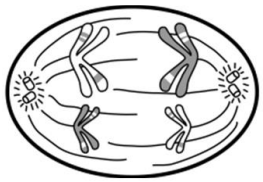
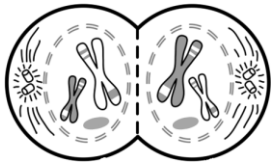
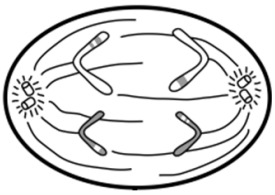
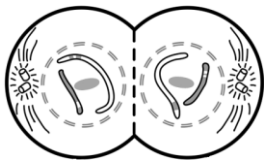
Big Meiosis Foldable – Answer Key

What you expect your students to produce will depend on their grade level and their academic level. The detailed information provided in the answer key is to give you a more thorough understanding about this topic. You most likely do not require your students to know all the details, so for your ease of use, highlight which details you would like students to know and use these to guide your lessons.

Structure	Function
1. Interphase G1 	• This is the part of the cell cycle (and first part of interphase) where the cell is increasing in size (by synthesizing cytoplasmic components). It contains one copy of each chromosome in this stage (or 23 pairs of homologous chromosomes). • Ensure that students understand what homologous chromosomes are before going further in this lesson. Each member of a homologous chromosome pair is called a homologue, and there is one paternal homologue and one maternal homologue in each homologous pair. • In this example in the foldable, there are **two pairs of homologous chromosomes** – one long pair and one short pair. Each member of a pair is illustrated in either white or grey. Designate one color the **paternal** homologues (e.g. the white chromosomes) and the other color the **maternal** homologues (e.g. grey chromosomes).
2. Interphase S 	• This is the part of the cell cycle (and second part of Interphase) where the DNA is replicated to create two copies of each chromosome. Identical copies are attached to one another at a midpoint called the centromere to create a duplicated chromosome. • For animal cells, the centriole pair is also duplicated at this stage. Plant cells do not contain centrioles.
3. Prophase I 	• This is the beginning of Meiosis I, the first meiotic division. • **Synapsis** occurs when the homologous chromosomes migrate towards one another and pair up. They line up closely next to one another to form a tetrad (tetrad refers to 4 sister chromatids). • When the tetrad forms, the paternal and maternal homologues exchange DNA at various loci called **chiasmata**. This process of forming **recombinant DNA** is called **crossing over.** • Since crossing over is random, this process results in **random genetic variation** in the resulting sex cells (egg/sperm). • Other events that occur: the chromosomes begin to thicken and condense, the nuclear envelope begins to dissolve, the nucleolus begins to disappear, centriole pairs begin to migrate to opposite poles and spindle fibers begin to form between them.

4. Metaphase I 	• The tetrads are pulled to the equatorial/metaphase plate by spindle fibers and are lined up along this plate so that each homologue in the tetrad faces an opposing pole. • This is where **random genetic variation** occurs again. The orientation of the paternal and maternal homologues on the equatorial/metaphase plate is random, so they can face either pole. This means that when they are separated in Anaphase I, there is variation in which maternal and paternal chromosomes end up in which pole. This random sorting of homologues is called **independent assortment**. • Other events that occur: the centriole pairs are fully migrated to opposite poles, the spindle apparatus is fully formed and the nuclear membrane is completely dissolved.
5. Anaphase I 	• The spindle fibers (microtubules) attached to each homologue shorten and pull homologues to their opposite poles. (Unlike in Anaphase of mitosis, the sister chromatids are not pulled apart at the centromere in Anaphase I.) • The cell enlarges and elongates in preparation for division.
6. Telophase I 	• Telophase I signals the end of the first meiotic division. • Two distinct poles of the cell begin to form with one set of (non-identical) DNA on each side. Each side contains a haploid number of duplicated chromosomes. • A cleavage furrow forms to divide the cell in half. This marks the beginning of cytokinesis which results in two non-identical daughter cells which will each enter meiosis II. • Other events that occur: the DNA decondenses back into stringy chromatin, the nuclear envelope reforms around each haploid set of DNA, the nucleolus reforms and the spindle fibers dissolve. • Between Telophase I and Prophase II, the centriole pairs in both poles are duplicated again. • **Note:** The DNA does not replicate again before entering Meiosis II. This question may come up with your students.
7. Prophase II 	• This is the beginning of Meiosis II, the second meiotic division. The stages of Meiosis II are very similar to mitosis except that the resulting daughter cells are non-identical in meiosis (as opposed to identical in mitosis). • The nuclear membrane begins to dissolve; the chromosomes condense and thicken, the nucleolus begins to disappear and the centriole pairs migrate to opposite poles as spindle fibers form between them.

8. Metaphase II 	• Spindle fibers move the chromosomes to the equatorial/metaphase plate so that they are lined up along it. • This is where **<u>random genetic variation</u>** occurs again. The orientation of the sister chromatids at the equatorial/metaphase plate is random, so they can face either poles. This means that when they are separated in Anaphase II, there is random variation in which chromatid ends up in which pole. • The centrioles are fully migrated to opposite poles. • The spindle apparatus is fully formed. • The nuclear membrane is completely dissolved.
9. Anaphase II 	• The spindle fibers attached to the sister chromatids shorten and pull at the sister chromatids which separates them at their centromeres. • The cell elongates in preparation for cell division.
10. Telophase II 	• Telophase II signals the end of the second meiotic division. • The DNA decondenses back into stringy chromatin. • A nuclear envelope reforms around each set of DNA. • The nucleolus begins to reappear. • The spindle fibers dissolve. • A cleavage furrow forms to divide the cell in half. This marks the beginning of cytokinesis which will lead to two non-identical daughter cells. • If meiosis occurs as a part of **<u>spermatogenesis</u>**, then 4 sperm are created at the end of meiosis (as shown in the foldable). If meiosis occurs as a part of **<u>oogenesis</u>**, then 1 egg and 3 polar bodies are created at the end of meiosis. • **<u>Note</u>:** Emphasize that each gamete produced is different from the other and is a result of the 3 events during meiosis that lead to genetic variation (crossing over and the independent assortment in Metaphase I and Metaphase II.)

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