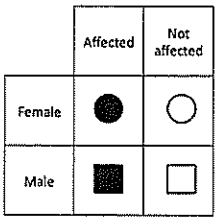
pedigree charts

Key to pedigree charts



Key to alleles

D = dominant allele

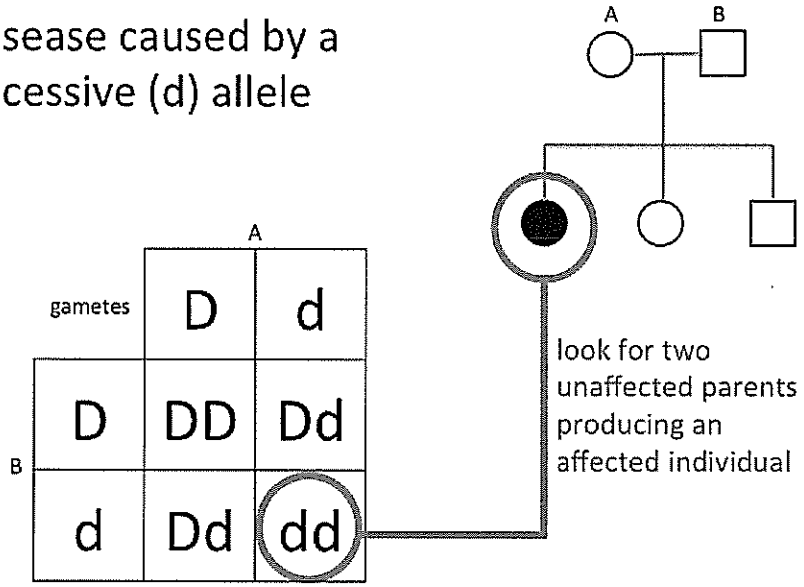
d = recessive allele

X^D = dominant allele on the X chromosome

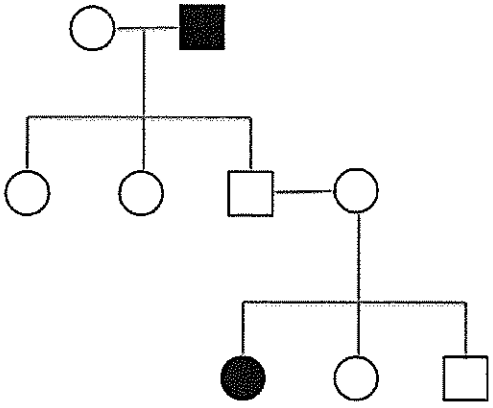
X^d = recessive allele on the X chromosome

Y = Allele not carried on the Y chromosome

Disease caused by a recessive (d) allele

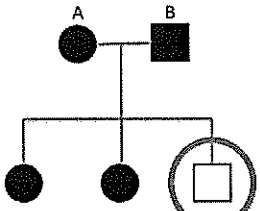


Disease caused by a recessive (d) allele



In recessive diseases affected individuals often occur every other generation

Disease caused by a dominant (D) allele

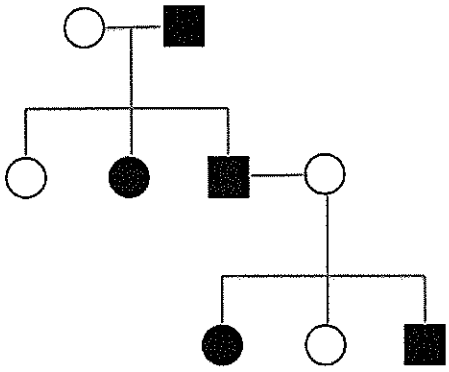


gametes	D	d
D	DD	Dd
d	Dd	dd

(A = top, B = left)

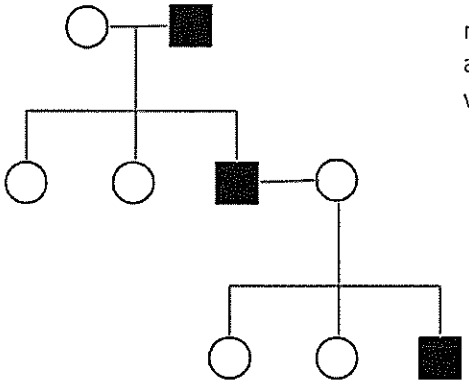
look for two affected parents producing a normal individual

