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Grade level(s):10,11,12 Math, Special Ed, and Teacher's Candidate for Science

Objectives:

Students will use the graphing calculator to simulate a probability experiment.

Students will be able to compute probabilities in fraction form and then translate them into percentages.

Students will use Agent Sheets to relate probability and genetics.

Description:

Students will integrate probability through Math and genetics using Punnett Squares. Students will manipulate a probability trail with the Graphing Calculator application of a probability simulator using marbles. Students will connect marbles with homozygous and heterozygous genes. Students will communicate their trials in fraction and percentage form. Students will then manipulate Agent Sheets to understand how Punnett Squares determine Homozygous and Heterozygous genetic trait probabilities.

Procedure:

Activity #1 (Using the Graphing Calculator)

We will access prior knowledge by asking the students what they remember about probability and percentages. We will then ask them if they know the difference between Homozygous and Heterozygous traits. (We will relate it to Homosexual=same sex, same trait; Heterosexual=different sex, different trait) The students will be put into pairs and be asked to complete the graphing calculator activity below. Their answers will be recorded on an activity worksheet. (see attached)

The students will use the application button on the calculator to review probability with replacement. Throughout the activity the teachers will demonstrate and walk around the classroom, checking for understanding.

Step 1: Students will press the "APPS" Button they will then scroll down to the "Prob Sim" and then press enter. They will then choose the simulation, "Pick Marbles #3".

Step 2: Students will then set up the trials by pressing the Set Button (ZOOM). Under this menu the trials need to be set at 10, the types have to be set at 2 (for homo and hetero), and the replace has to have "yes" highlighted. Then press the OK Button (GRAPH).

Step 3: Students will then press the Pick Button (WINDOW). Once the simulation has stopped the students will then press the Table Button (GRAPH).

Step 4: On their worksheet they will pair up trail 1 with trial 2, trial 3 with trial 4, etc. AA and BB will represent a Homozygous trait and AB or BA will represent a Heterozygous trait.

Step 5: The students will answer questions on their worksheet relating to this part of their experiment.

Step 6: The students will know repeat this process but change the number of trials to 20. And then answer the questions on their worksheet related to this trial.

After the students have completed the worksheet they will turn it into the teacher to be used as an assessment.

This is the rubric for activity #1 using the graphing calculator.

CATEGORY	4	3	2	1
Mathematical Concepts	Explanation shows complete understanding of the mathematical concepts used to solve the problem(s).	Explanation shows substantial understanding of the mathematical concepts used to solve the problem(s).	Explanation shows some understanding of the mathematical concepts needed to solve the problem(s).	Explanation shows very limited understanding of the underlying concepts needed to solve the problem(s) OR is not written.

Use of Graphing Calculator	Student always listens and follows directions and only uses calculator as instructed.	Student typically listens and follows directions and uses calculator as instructed most of the time.	Student sometimes listens and follows directions and uses calculator appropriately when reminded.	Student rarely listens and often "plays" with the calculator instead of using them as instructed.
Working with Others	Student was an engaged partner, listening to suggestions of others and working cooperatively throughout lesson.	Student was an engaged partner but had trouble listening to others and/or working cooperatively.	Student cooperated with others, but needed prompting to stay on-task.	Student did not work effectively with others.
Completion	All problems are completed.	All but 1 of the problems are completed.	All but 2 of the problems are completed.	Several of the problems are not completed.

The next activity will be related to Punnett Squares.

Activity #2 (Using Agent Squares)

Prior to this activity, students have been learning about genetics. The terms that are used with this activity have been introduced through the idea of the Mendel's pea plants, basic Mendelian genetics, and the concepts associated with Punnett Squares.

The lesson will open with a review of Punnett Squares. Students will be presented with a warm-up word problem on the board. The warm-up problem is shown below. As a class, we will discuss the answer.

If your great grandfather has blue eyes and your great grandmother has brown eyes, and your grandfather has blue eyes, what is the probability that you will have blue eyes?

(The answer to the warm-up is open ended. There are a couple of facts that are missing which would be needed to answer the warm-up. This is what we want the kids to understand thru our discussion.)

Once the warm up activity has been completed, the students will be introduced to a

demonstration using agent sheets. (File attached). This simulation has been set up to show how probability in genetics will apply when the parameters are set at random. We will use the worksheet to show what would happen when there are 2 homozygous traits (either dominant or recessive) crossed, when homozygous and heterozygous traits are crossed, and when 2 heterozygous traits are crossed. Several different trials will be run side by side with the same crosses to show that there are no definite probabilities; however there is a trend that tends to occur when crossing traits.

After the simulation, there will be a class discussion where students would explain the genetic trends. They will use the model to conclude probability values for crossing traits.

Critical thinking will take place. From prior knowledge in math and science class, the students should understand the difference between theoretical probability and experimental probability. With theoretical probability, the students know all the possible outcomes and can count favorable outcomes. With experimental probability, the student conducts repeated trials of an experiment to find how frequently a favorable outcome occurs.

Below is a rubric for Activity #2

CATEGORY	4	3	2	1
Conclusion/Summary	Student provided a detailed conclusion clearly based on the data and related to previous research findings and the hypothesis statement(s).	Student provided a somewhat detailed conclusion clearly based on the data and related to the hypothesis statement(s).	Student provided a conclusion with some reference to the data and the hypothesis statement(s).	No conclusion was apparent OR important details were overlooked.
Working with Others	Student was an engaged partner, listening to suggestions of others and working cooperatively throughout the lesson.	Student was an engaged partner but had trouble listening to others and/or working cooperatively.	Student cooperated with others, but needed prompting to stay on-task.	Student did not work effectively with others.