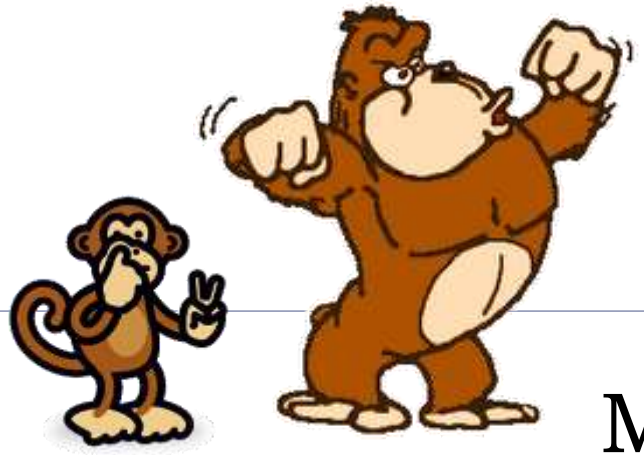


Mendelian Genetics

C Kohn, Waterford WI

Genetics

- Genetics is the study of inheritance of genes.
  - i.e. genetics is how traits are passed down from parents to offspring
- Every individual offspring inherits at least two copies of every gene – one from the mother and one from the father.
  - Each version of a gene is called an allele.
  - You inherit at one allele from both parents for every gene.
- Genes can either be dominant or recessive –
  - Dominant genes are always expressed if they are present
  - Recessive genes are only expressed if no dominant genes are present.

Source: blogography.com

Source: techcynic.wordpress.com

Homozygous vs. Heterozygous

- The combination of genes that you have can be described by *homozygous* or *heterozygous*.

- Homozygous means that both of your genes are the same – either both are dominant or both are recessive
  - AA would be Homozygous Dominant (both alleles are dominant)
  - aa would be Homozygous Recessive (both alleles are recessive)

- Heterozygous means that you have both a dominant and a recessive copy of a gene.
  - Aa would be Heterozygous (one dominant allele, one recessive allele)

Source: zazzle.com

Genotype vs. Phenotype

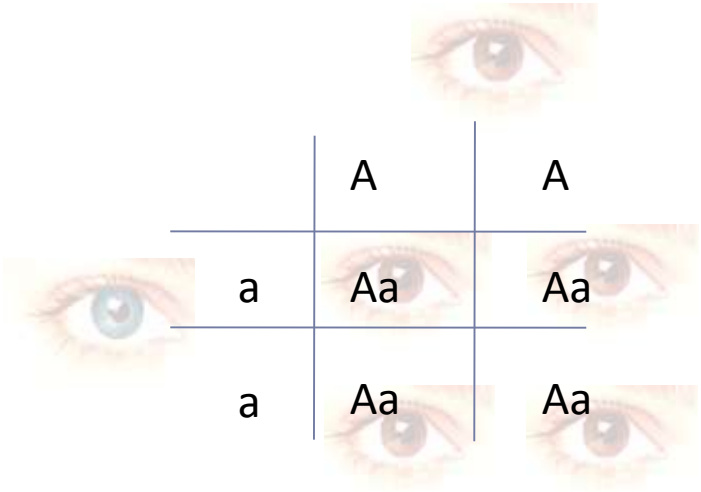
- Genotype is the term for the genes that an organism has.

- Phenotype are the physical characteristics created by the combination of genes that an organism has.
  - For example, Mr. Kohn is heterozygous for eye color – his genotype has genes for both blue and brown eyes.
  - However, Mr. Kohn's phenotype is brown eyes – the blue eye color is not expressed because it is recessive.