Disease caused by a dominant (D) allele



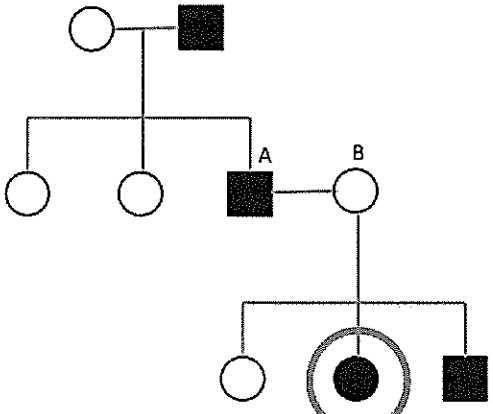
in dominant diseases usually more than 25%, by probability 50% of individuals in a pedigree chart will be affected

Disease is sex-linked (carried on the X chromosome)



most if not all affected individuals will be male

Disease is sex-linked (carried on the X chromosome)

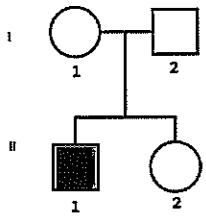


	A	
gametes	X^d	Y
X^D	X^DX^d	X^D Y
B X^d	X^dX^d	X^d Y

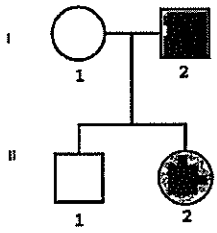
females maybe affected, but only if the male parent is affected

Now it's your turn to try to determine the Genotypes for each of these pedigrees.

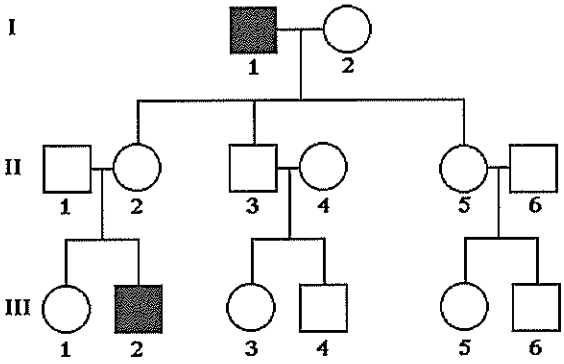
1. Attached ears (A) is an autosomal recessive trait.
   AA = unattached, Aa = unattached, aa= attached



2. Widow's peak (W) is an autosomal dominant trait
   WW = widow's peak, Ww = widow's peak, ww = no widow's peak

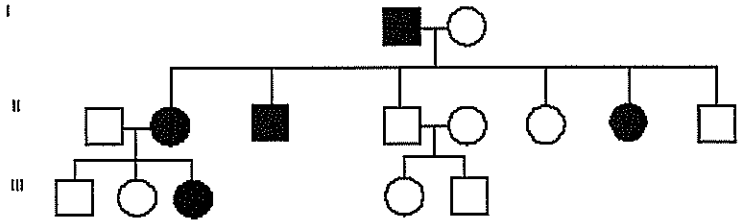


3. Colorblindness is a sex-linked recessive
   C= normal vision, c = colorblind



What are the genotypes of I-1? ____ II-2?
III-1? _____ II-2? _____ II -3? _____

4. Huntington's disease is an autosomal dominant
   HH = Huntington's , Hh = Huntington's, hh= no Huntington's



What are the genotypes of I-1? ___ I-2? _____
II-2? ____ II-3? ____ III-1? ____ III-3? ____

