The Big Picture

What does mitosis do for the organism (what is the function)?
**Mitosis produces new body (somatic) cells.**

What does meiosis do for the organism (what is the function)?
**Meiosis produces gametes (animals) or spores (plants).**

Focusing on Details

**Interphase:** What are the stages? What happens to the chromosomes during interphase?
The stages of interphase are G1, S, and G2. The chromosomes are replicated during S phase so that each chromosome has two sister chromatids joined by common centromere.

Given facts:
Interphase precedes either mitosis or meiosis.
A cell cycle containing interphase followed by mitosis may be repeated many times.
A cell cycle containing interphase followed by meiosis happens only once.
Why?
**Mitosis** produces new body cells that have all the chromosomes of the original cell and thus can be replicated over and over again to produce additional cells, all of which will be genetically identical. Meiosis reduces the chromosome complement by half in preparation for joining of gametes (syngamy, in animals), or in producing a new haploid generation (alternation of generations in plants). The new cells produced by meiosis are genetically different from the original cell.

**Mitosis:**
What are the stages?
The stages of mitosis are prophase, metaphase, anaphase, and telophase.

Do homologous chromosomes pair up?
No, homologous chromosomes act independently from one another during alignment in metaphase and chromatid segregation in anaphase.

Does crossing over occur?
No, because chromosomes do not pair up (synapsis), there is no chance for crossing over.

Following cytokinesis what chromosomes do the daughter cells contain?
**Daughter cells contain the same number and kind of chromosomes that were in the original cell.**
Are they replicated or non-replicated?  
Chromosomes in the daughter cells are non-replicated because the replicated chromatids were separated during mitosis.

Are the chromatids (soon to be chromosomes) separated by mitosis genetically similar or genetically different?  
They are genetically identical.

**Meiosis:**  
What are the stages?  
Meiosis I: prophase, metaphase, anaphase, telophase; Meiosis II: prophase, metaphase, anaphase, telophase

Do homologous chromosomes pair up?  
Yes, homologous chromosomes (replicated in S phase) pair up during synapsis to form tetrads.

Does crossing over occur (if so, when)?  
Yes, crossing over occurs during synapsis when the chromosomes are bundled in tetrads. This occurs in prophase of meiosis I.

How many rounds of cell division occur?  
Two rounds of cell division occur.

What are the cell divisions called and why?  
Meiosis I is called the reduction division because this is when the sets of homologous chromosomes get separated (diploid or 2n is reduced to haploid or 1n).  
Meiosis II is called the equational division because this is when chromatids of the replicated haploid set of chromosomes are separated into daughter cells, each receiving one haploid set of non-replicated chromosomes (formerly chromatids).

When are homologous chromosomes separated?  
Homologous chromosomes are separated during anaphase of meiosis I.

When are chromatids separated?  
Chromatids are separated during anaphase of meiosis II.

Are the chromatids (soon to be chromosomes) separated by meiosis genetically similar or genetically different?  
The chromatids that are separated into the four daughter cells produced by meiosis are all genetically different because of the exchanges across chromatids that occurred during crossing over in prophase of meiosis I and because of the random segregation of homologous chromosomes bearing different combinations of alleles during anaphase of meiosis I.