	A	A
a	Aa	Aa
a	Aa	Aa

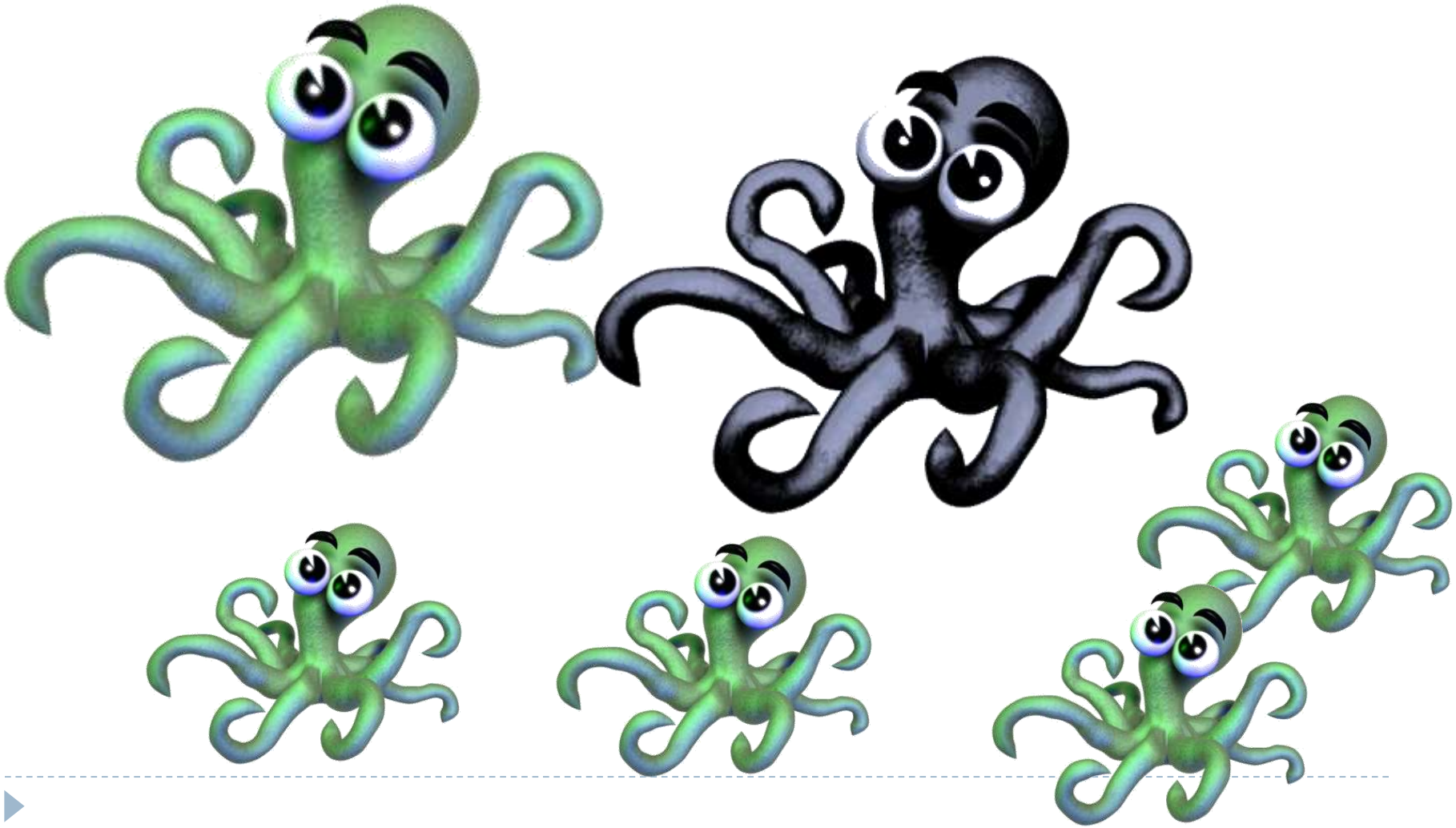
Punnett Squares

- A Punnett Square is a tool used for determining the possible genetic outcomes of the offspring of two parents
  - Punnett Squares are can be used to determine the parents' or offsprings' phenotypes and genotypes.
  - Punnett Squares show all of the possible combinations of offspring genotypes that a couple could have.