Can an autosomal dominant "skip" a generation? _____

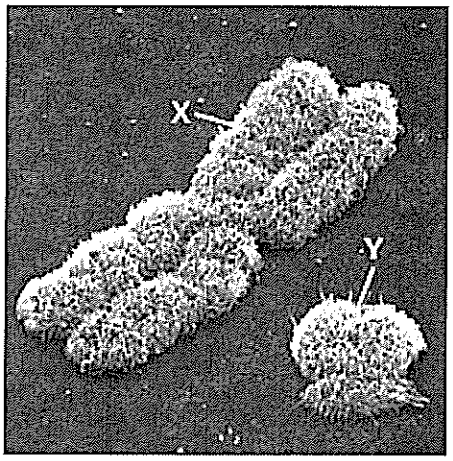
Are males or females mostly affected with a sex-linked recessive trait? _____

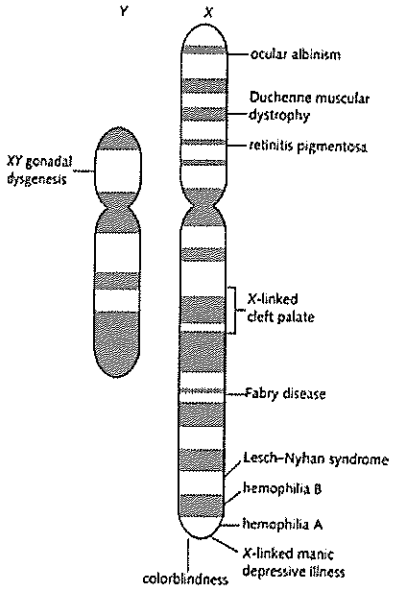
Name _____ pd_____ date _____
http://www.sciencemusicvideos.com/solving-genetics-problems-involving-sex-linked-alleles/

1. Hemophilia: A Sex Linked Trait

In humans, most other mammals, and some insects (notably, the well studied fruit fly), sex is determined by **sex chromosomes.** These chromosomes are also known as the X and Y chromosomes, and the way they determine sex is as follows:

- If you possess an X chromosome and a Y chromosome, you're male.
- If you possess two X chromosomes, you're female.





As you can see in the photograph above, the X chromosome is a lot bigger than the Y chromosome.As a result, as you can see in the partial chromosome map on the right, many of the genes on the X chromosome have no corresponding gene on the Y chromosome.

This makes the inheritance of genes on the X chromosome different from genes that are on autosomal (non-sex) chromosomes. And to see how, let's look at a gene that's close to the bottom of the X chromosome: the gene for **hemophilia**.

Hemophiliacs have difficulty forming blood clots

Hemophilia is a recessive inherited blood disorder. Hemophiliacs can't form blood clots. While minor cuts aren't usually a problem, hemophiliacs have significant problems with internal bleeding. How is this disease inherited?

If you're a male hemophiliac, you've inherited the allele that causes the disease through your X chromosome. Remember that the allele is a sequence of DNA that codes for a protein. In this case, the allele codes for a protein that isn't working. Males only have one X chromosome. So, if they inherit an X chromosome with the hemophilia allele, they'll be a hemophiliac.

Because the allele is on the X chromosome, we use a special symbol notation to indicate the presence of the allele: X^h. An X chromosome that possessed the allele for normal blood clotting would be written as X^H. No corresponding allele (either dominant or recessive) is found on the Y chromosome.

Traits like hemophilia that are caused by alleles on the X chromosome are called **sex-linked** or **X-linked traits.**
Use that information to complete the following table of possible hemophilia genotypes.

Check this with the online activity:

Description	Genotype
Normal male	
Hemophiliac male	
Homozygous Normal Female	
Heterozygous Normal female	
Hemophiliac Female	

Move each item to its correct place
- X^H
- X^h
- Y

In addition, answer these questions:

