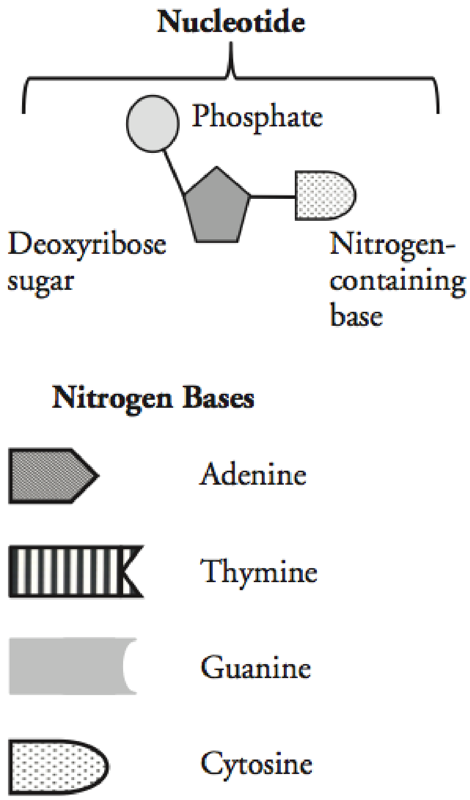
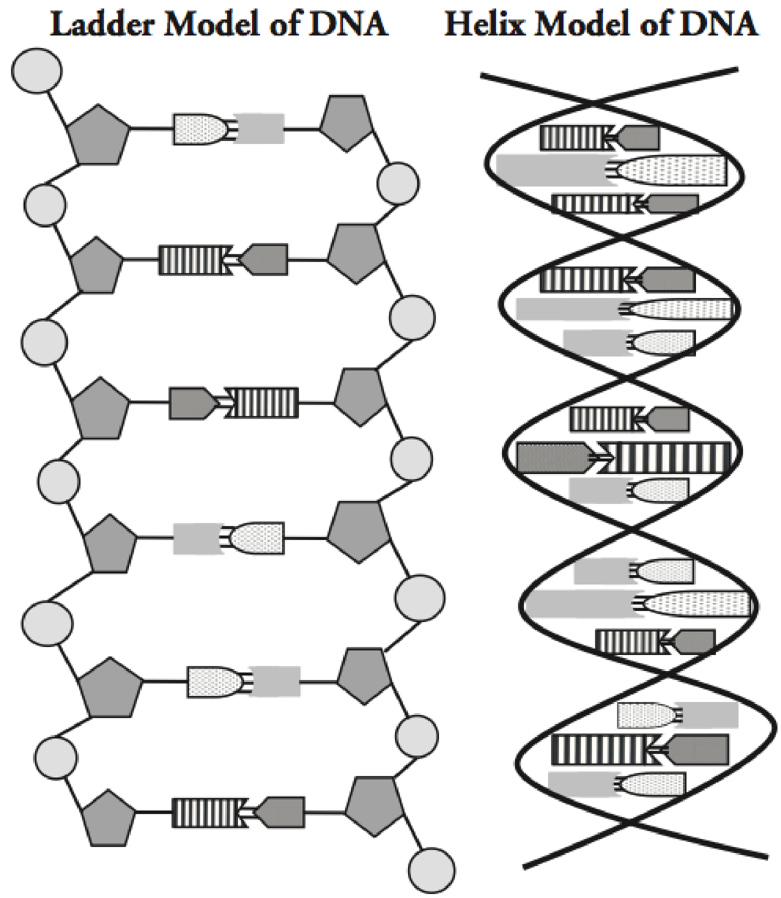
Names: ____