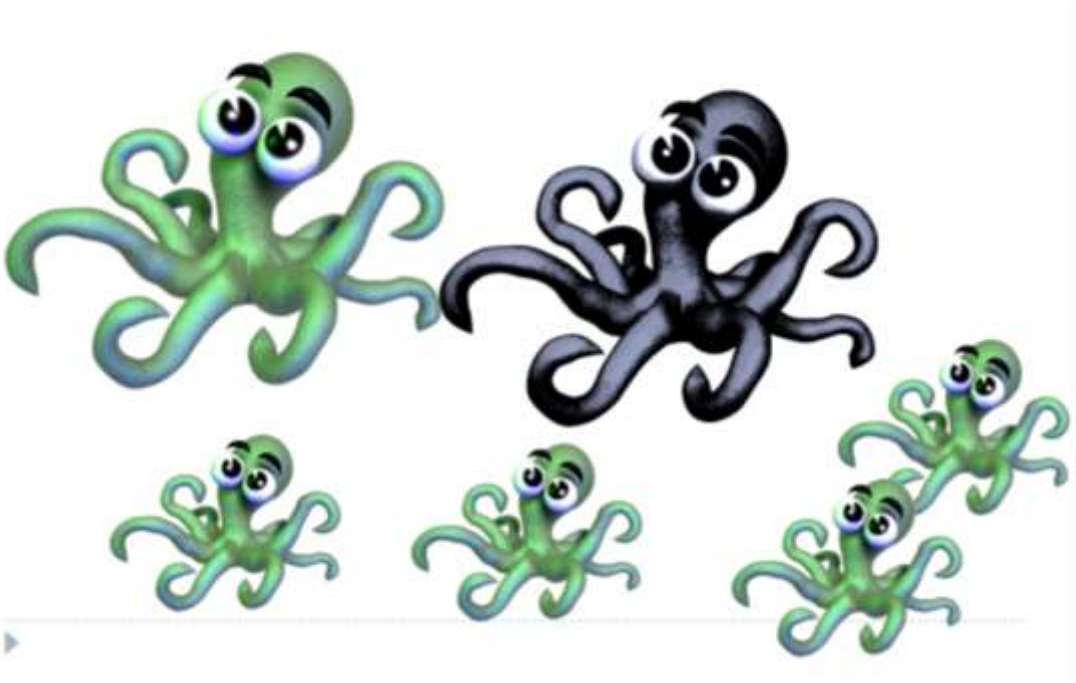
	A	A
a	Aa	Aa
a	Aa	Aa

How would you create a Punnett Square for this family?



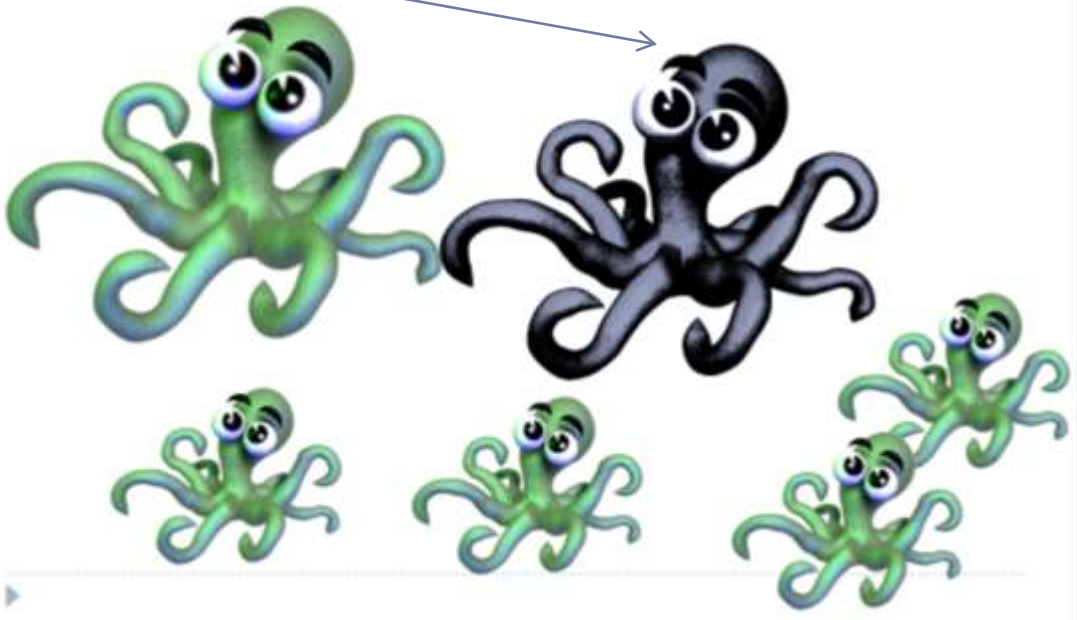
5 Steps of Punnett Square Problems

- Step 1: Figure out what is recessive.
  - Usually the trait that is dominant is more common.
  - Usually the trait that is recessive is less-prevalent.
  - In this case, we can tell that purple is recessive and green is dominant.



5 Steps of Punnett Square Problems

- Step 2: Determine the genotypes of the parents
  - One is pretty simple – the purple recessive parent has to have two little letters: aa
  - The other green parent has only two possibilities – AA or Aa
  - So we know that one parent is aa and the other is either Aa or AA.