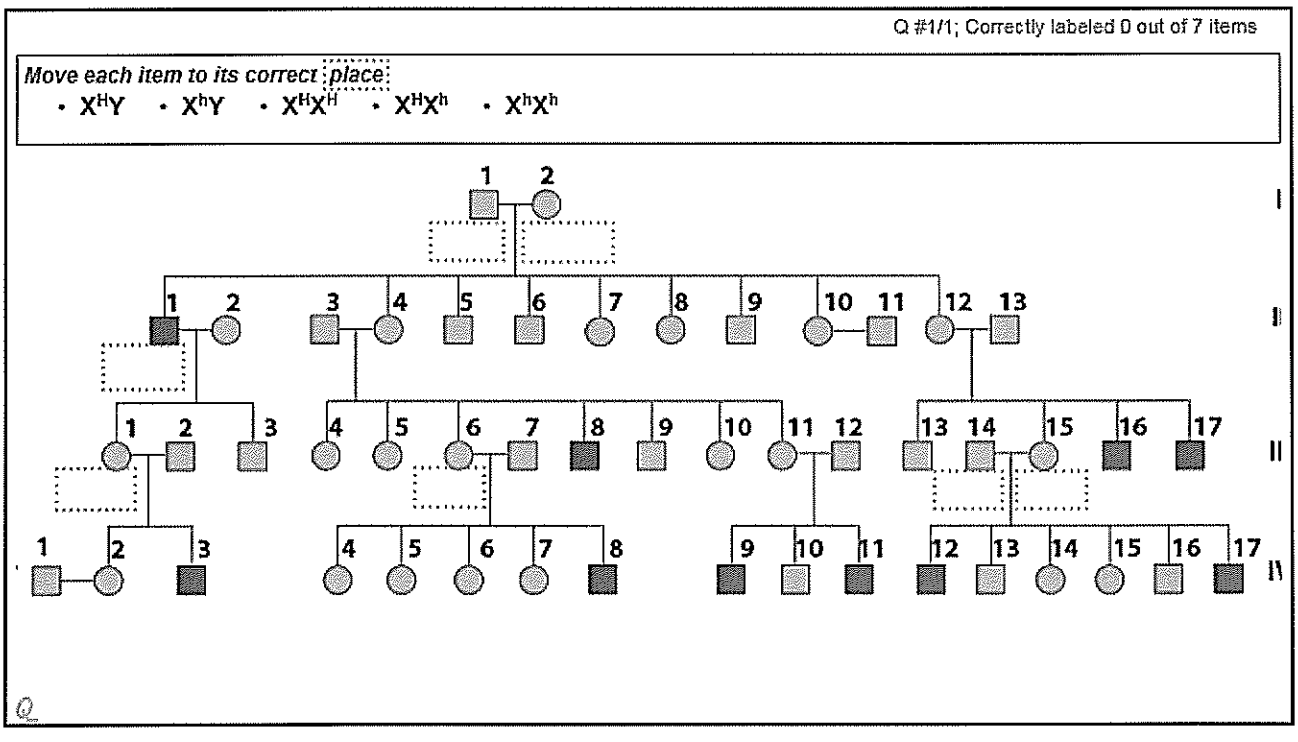
1. What is the genotype of a female who is considered a "carrier"?

   _____

2. Why do fewer females get hemophilia than males?

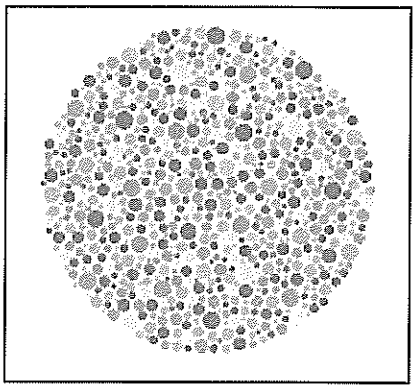
3. If a male has hemophilia, which parent gave him the defective gene? _____

While males and females are equally likely to inherit the hemophilia allele, it's much more likely for males to express the allele, and have the hemophilia trait. You can see this in the pedigree chart below. Individual I-2 is none other than Queen Victoria, the first person in which the hemophilia appears in the royal families of Europe. She passes the allele to II-1, her son Leopold, and to at least some of her daughters, who then pass it to Victoria's grandchildren, three of whom are hemophiliacs. Generation IV includes six hemophiliacs.
See if you can identify the genotypes of some of the individuals below. Here's the key
SQUARES are males
Circles are females.
Squares that are filled in are hemophiliacs.
In this pedigree, carriers are not explicitly shown. Some pedigrees show carriers as a half-filled in circle. ◑



2. Solving a Genetics Problem Involving Sex Linkage

The allele for white eyes in fruit flies is found on the X chromosome



Ishihara color blindness test, from www.colour-blindness.com. If you can't see the number 5, you might be colorblind

Hemophilia is only one of several human, sex-linked conditions. Others include Red-Green colorblindness, and Duchenne's muscular dystrophy.

