Figure S2 Sample in-class activity worksheet

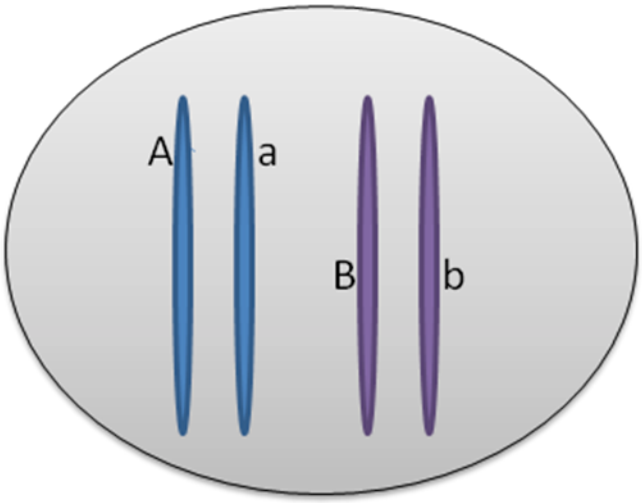
Group #:
Group Name:
Facilitator: Monitor:
Recorder: Reporter:

Cell Division worksheet

Today's exercise is about understanding the mechanisms of mitosis and meiosis. Learning how these processes work sets the foundation for understanding much of genetics.

Directions:
Each group needs to draw their answers to the following questions. Different color pens or pencils should be used to indicate different chromosomes and alleles should be labeled in each of the diagrams. Each group should turn in one copy of the worksheet at the end of the class period.

1. A diploid cell contains two sets of chromosomes and is heterozygous for a gene (containing alleles A and a) on chromosome one and is heterozygous for a gene (containing alleles B and b) on chromosome two. Draw this cell in G1 labeling the alleles on the chromosomes.

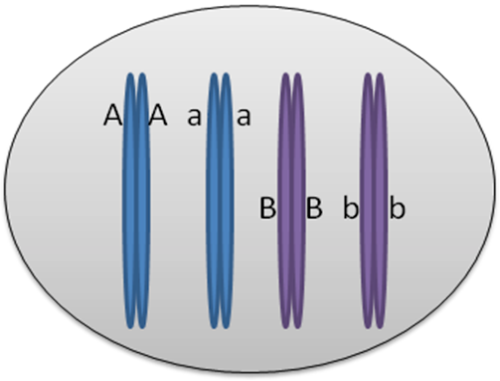


*A **good** answer is similar to the neighboring diagram including four chromosomes and the A and a on the same color chromosomse and B and b on the other color chromosomes. The total DNA content should be 2C. **Excellent** answers include drawing the chromosomes in a nucleus and indicating prior to mitosis the chromosomes would be decondensed. **Poor** answers will not have the correct number of chromosomes, will have the alleles labeled on the same chromosome, will show the chromosomes in a replicated state as an X, or will show the homologous chromosomes physically touching.*

2. This cell receives cues to duplicate itself.

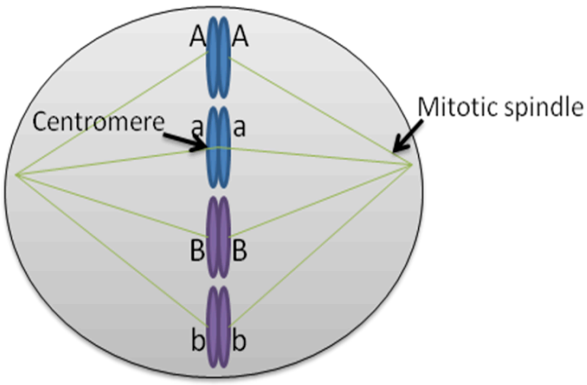
Draw your cell at the following stages:

- G2 just after DNA replication prior to mitosis



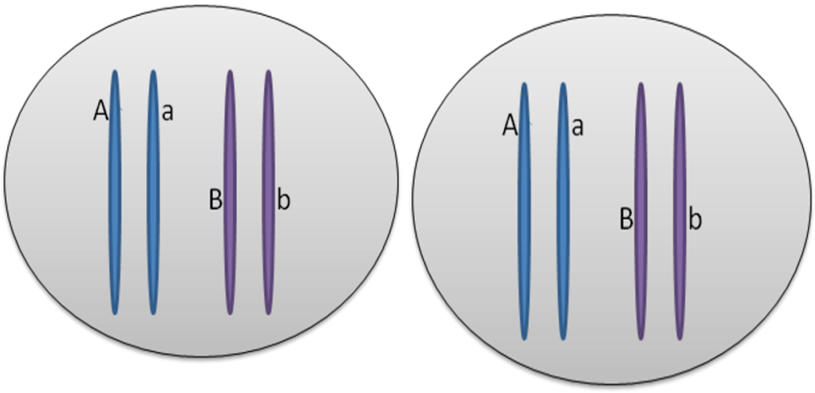
*For **good** answers, students should have a total of 8 chromatids with each allele being present on the adjacent sister chromatids. The DNA content is 4C. **Excellent** answers will include an intact nuclear envelope and indicate that the chromosomes are still decondensed. **Poor** answers will label the sister chromatids with different alleles, will not have the sister chromatids physically touching, do not show duplication of the genetic material, or will already show the chromosomes entering into mitosis (aligning along the metaphase plate).*

- Metaphase (Mitosis)