5 Steps of Punnett Square Problems

- Step 3: Create the Punnett Squares for each possibility.
- Step 4: Select the Punnett Square that reflects what we see for offspring below.

	A	a
a	Aa	aa
a	Aa	aa

	A	A
a	Aa	Aa
a	Aa	Aa

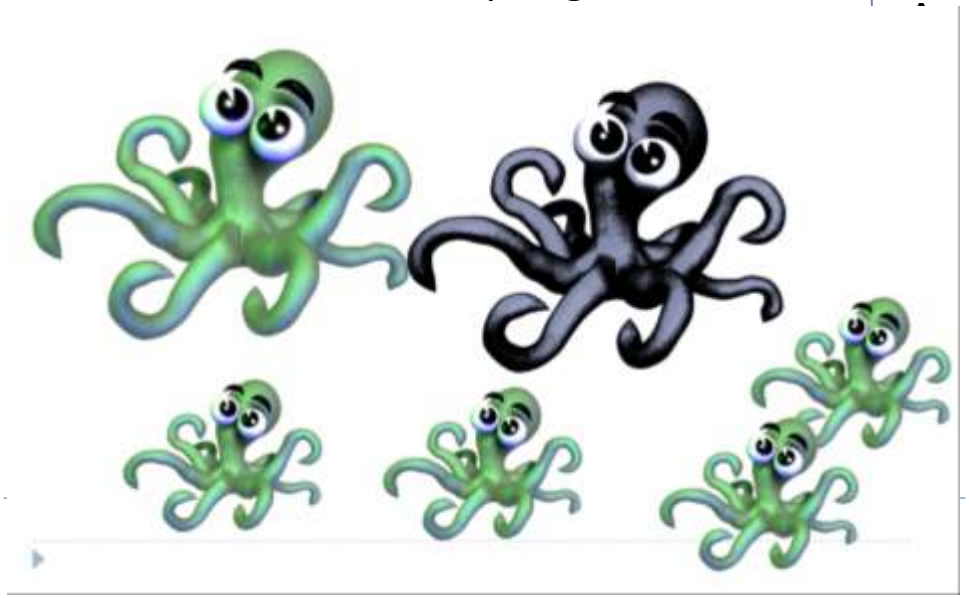
5 Steps of Punnett Square Problems

- Step 5: Confirm that you are correct.

	A	a
a	Aa	aa
a	Aa	

You know that the Punnett Square on the left cannot be correct because ½ the offspring

	A	A
a	Aa	Aa
		Aa



How would you create a Punnett Square for this family?

Step 1: Figure out what is recessive

- Usually the recessive trait is the less-prevalent trait (not always, but usually).
  - In this case we know both green and purple are equally common, but we know from before that green was dominant.

Step 2: Determine the genotypes of the parents

- We know that the purple parent has to be aa
- We know the green parent could either be AA or Aa

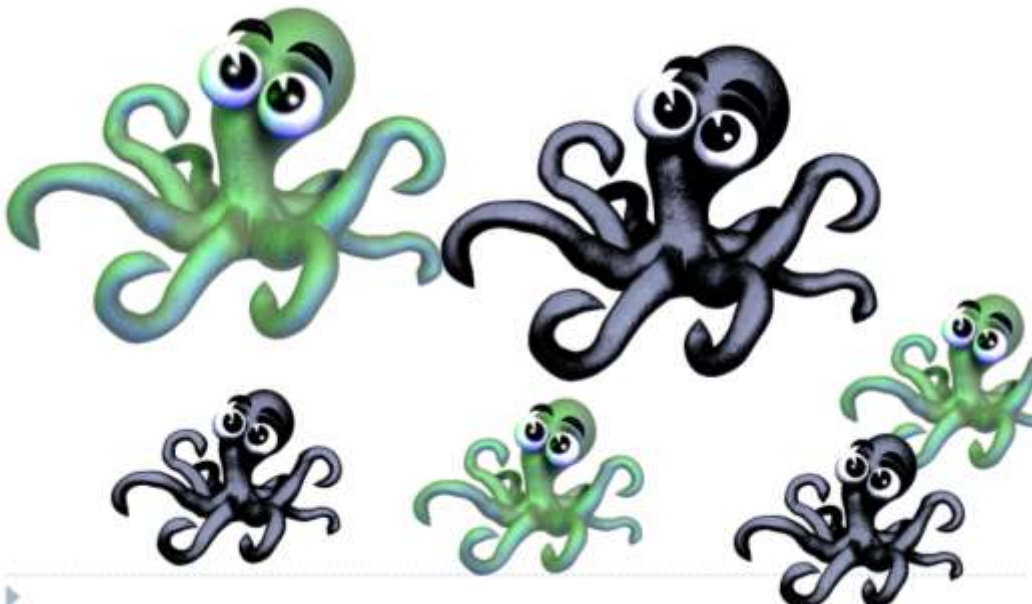
Step 3 & 4: Create Punnett Squares for each possibility; pick the correct square