Sex linkage also occurs in animals, most notably fruit flies, one of biology's most studied organisms. In fruit flies, a recessive allele that causes white eyes is located on the X chromosome. The dominant allele codes for the normal phenotype, red eyes.

To solve genetics problems involving sex linkage, you use the same six steps that you've used in previous tutorials. Click here for a review.

Q #1/1; Correctly labeled 0 out of 26 items

A woman who a carrier for hemophilia (she has the allele but not the trait) has children with a normal (non-hemophiliac) man. What will be the genotypes and phenotypes of their offspring?

Genotypes of the parents

Mother: ☐ ☐

Father: ☐ ☐

Move each item to its correct place:

- X^H
- Y
- X^h
- 0%
- 25%
- 50%
- 75%
- 100%

		Father	
		☐	☐
Mother	☐	☐ ☐	☐ ☐
	☐	☐ ☐	☐ ☐

Genotype ratio:

☐ X^HY: ☐ X^hY: ☐ X^HX^H: ☐ X^HX^h: ☐ X^hX^h

Phenotype ratio:

☐ Hemophiliac man

☐ Normal blood-clotting man:

☐ Homozygous normal woman

☐ Carrier (heterozygous) woman

☐ Hemophiliac woman

Additional problems

1. . Red-green color blindness (b) is a recessive sex-linked trait. A colorblind male marries a normal female. Their daughter is colorblind.

   a)What are the genotypes of both parents and the daughter? (show your work)

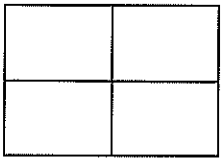
   b) Can a colorblind father have daughters who are not colorblind? Explain and show your work.

   c) If a normal sighted woman whose father was color-blind marries a color-blind man, what is the probability that they will have a colorblind child? (show your work)

Dragon Genetics

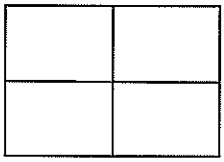
Answer the following questions using one or more Punnett squares. Show your work!!

1. Three claws is dominant to two claws. A dragon has four claws and is crossed with a homozygous three-clawed dragon. What would their offspring look like?



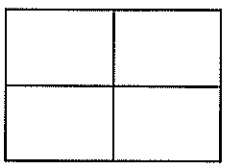
Answer: _____

2. Red eyes in dragons are dominant over yellow eyes. What is the genotypic and phenotypic ratio of a cross between two heterozygous red-eyed dragons?



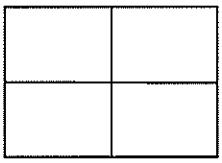
Genotypic ratio: _____ Phenotypic ratio: _____

3. Having a long tail is dominant over having a short tail. What would be the chance of having dragon offspring with short tails if one long-tailed parent was homozygous dominant and the other had a short tail?



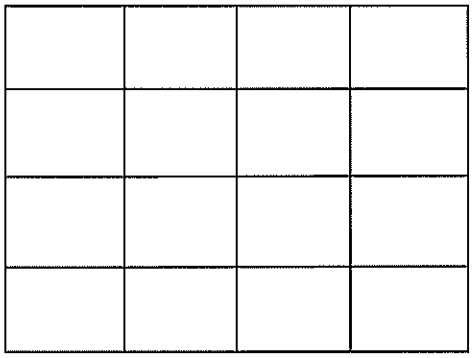
Answer: _____

4. Dragons with no horn are recessive to those with a horn. If we investigated the offspring of two dragons and found that 52 had a horn and 48 had no horn, what were the genotypes of the parents? (Think, what cross creates a 50%/50% ratio)



Parental genotypes: _____

6. In dragons, breathing fire is dominant over not being able to breathe fire and having red wings is dominant over yellow wings. If a fire-breathing heterozygous dragon (BbRr) with red wings is crossed with a red-winged dragon that cannot breathe fire (bbRr), how many of each phenotype would you expect?