*For a **good** answer, the students will show the chromosomes aligned along the metaphase plate and have the mitotic spindle and centromere labeled and 4C DNA content. **Excellent** answers will indicate nuclear envelope breakdown has occurred and chromatin condensation has happened. **Poor** answers will include a loss in the total number of chromatids from the previous section, will have the chromosomes rotated 90 degrees, or will pair the homologous chromosomes along the metaphase plate.*

- After cytokinesis (Mitosis)

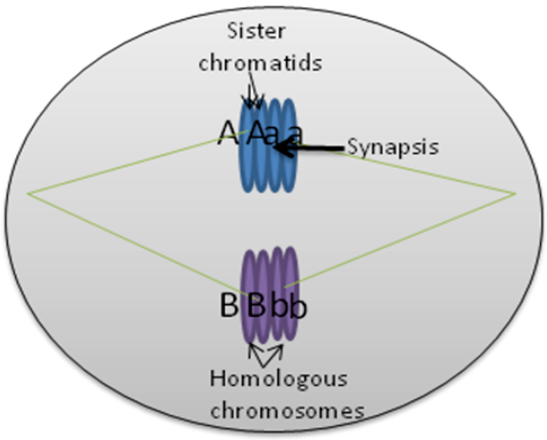


***Good** answers will diagram two identical cells the same as the cell in question 1. The DNA content of each cell is 2C. **Excellent** answers indicate that the DNA is now decondensed and the nuclear envelope has reformed. **Poor** answers will show daughter cells containing different genotypes and chromosome composition from the parent cell or will label the chromosomes as sister chromatids.*

Label your pictures with terms such as centromeres and mitotic spindle. What is the DNA content (C) at each of these stages?

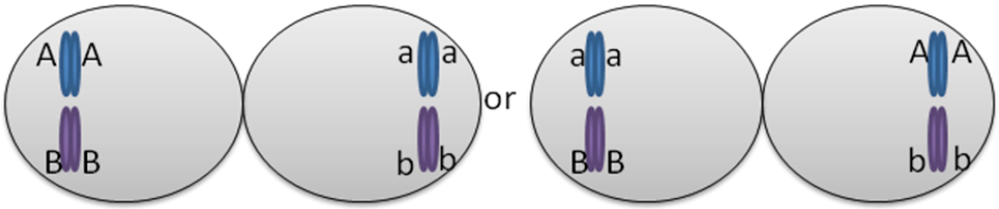
3. Your original cell (in question 1) enters **meiosis**.
   Draw your cell at the following stages:

- metaphase I



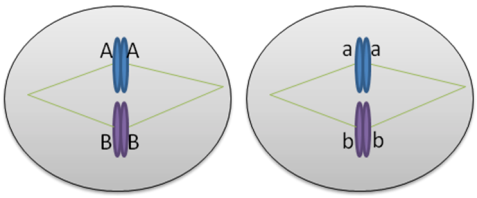
Good *answers will pair homologous chromosomes on the metaphase plate and successfully indicate sister chromatids, homologous chromosomes, and synapsis.* ***Excellent*** *answers will indicate diagram recombination at the synapse and show appropriate genetic exchange of the alleles.* ***Poor*** *answers will not include the pairing of homologous chromosomes but instead show alignment similar to what occurs in metaphase during mitosis. Some students will quadruple rather than double the DNA content, will label the connection between sister chromatids as the synapse, or will mislabel the sister chromatids and homologous chromosomes.*

- telophaseI/cytokinesis

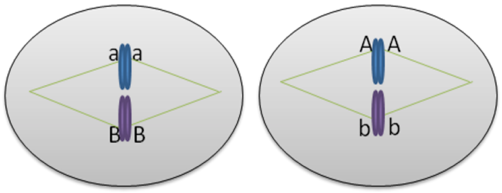


Good *answers will have the homologous chromosomes separated to opposite poles with each new cells containing two sister chromatids of each chromosome.* ***Excellent*** *answers will diagram both potential results and explain that according to the principle of independent assortment the alleles will segregate independently.* ***Poor*** *answers with have cells lacking one of the chromosomes or containing two different alleles in each of the daughter cells assuming no recombination has taken place (i.e. Aa).*

- metaphase II

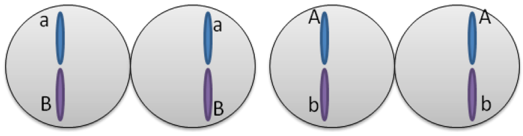


or

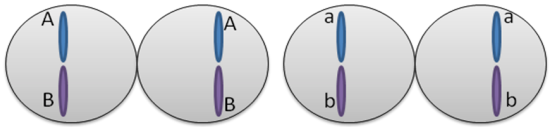


Good *answers will show two of the daughter cells from meiosis I with the sister chromatids of the same allele aligning along the metaphase plate.* ***Excellent*** *answers will include the mitotic spindles and both scenarios depending on independent assortment.* ***Poor*** *answers will most likely occur if there were mistakes in the students' diagram of meiosis I and may include having A and a paired on the metaphase plate.*

- telophaseII/cytokinesis.



or



*G**ood** answers will show four daughter cells each with half the DNA content (1C) of the original cell.* ***Excellent*** *answers will indicate that due to independent assortment you will generate daughter cells that contain AB and ab or daughter cells that are Ab and aB.* ***Poor*** *answers will not contain half the DNA content of the parent cells and will not have four daughter cells.*

Label your model identifying sister chromatids, homologous chromosomes, and synapsis. Use your model to explain independent assortment.