- Create Punnett Squares for all parent genotype combo possibilities

	A	a
a	Aa	aa
a	Aa	aa

You know that the Punnett Square on the left is correct because half are the dominant phenotype and half are the recessive phenotype.

	A	A
a	Aa	Aa
a	Aa	Aa



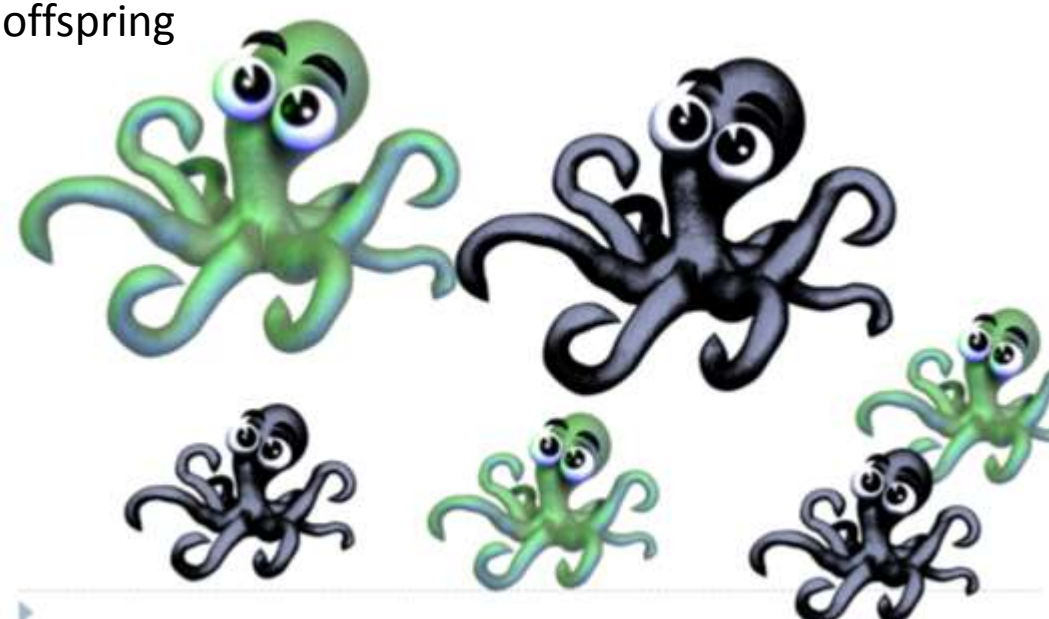
Step 5: Confirm that you are correct.

- Be prepared to explain why the other Punnett Square would not work.