Fire-breathing, red wings: _____
Fire-breathing, yellow wings: _____
Not fire-breathing, red wings: _____
Not fire-breathing, yellow wings: _____

Four Ways Inheritance Is More Complex Than Mendel Knew

https://biobeat.nigms.nih.gov/2016/03/four-ways-inheritance-is-more-complex-than-mendel-knew/#more-2902

Posted by Carolyn Beans on March 4, 2016

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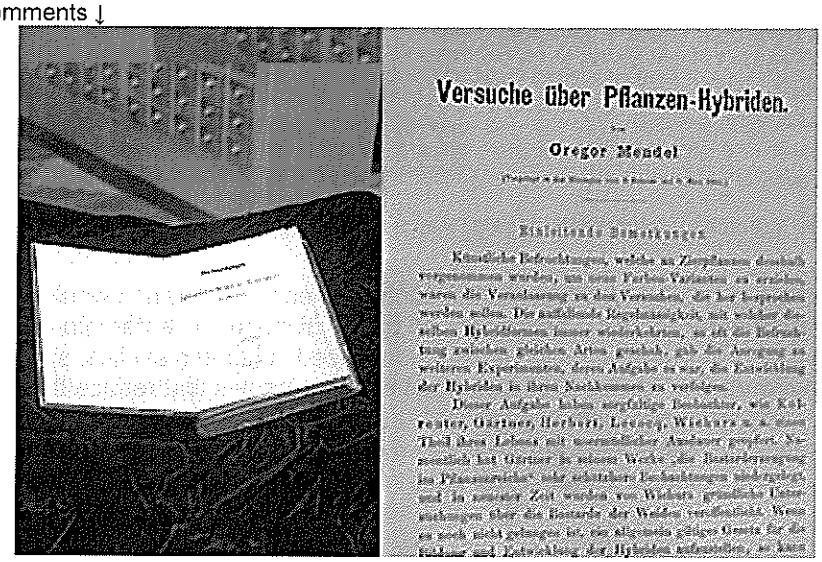


An original edition of Gregor Mendel's 1866 publication, "Experiments in Plant Hybridization," housed in NIH's National Library of Medicine. Credit: Alisa Machalek.

This year marks the 150th anniversary of Gregor Mendel's publication that—after sitting ignored for a few decades—helped launch the field of modern genetics. Mendel didn't know about DNA. But after painstakingly cross-fertilizing tens of thousands of pea plants over the course of 8 years, this Austrian monk came very close to describing genes.

By picking a species with a handful of visible characteristics that occur in two easily identifiable forms, Mendel was able to pinpoint what he called "factors." These factors determine traits like a pea's shape or color, for instance, and are passed down from parents to offspring. He also observed that factors can be dominant or recessive.

Today, we know that inheritance is far more complex than what Mendel saw in his pea plants. Here are some of the things scientists have learned about how traits are passed from one generation to the next.

1. **Some of our genes come only from Mom.**

   Mendel believed that parents contribute equal numbers of factors to their offspring. If we focus on DNA in the nucleus, it would appear that he was right. In each cell, nuclear DNA is bundled into two sets of chromosomes—one from Mom and one from Dad. But mitochondria, the organelles that generate the cell's energy supply, have their own DNA that comes only from Mom. That means that your mitochondrial DNA is likely the same as your mother's, grandmother's, great grandmother's and so on. Mitochondrial DNA carries far fewer genes than DNA in the nucleus does, but changes in mitochondrial DNA sequence can have a major impact on health. Scientists are studying how variations in mitochondrial genes may lead to disorders of the brain, eye, and skeletal and cardiac muscles.