Model 1: Recap on DNA structure

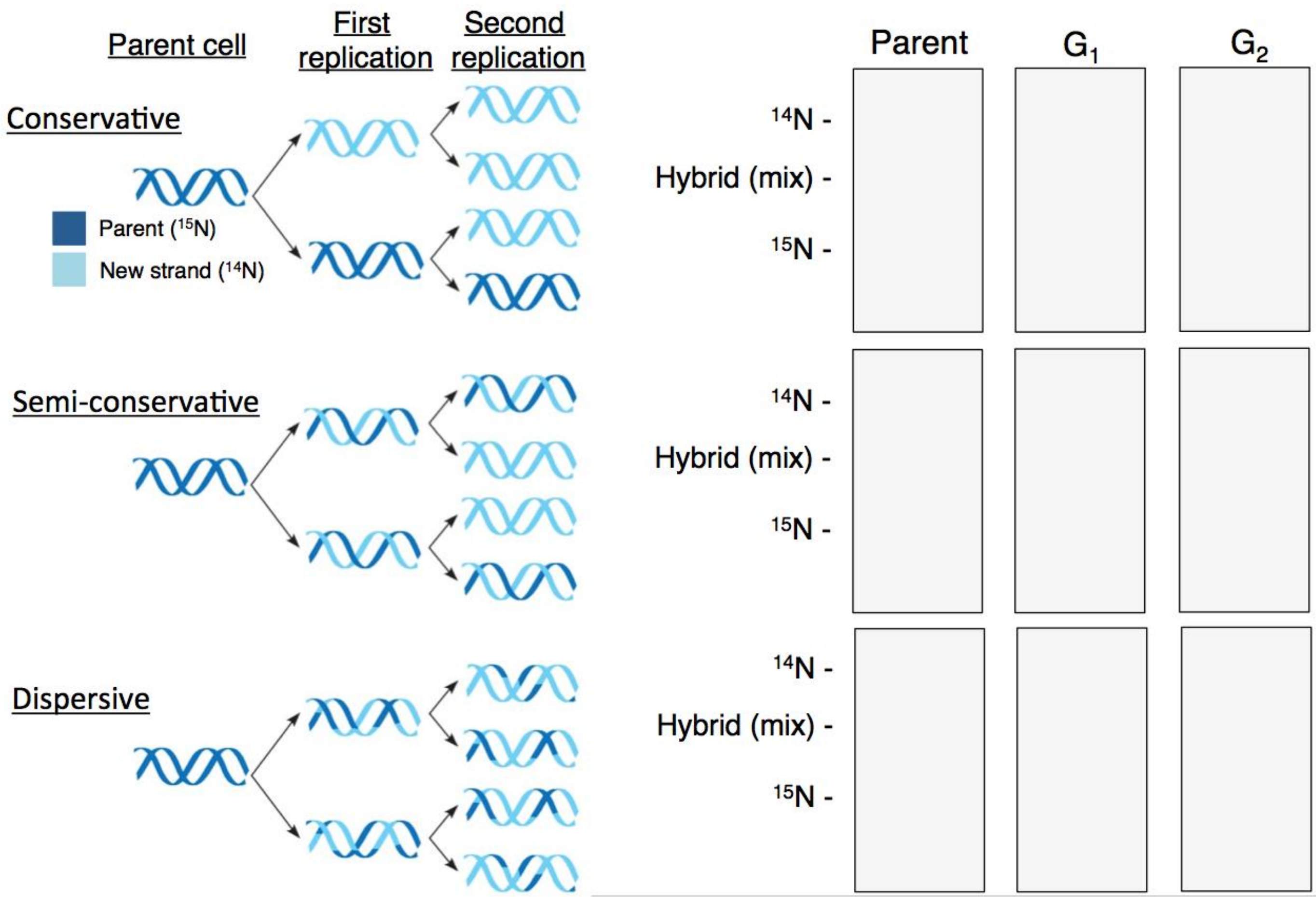




1. Look at the two strands of DNA and justify your response to each question in 1-2 sentences:
   - **a.** Do the two strands run **parallel** (*the ends of strands match*) or **antiparallel** to one another?
   - **b.** What "rules" for complementary base pairing between nitrogenous bases can you determine?
   - **c.** How do weak hydrogen bonds reinforce the rules in part b? Hint: hydrogen bonds are represented as thin lines connecting the two strands of DNA.
   - **d.** What can you say about the **ratios** of *adenine, thymine, guanine,* and *cytosine* in a double helix of DNA?
   - **e.** The phosphate and deoxyribose sugar groups form a DNA "backbone". Why is this name appropriate?

Model 2: Potential Replication Patterns

*Meselson and Stahl performed an experiment in 1958 to determine whether any "parent" DNA could be found in "daughter" DNA strands following replication. Three potential hypotheses were posed regarding parental DNA distribution; **conservative, semi-conservative**, and **dispersive** replication. By labeling parental DNA with an uncommon isotope of nitrogen (^{15}N) and then growing bacterial cells in ^{15}N media during subsequent cell divisions, Meselson and Stahl could track the fate of DNA following replication.*



