PUNNETT SQUARE SCENARIOS

Activity:
Below are sample scenarios that can be used to practice making Punnett Squares and interpreting the results.

1. Tom and Tina decided they wanted to start a family. Tom knew his grandfather had sickle-cell disease. Sickle-cell disease is a recessive disorder that causes blood cells to stiffen and take on a crescent shape. These blood cells have a difficult time moving through the blood vessels and can cause health problems. Tina didn't know of any family members that had it. Still, before they got pregnant they both went to the doctor for genetic tests. The doctor found that even though Tom and Tina were healthy, they both carried the gene for sickle-cell disease. Make a Punnett Square to determine the probability of Tom and Tina's child having sickle-cell disease.

2. Some cattle are naturally hornless, a condition called "polling". Polling is dominant over the more common horned trait. A polled bull is mated with three cows with the following offspring:

Cow A (horned) = polled calf
Cow B (horned) = horned calf
Cow C (polled) = horned calf

What are the genotypes of the four parents?

3. Short hair is dominant over long hair in guinea pigs. A long-haired male guinea pig and a heterozygous short-haired female are kept in the same cage and mate numerous times, ultimately producing 32 total offspring. What is the most likely distribution of short hair and long hair among their offspring?

4. Tay-Sachs disease is due to a homozygous recessive genotype (nn). About 4% of the alleles in a given population are “n”. This means that about 96% of the alleles are “N”. Use the Punnett Square below to determine the approximate percentage of each genotype within the population.

	N =	***n*** =
N =		
n =		

PUNNETT SQUARE SCENARIO SOLUTIONS

1. Tom and Tina decided they wanted to start a family. Tom knew his grandfather had sickle-cell disease. Sickle-cell disease is a recessive disorder that causes blood cells to stiffen and take on a crescent shape. These blood cells have a difficult time moving through the blood vessels and can cause health problems. Tina didn't know of any family members that had it. Still, before they got pregnant they both went to the doctor for genetic tests. The doctor found that even though Tom and Tina were healthy, they both carried the gene for sickle-cell disease. Make a Punnett Square to determine the probability of Tom and Tina's child having sickle-cell disease.

	S	***s***
S	SS	Ss
s	Ss	ss

The child has a 25% chance of having sickle-cell disease.

2. Some cattle are naturally hornless, a condition called "polling". Polling is dominant over the more common horned trait. A polled bull is mated with three cows with the following offspring:

Cow A (horned) = polled calf
Cow B (horned) = horned calf
Cow C (polled) = horned calf

What are the genotypes of the four parents?

Since being horned is recessive, ***Cow A*** *and* ***Cow B*** *must both be* ***homozygous recessive (pp).*** *Since the polled bull has horned (homozygous recessive) offspring via Cow B, the* ***bull*** *must be* ***heterozygous (Pp)****, as per this Punnett Square:*

	P	***p***
p	Pp	pp
p	Pp	pp

If he were homozygous dominant (PP), all of his offspring via Cow B would be heterozygous polled, as per this Punnett Square:

	P	***P***
p	Pp	Pp
p	Pp	Pp

Similarly, ***Cow C*** *must also be* ***heterozygous (Pp)****, as she has horned offspring with the heterozygous bull, as per this Punnett Square:*

	P	***p***
P	PP	Pp
p	Pp	pp

3. Short hair is dominant over long hair in guinea pigs. A long-haired male guinea pig and a heterozygous short-haired female are kept in the same cage and mate numerous times, ultimately producing 32 total offspring. What is the most likely distribution of short hair and long hair among their offspring?

The male must be homozygous recessive (ll), as he has long hair. Mating him with the heterozygous (Ll) female results in the following Punnett Square:

	L	***l***
l	Ll	ll
l	Ll	ll

Thus, the most likely distribution is about ***50% short-haired*** *(all heterozygous) and* ***50% long-haired****, or* ***16 of each****. In practice, it is unlikely to be an exact 50-50 split, but it is the most likely single outcome, and the actual result will probably be close to it.*

4. Tay-Sachs disease is due to a homozygous recessive genotype (nn). About 4% of the alleles in a given population are “n”. This means that about 96% of the alleles are “N”. Use the Punnett Square below to determine the approximate percentage of each genotype within the population.

	N=0.96	***n=0.04***
N=0.96	~0.922	~0.038
n=0.04	~0.038	~0.002

Those ***without the allele (NN)*** *make up about* ***92.2%*** *of the population.* ***Heterozygous carriers (Nn)*** *make up about 3.8% + 3.8% =* ***7.6%****. Those* ***with the disease (nn)*** *make up about* ***0.2%****.*