Hands-on Genetics Activity

Topic: Junior Genetic Counselor

Learning Objective: Students will learn of a career in genetics. Using knowledge from the previous two days about mendelian genetics and pedigrees, students will be set on a challenge to help a family identify genetic traits in the family and suggest preventative steps

Alignment with NGSS Grades 3-5

Science and Engineering Practices

Analyzing and Interpreting Data

- Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.
- Analyze and interpret data to make sense of phenomena using logical reasoning.

Disciplinary Core Ideas

LS3.A: Inheritance of Traits

- Many characteristics of organisms are inherited from their parents.

LS3.B: Variation of Traits

- Different organisms vary in how they look and function because they have different inherited information.

Materials: Pencils (114, Shelf), Extra paper, Copies of Clues/Information, manila folders

Describe the activity in detail and how it will work toward an understanding of the learning objective:

First students will learn what a genetic counselor does and will become junior genetic counselors. Students will pair up and receive a case file about a family wondering what genetic disease their child has. Students will make a pedigree based on the family information given (worksheet). From there, they will decide if the disease is dominant or recessive. Then they will be given a list of genetic diseases based on it being dominant and recessive, and what those diseases do (additional handout, only provide either dominant or recessive depending on group decision). From there they decide on the disease. Once the group has decided on diseases, each pair will say what disease they think it is and why at a “conference”.

How will you conclude the lesson to enforce the learning objective?

By having pairs discuss with one another to identify the correct disease.

What science process skills will this lesson exercise?
Observing, Inferring, Classifying, Predicting, Acquiring Data, Analyzing Data

Safety precautions: None

Board Notes
What is a genetic counselor?

- A genetic counselor is a healthcare professional with specialized training in medical genetics and counseling. Genetic counseling is a process to evaluate and understand a family's risk of an inherited medical condition/disease.

What is a genetic disease/disorder?

- A genetic disorder is a disease that is caused by a change, or mutation, in an individual's DNA sequence. Sometimes specific diseases can be passed along in families. They can be dominant or recessive.

Worksheet Directions:
You and your partner(s) will be pretending to be genetic counselors. With this scenario, your group will help a family determine what genetic disease is in their family by making a pedigree (family tree that marks the trait) and using your manual. Each group will then report their findings to the class. If groups disagree on the disease, then all of you will discuss together.

Case:
A family comes in to discuss the chances of having a genetic disease. They need your help to determine if it's something to worry about, and they want to know what it is. You ask the family questions to learn more about their family history over three generations.

First, you need to make a pedigree and highlight those in the family that are sick. The family tells you the following information.

- The two parents (Susan and John) are married and have kids. Susan, the mother, is sick, but John, the father, is not. They have four children, 2 boys and 2 girls. One boy and one girl are sick. Both the sick boy and girl have problems controlling their muscle movements.
- Susan has four other siblings, three brothers and one sister. Her sister and one brother are sick. Susan believes they have problems with their emotions.
- Her sick brother is married to someone that's not sick and they have four children, two boys and two girls. One girl is sick and one boy is sick.
- Susan's brother that is not sick is also married to someone who is not sick. All four of their children are healthy, three girls and one boy.
- Susan's mom was healthy, but her father was not. He had trouble with thoughts.

Draw your pedigree below:

Based on the pedigree your group drew, do you think the trait dominant or recessive? Why?

Now tell Ms. Caitlin if you think the disease is dominant or recessive. She will give your group a manual based on your choice.

Reading the manual, what disease do you think is present in the family. Why?

Wait for the rest of the class to be finished so that we may compare results.