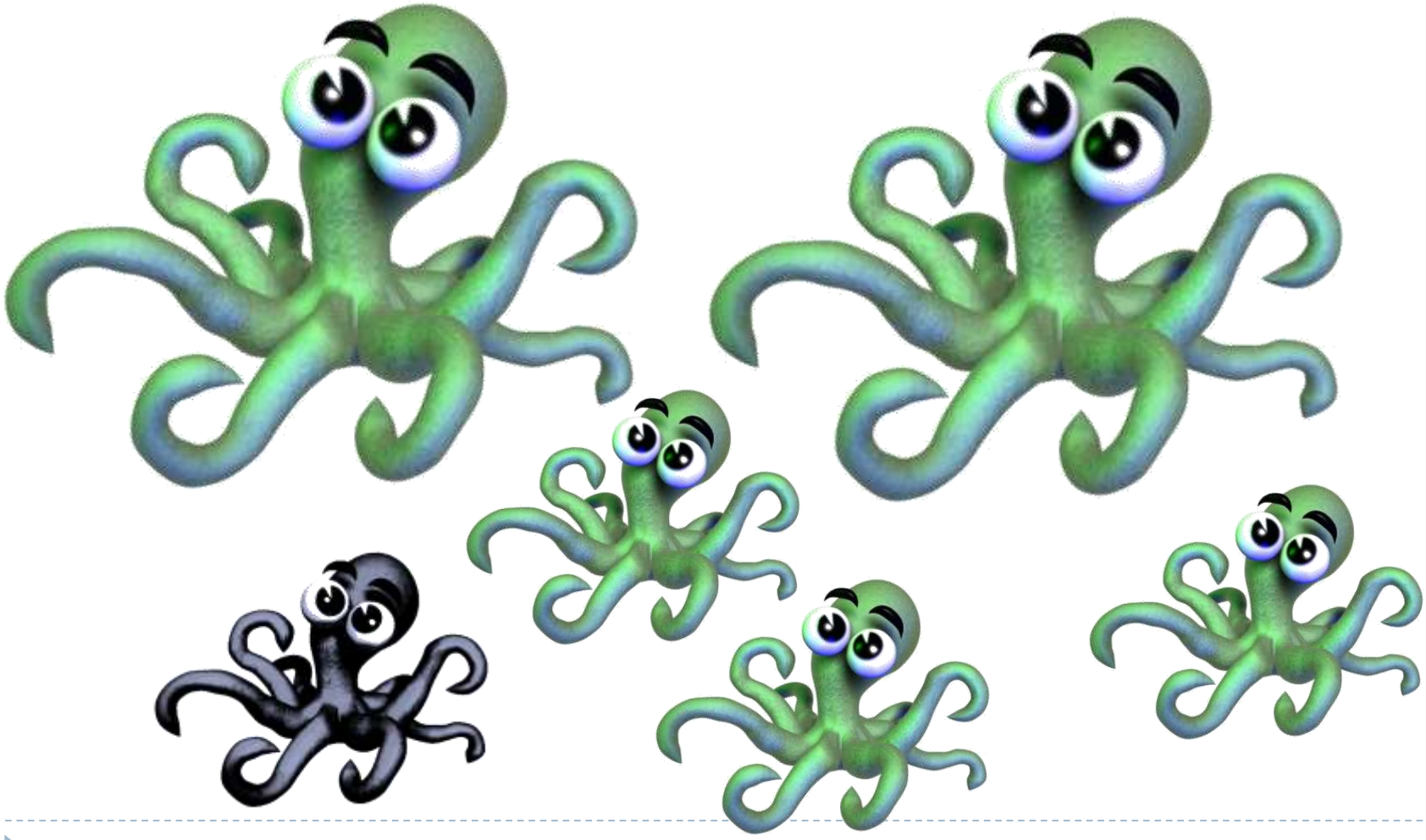
	A	a
a	Aa	aa
a	Aa	aa

You know that the Punnett Square on the left is correct because half are the dominant phenotype and half are the recessive phenotype. The other has only green offspring

	A	A
a	Aa	Aa
a	Aa	Aa



Personal Test: How would you create a Punnett Square for this family?