2. **The environment may have the potential to trigger molecular changes that pass from generation to generation.**

Gregor Mendel's studies in pea plants helped launch the field of modern genetics. Credit: Stock image.

Mendel used math to predict how factors that control a pea's appearance would pass from parent plants to offspring. Environmental conditions experienced by the plants didn't enter into his equations. New research in a tiny worm called C. elegans, which is commonly used in genetic studies, suggests that it may be possible for environmental stress to trigger small RNA molecules that reduce the activity of specific genes. Scientists think that this gene silencing process, known as RNA interference (RNAi), might help the worms adapt to changing conditions. One study revealed that gene silencing triggered by mild heat stress continued in future generations of these worms, even after the initial heat stress was gone.

3. **One trait can be controlled by hundreds of genes.**

The traits that Mendel studied in peas, such as pod shape, pea shape and pea color, were each associated with a single gene. Though this is true for some traits, we now know that many traits are controlled by tens or even hundreds of genes spread throughout our genomes. Scientists are finding that some conditions, like preeclampsia, diabetes and asthma, likely involve changes in many genes working in concert.

4. **Genes can tag along for generations.**

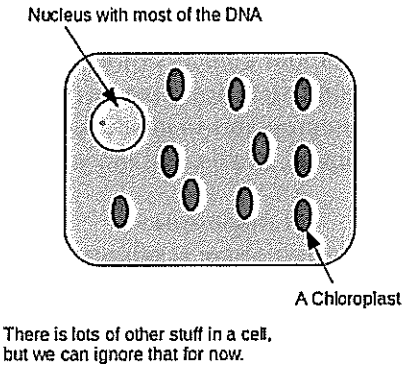
Mendel believed that the factors for different traits are passed down independently of each other. He thought that whether a pea plant passes down a gene for yellow peas, for example, should be unrelated to whether it also passes down a gene that makes the peas wrinkled. For many genes, this rule holds true. However, some genes are close enough together on the same chromosome that they frequently do get passed along together. Genes on completely different chromosomes can also get passed down in groups if they work together in some way to increase an individual's chances of surviving.

The genetic toolkit has expanded greatly since Mendel made his groundbreaking observations. To learn more, check out these other stories.

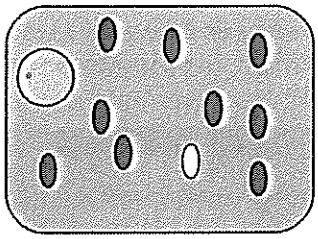
So where do new variegated hostas come from? Well, in some cases, people just have to be patient and wait for a variegated mutant (aka sports) to pop up. But there is also a special trick that results in variegated plants that can pass on their variegation to the next generation.

Chloroplast mutants

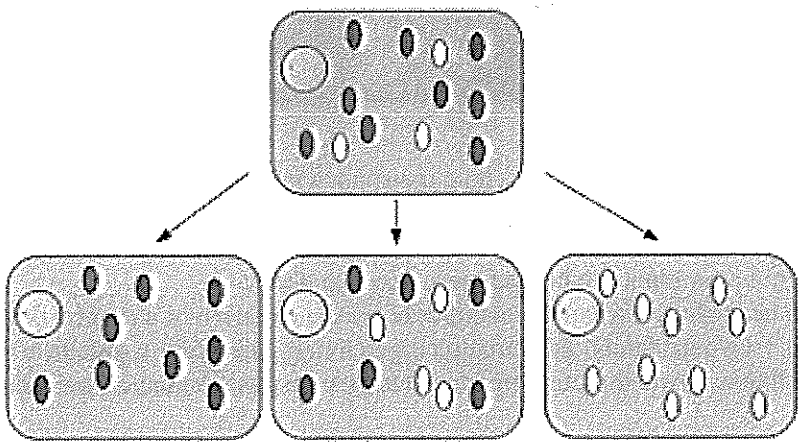
Here is a cell.