Dominant Genetic Disorders

- Osler-Weber-Rendu Syndrome
    - A genetic blood vessel disorder that often leads to excessive bleeding.
- Marfan's Syndrome
    - A disorder that affects the connective tissue in many parts of the body. The two primary features of Marfan syndrome are vision problems and defects in the large blood vessel that distributes blood from the heart to the rest of the body.
- Tuberous Sclerosis
    - Characterized by the growth of tumors in the body. These tumors can occur in the skin, brain, kidneys, and other organs. Symptoms include patches of unusually light-colored skin, areas of raised and thickened skin, and growths under the nails. It often affects the brain, causing seizures, behavioral problems such as hyperactivity and aggression, and intellectual disability or learning problems.
- Huntington's Disease
    - A progressive brain disorder that causes uncontrolled muscle movements, emotional problems, and loss of thinking ability.
- Von Hippel-Lindau Syndrome
    - Characterized by the formation of tumors and fluid-filled sacs in many different parts of the body. Symptoms include headaches, vomiting, weakness, and a loss of muscle coordination. Can also occur in the light-sensitive tissue that lines the back of the eye and cause vision loss.

Recessive Genetic Disorders

- Cori’s Disease
    - People with low blood sugar and excess amounts of fats in the blood. Symptoms can include being short in height, muscle weakness, and an enlarged liver.
- Cystic Fibrosis
    - Buildup of mucus that can damage many organs. Symptoms include damage to the respiratory system and digestive system, problems with breathing, and infections in the lungs. These infections cause coughing, wheezing, and inflammation. Over time, mucus buildup and infections result in lung damage.
- Albinism
    - Affects coloring of the skin, hair, and eyes. Symptoms include having very fair skin and white or light-colored hair, and vision problems.
- Pompe’s Disease
    - Caused by the buildup of a complex sugar called glycogen in the body's cells. Symptoms include muscle weakness, poor muscle tone, an enlarged liver, heart defects, and breathing problems.
- Hartnup’s Disease
    - Caused by the body's inability to absorb certain protein building blocks (amino acids) from the diet and have difficulty producing vitamins and proteins. Symptoms include skin rashes, difficulty coordinating movements, and psychiatric symptoms (like depression).

Worksheet Answers

- The two parents (Susan and John) are married and have kids. Susan, the mother, is sick, but John, the father, is not. They have four children, 2 boys and 2 girls. One boy and one girl are sick. Both the sick boy and girl have problems **controlling their muscle movements.**
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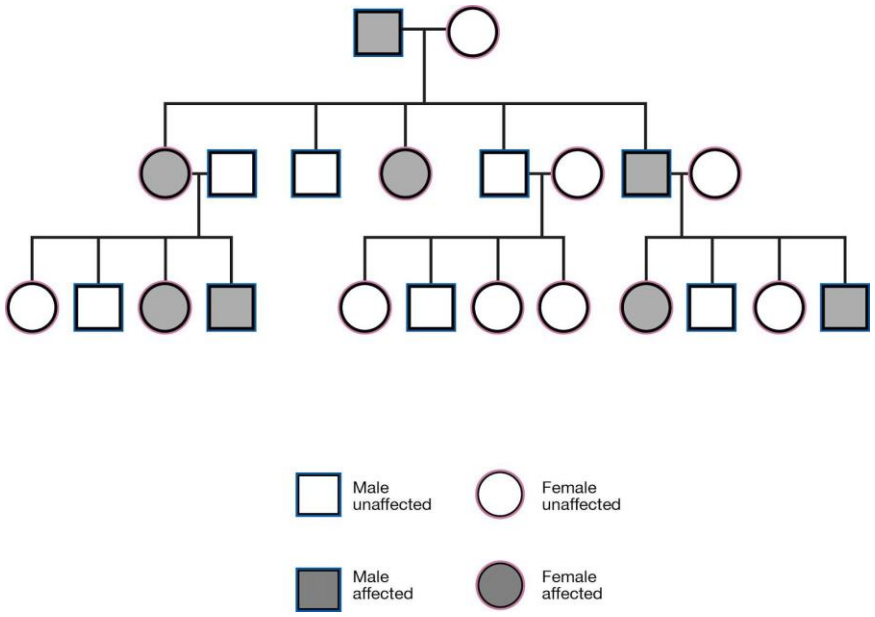

Disease: Huntington's Disease

Extra: If the mother is heterozygous and the father is homozygous recessive, what is the chance of their next child having Huntington's Disease?