Inheritance I
What is the genetic material?
How does it influence all aspects of the cell's function?
What drives those red arrows?
Our genetic instructions consist of ~25,000 genes spread out over $3.2 \times 10^9$ DNA nucleotides. We inherit one full set from Mom (“maternal”) and one full set from Pop (“paternal”).

How is the genetic material passed on so completely from one generation to the next? How is variation introduced? (ie. Why are you not identical to all your siblings, or to either of your parents?)

Study of Heredity: how genetic instructions are passed through generations
Genetic material packed into convenient packages

Each cell has 46 such packages

1 chromosome
Karyotype:
46 “packages” = 23 distinguishable chromosomes
2 of each (1 maternal, 1 paternal): “homologous pair”
Chromosomes duplicate (via DNA replication) before every cell division

At every cell division (mitosis), all of the genetic material is equally split between the two daughter cells.
Regular cell division (mitosis)
 Produces cells with same number of chromosomes as starting cell

- DNA replication
- Duplication of chromosomes
- Chromosomes line up individually on the spindle
- Separation of sister chromatids
- Resulting in two daughter cells with the same number of chromosomes as the parent cell
Movie vault 18.3-6
Passing of genetic material to next generation through sexual reproduction necessitates generation of special “germ cells” (egg/sperm) that have only half the number of chromosomes.

Mom passes only half of her genetic material
Pop passes only half of his genetic material

Regular (“somatic”) cells are DIPLOID (2n)
Germ cells are HAPLOID (1n)

where  \( n = 23 \) for humans
       \( n = 20 \) for squirrels
       \( n = 32 \) for guinea pigs
       \( n = 16 \) for alligator
       \( n = 39 \) for chicken
       \( n = 4 \) for fruit fly
       etc.

How is this done precisely?
How is this done differently every time?
How is this done precisely?

Regular cell division (mitosis) maternal and paternal chromosomes do not interact

Generation of germ cells (meiosis) maternal and paternal chromosomes DO interact

Figure 19-6: Essential Cell Biology 3/e © Garland Science 2010
Chromosome Behavior through Meiosis

Follow two chromosome pairs: they act independently (random assortment at the metaphase plate)

Because the line up of chromosomes is random, we can talk about probabilities:
What are the chances that this egg will receive the large paternal chromosome?
What are the chances that this egg will receive both paternal chromosomes?
Unique steps for meiosis: what do they accomplish?