions in Claim, Evidence, Reasoning format. The teacher will analyze the students conclusions using CER conclusion rubric.

SUPPORTING MATERIALS

The following support materials are included.

- Video Link: http://www.youtube.com/watch?v=9SdCoNpDzqw
- Worksheets/Handouts/Assessments:
  - CER Conclusion Exit Ticket
  - Investigating Genetic Traits PowerPoint Presentation
  - Genetic Traits Vocabulary
  - Genetics Practice Problems Set #1
  - Genotype and Phenotype Quiz
  - CER Conclusion Rubric

REFERENCES

1. Allchin, D. (2005). The dilemma of dominance. *Biology and Philosophy, 20*(2-3), 427-451.

2. Brown, M. (2010). *State Your Traits: Basic Principles of Inheritance (High School Level)* [PDF]. Retrieved from https://gsoutreach.gs.washington.edu/files/statetraitshs2.pdf.

3. No Author. (n.d.). *Genetics Practice Problems Worksheet* [Word document]. Retrieved from http://www.ops.org/HIGH/BURKE/LinkClick.aspx?fileticket=LzaOQbjSpVk%3D&tabid=213.

4. No Author. (n.d.) *Genotype and Phenotype Practice* [Word document]. Retrieved from http://www.wsfcs.k12.nc.us/cms/lib/NC01001395/Centricity/Domain/849/genotype_and_phenotype_practice.doc.

5. Sherman, K. (2012). *Genetics-5E Lesson Plan Sherman* [Word document]. Retrieved from https://quigleysciencestandards.wikispaces.com/file/view/Genetics-5E+lesson+plan+Sherman.doc.

SELF-ASSESSMENT

Using the rubric for EDI 432 to evaluate lessons, I have evaluated this lesson. My self-evaluation is attached.

DATA-SUPPORTED REFLECTION

To be completed at a later date (within 7 days after instruction).