Hardy-Weinberg Lesson

Objective: ***Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.***

Video: <https://www.youtube.com/watch?v=xPkOAnK20kw> 0:00-4:40

1. Read through the notes in red (make sure you understand all of the definitions)
2. Watch the video only until 4:40
3. Complete the practice problems on your own, then use my answers to check your work.

**Hardy-Weinberg**

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| **Term** | **Definition** |
| Allelic Frequencies  What are p and q? | how common an allele is in a population |
| Hardy-Weinberg Principle | When allelic frequencies remain constant, a population is in genetic equilibrium |
| Hardy-Weinberg Equation | * p2 + 2pq + q2 = 1 * p + q = 1 |
| Heterozygous  Ex: Hh | Organism carries both dominant and recessive alleles, but the dominant trait is expressed  (2pxq)=% that are heterozygous |
| Homozygous dominant  Ex: HH | Organism carries two dominant alleles  (p2)= % that are homo. dominant |
| Homozygous recessive Ex: hh | Organism carries two recessive alleles  (q2 )= % that are homo. recessive |

p value = \_dominant\_ allele frequency / total alleles = \_\_\_\_\_\_\_ (decimal)

q value = \_recessive\_ allele frequency / total alleles = \_\_\_\_\_\_\_ (decimal)

p + q = always equals \_\_1\_\_

**Example 1: PTC Write all highlighted things on assignment 5**

**Part 1:** **Sixteen percent** of a population is unable to taste the chemical PTC. These non-tasters are homozygous recessive for the tasting gene. q2 = 0.16

* + - 1. p= ?
      2. q=?
      3. % Homozygous recessive hh = ?
      4. % Homozygous dominant

1. What is the frequency of the recessive allele? What is q?
2. What is the frequency of the dominant allele? Hint: p + q = 1

p=? answer\_\_\_\_

**Part 2:** **FDA regulations**, all bitter-tasting and poisonous fruits have been eliminated; therefore, there is no fear about which fruits to eat. Over a period of many generations, the population unable to taste PTC has changed to **thirty-two percent hh**.

1. Make a prediction: Has the population evolved? (Yes or no?)

How do you know?

1. Calculate your new p + q values.

These are supposed to be decimals.

p=

q=

Write a concluding paragraph: Did your population evolve? Use your Hardy-Weinberg evidence from number 2 to support your answer.

Yes, this population evolved because the initial population began with 40% of the population having the recessive trait to 57% of the population having the recessive trait. This increase in numbers within a population proves that this trait is advantageous, thus increasing in frequency in a population, thus indicating evolution has occurred for that trait.

Practice problems (in your notes):

1. [I Do] Mr. and Mrs. Nemo are apart of a the larger clownfish population. Mrs. Nemo has purple stripes while Mr. Nemo has orange stripes. Purple stripes are recessive to orange stripes. 15 out of the 100 clownfish in the population have purple stripes like Mrs. Nemo.
   1. Calculate the allele frequency for the Recessive Trait.

q = Square root 0.15= 0.39 39% of the population has the recessive trait

* 1. Calculate the allele frequency for the Dominant Trait.

p + q = 1 1-0.39 = 0.61 61% of the population has the dominant trait

1. [We Do] The coral reef where the clownfish live has changed over the past 50 years. Due to new chemicals in the water, the corals are more purple, red and green in color instead of orange, white, and yellow. Now 75 out of the 100 clownfish are purple. How do we know purple is recessive?
   1. Name the variation between the clownfish. Color of clownfish
   2. Which trait would have the reproductive advantage in this new environment? purple
   3. Make a prediction: did the population evolve for this trait? (Yes or no?)
   4. Calculate your p + q values.

q = Square root 0.75= 0.87 87% of the population has the recessive trait p + q = 1 1-0.85 = 0.13 13% of the population has the dominant trait

* 1. Write a concluding paragraph: Did your population evolve? Use your Hardy-Weinberg evidence to support your answer.

Yes, this population evolved because the initial population began with 39% of them having the recessive trait to 87% of them having the recessive trait. This increase in numbers within a population proves that this trait is advantageous, thus increasing in frequency in a population, thus indicating evolution has occurred for that trait.

1. [You Do] In a population of 2,000 butterflies, sparkling wings (WW) are dominant over plain wings (ww). 500 butterflies have the recessive trait.
   1. Calculate the allele frequencies (p and q) within the population.

q = Square root 0.25= 0.50 50% of the population has the recessive trait

p + q = 1 1-0.50 = 0.50 50% of the population has the dominant trait

1. A population of 1,000 cows lives in a magical forest with blue glitter trees. 20% of the cow population is blue. The allele for blue cows is recessive (w) while the allele for white cows is dominant (W).
   1. Calculate the allele frequencies (p and q)

q = Square root 0.20= 0.45 45% of the population has the recessive trait

p + q = 1 1-0.45 = 0.55 55% of the population has the dominant trait

* 1. Describe an environmental change that would alter the allele frequencies of the cow population. The trees were cut down in the forest and the winters lasted longer than usual.

1. A population of wild mountain sheep is in Hardy-Weinberg equilibrium. The allele for white wool (W) has an allele frequency of 0.19, and the allele for black wool (w) has an allele frequency of 0.81.
   1. What does p equal? 0.19 19% of the population has the dominant trait
   2. What does q equal? 0.81 81% of the population has the recessive trait
   3. What would have to happen in the environment for the wool type to change from being mostly black to mostly white? Ice Age occurs!
   4. (Extension) With your new environmental change and a new population of sheep from number 5, write a Hardy-Weinberg problem for one of your classmates to solve. Include: how many sheep are homozygous recessive for black wool (ww)? This is your q2 value. Your classmate would have to find p and q.