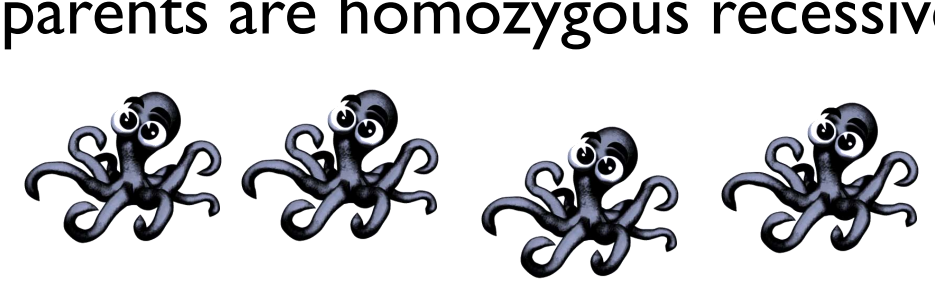
Possible Combinations

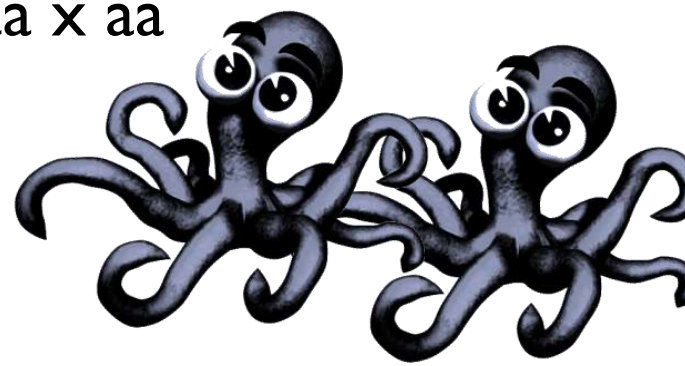
- With simple traits, there are only six possible combinations of parents
  - AA x AA
  - AA x Aa
  - Aa x Aa
  - AA x aa
  - Aa x aa
  - aa x aa

- Each one will have the same results for offspring ratios each time.

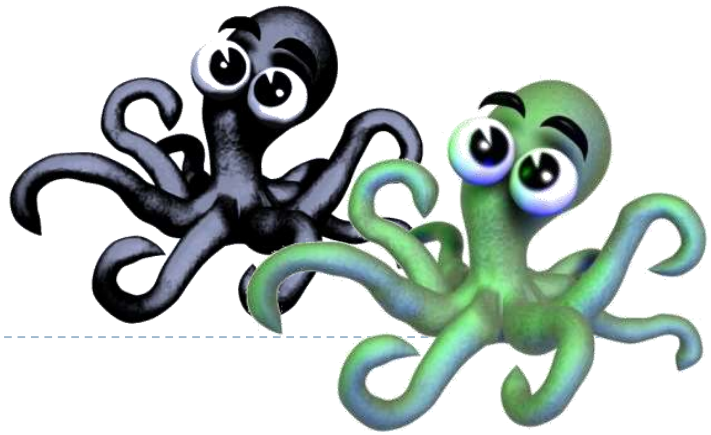
Offspring Ratios

- If we have only recessive phenotypes, we know that both parents are homozygous recessive – aa x aa





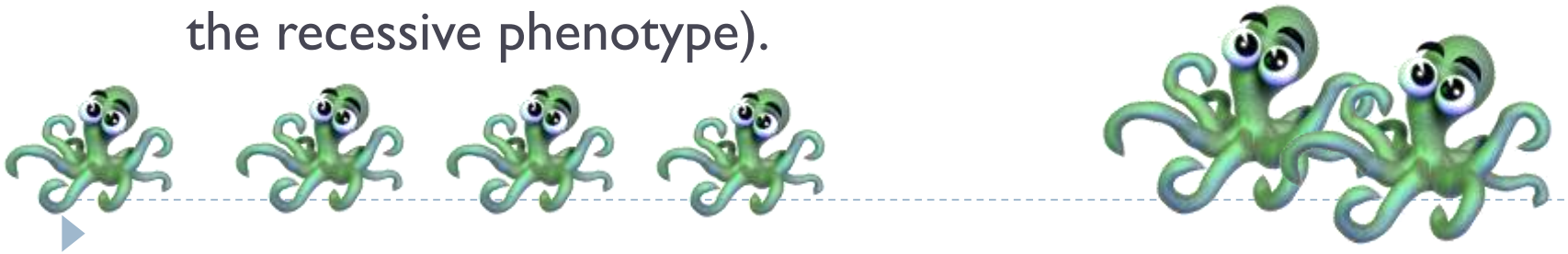
- If we have half recessive, half dominant phenotypes, we know that one parent is Heterozygous and one parent is Homozygous Recessive – Aa and aa



Offspring Ratios

- If we have ¼ recessive and ¾ dominant phenotypes, we know that both parents are Heterozygous – Aa and Aa

- If all offspring are the dominant phenotype, we know that the combination of parents must be one of the following:
  - AA x AA Aa x AA AA x aa
  - Additional combinations would be necessary to determine which it is (except in the last example, where one parent has the recessive phenotype).



Quiz Objectives

- Define an allele, a phenotype, and a genotype.
- Describe how homozygous recessive is different from homozygous dominant.
- Define heterozygous.
- State the genotype of an organism that has the recessive phenotype.
- State the genotypes of parents if they have all recessive-phenotype children.
- State the genotypes of parents if ¼ of their offspring have the recessive-phenotype.
- If half the children of a couple have recessive phenotypes, what are the genotypes of the parents?
- If a heterozygous couple has 3 offspring, all with the dominant phenotype, what are the odds their 4th offspring will have the recessive phenotype?