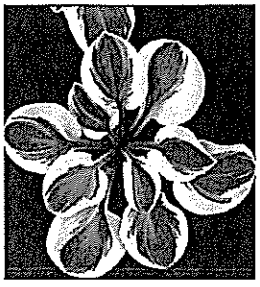
Chloroplasts are where photosynthesis actually happens, what makes a plant green. They also, strangely enough, have a little of their own DNA. They actually essentially little cells within a cell, doing their own dividing, reproducing, and of course, mutating. Sometimes those mutations cause them to stop making chlorophyll, and become white.



As long as a cell has mostly green chloroplasts, all is well. The white ones just hang out, dividing occasionally, doing their thing. But when a cell divides into two new cells, the chloroplasts get split up between the daughter cells. And if the parent cell has some white and some green chloroplasts, just by chance, sometimes it will make cells with all green chloroplasts, sometimes all white chloroplasts, and sometimes a mix of the two types.



When this happens in a plant, it looks like what you see here in yet another variegated sport of the (apparently very mutation prone) hosta 'Blue Mouse Ears'

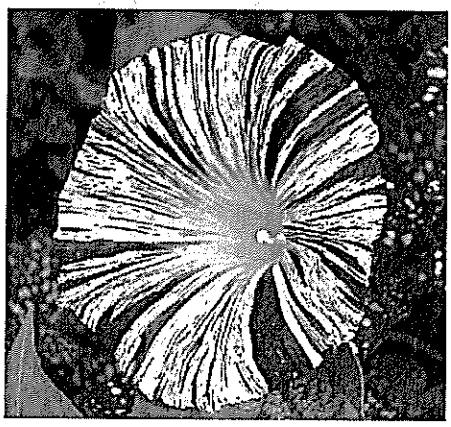


The white patches have all albino chloroplasts, while the green ones are either all green, or a mix of the two. This type of variegation will often come true from seed, because as long as the individual cells that develop into the embryo in the seeds contain both green and white chloroplasts, the new seedling will show just the same streaky, blotchy variegated pattern.

Sometimes, though, just by chance, the cells with white chloroplasts end up isolated in one of the layers, and the green cells end up in the other layers – the irregular chloroplast mutant variegation becomes a tidy chimeral variegation. Nursery people refer to this as the variegation stabilizing. Hosta breeders make use of this all the time, using plants with unstable streaky variegation in their breeding programs to create seedlings which can stabilize into varieties with neat variegation on leaf margins or centers which they can then sell to you.

Transposons

Another, completely different way variegation can come about is through the so called jumping genes, transposons. Genes are essentially little templates for making proteins. Proteins in cells can be incredibly complex, and act like little machines doing. They build stuff, take stuff apart, modify chemicals into other chemicals, and generally run the show. But transposons are genes that do something rather odd. Instead of making a protein that goes off and does something, the protein they make simply comes back, makes a copy of the gene that made it and sticks that copy somewhere else in the genome. Transposons are genes that can make copies of themselves, the chain letters of the genetics world. Transposons are everywhere. In fact, almost *half* of the DNA in your body is actually transposons. They keep copying and copying and copying, filling up the genome. All those transposons jumping around can cause problems. As they move about the genome, they sometimes land in the middle of other genes, causing them not to work right anymore. It is like you opened your cook book to make brownies and the recipe read: "1 cup COPY ME flour COPY ME COPY ME 2 COPY ME cu COPY ME ps sug COPY ME ar."And sometimes, the transposon moves in and out of a gene at different times in different cells as a flower or leaf develops. And then you can get this:



This poor morning glory has a transposon problem. The transposon keeps bouncing into the middle of a gene it needs to make the purple pigment for the flower. When it does, the gene stops working, so those cells are white. When the transposon moves out of the gene again, it starts working, and you get purple. Many striped flowers, and some striped leaves, are the lovely result of a poor plant with transposons moving about.

So next time you pick up a beautifully variegated plant, or admire the pattern of a striped flower, take a moment to appreciate that is happening. Two genetically different cell types living peacefully together, white and green chloroplasts getting shunted this way and that, or perhaps unruly transposons bouncing in and out of genes.