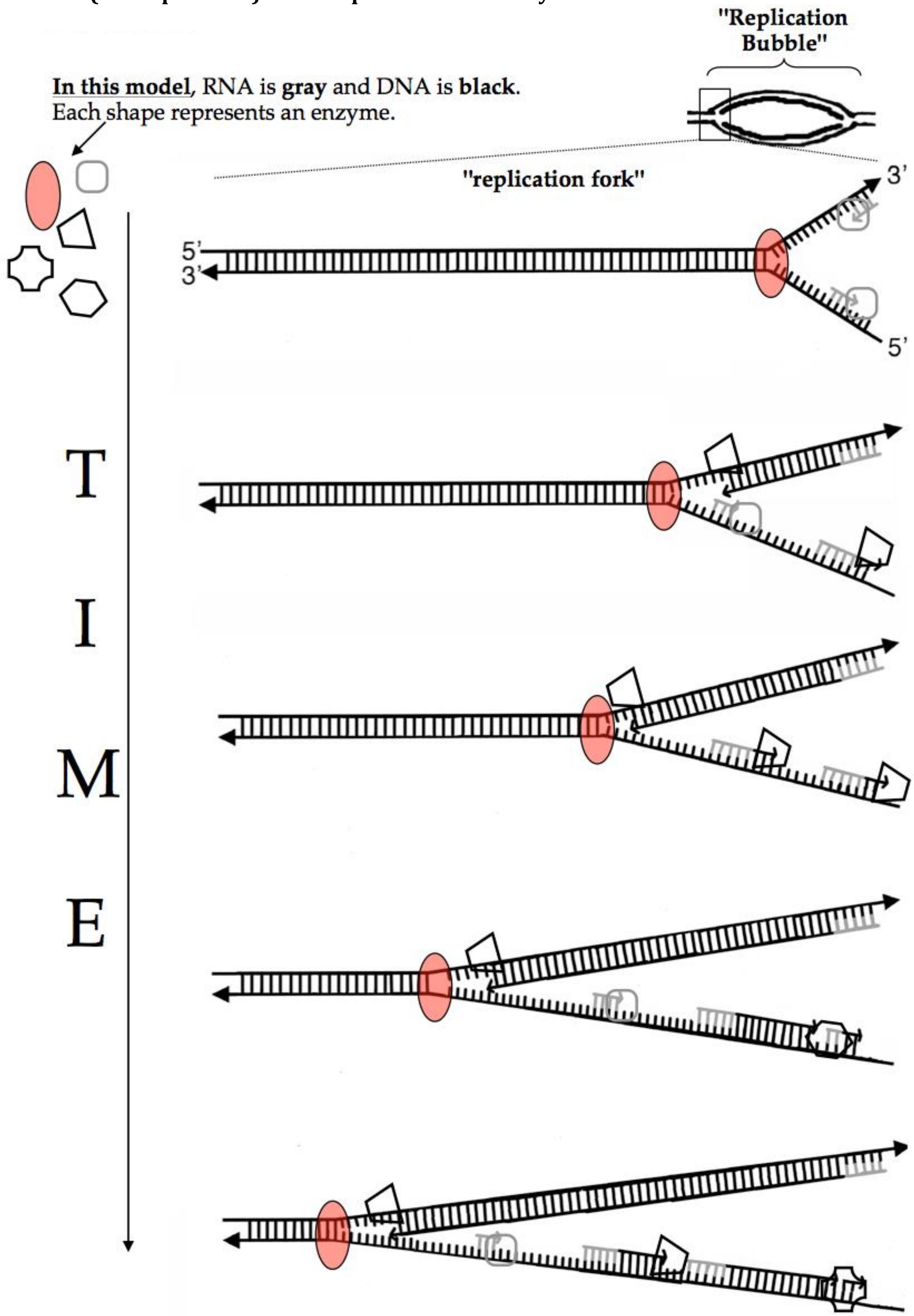
1. Given the illustrations on the left side of Model 2, explain why the terms **conservative, semi-conservative,** and **dispersive** are appropriate for the hypotheses regarding DNA replication.

2. *To visualize DNA, samples were centrifuged on a cesium gel to create a density gradient. DNA containing ^{15}N is denser and travels further down the gel than ^{14}N. Pure ^{15}N isotope DNA could only be composed of parental DNA, while pure ^{14}N strands would contain <u>no</u> parental DNA. By comparing the relative size of DNA bands for pure ^{15}N, ^{14}N, and DNA with a mix of both isotopes, Meselson and Stahl confirmed the way that DNA replication occurs.*

a. Using the information above, draw in bands for the parent, G1 (first daughter generation) and G2 (daughters of G1)

b. Based on your current understanding, which model for DNA replication do you think is correct? Why?

Model 3 (Concept Check): DNA Replication in Eukaryotes



1. Label the 5' and 3' ends of the new strands in the middle panel of Model 3, as well as the 5' and 3' ends of both parent strands.
    a. In which direction is DNA replication proceeding? *5'→3'* or *3'→5'* ?

2. Match each enzyme's shape with its function and fill in the column on the left:

Shape:	Job:	Name:
	Enzyme that synthesizes the largest part of the new **DNA** strands	
	Enzyme that forms a phosphodiester bond **without** adding a new nucleotide	
	Enzyme that synthesizes a short **RNA** primer	
	Enzyme that replaces RNA nucleotides with DNA	
	Enzyme that breaks H-bonds between strands of the **parent DNA** helix	

    a. Identify the name for each enzyme and fill that into the right hand column. One name will be used twice.
        i. ***DNA polymerase, primase, helicase, ligase (****Hint: "to ligate" means "to put together")*
    b. Also label these enzymes in a selected panel in Model 3.

3. The enzyme that does the majority of DNA synthesis is **DNA polymerase III**, while the enzyme that replaces RNA nucleotides with DNA is called **DNA polymerase I**. Denote DNA polymerase "I" and "III" in the table above and in one panel of your model. *(PS – the numbers I and III reflect an order of discovery)*

4. One new DNA strand in each replication fork is made in pieces, while the other is made continuously. Explain why this is the case in 1-2 sentences.

5. Label the **leading** and **lagging** strands in the middle panel of Model 3.

6. New DNA strands always begin with a short RNA primer. RNA eventually is replaced with DNA, which appears to be a waste of energy at first glance. Why are RNA polymerases (primases) needed in the first place? Consider what primases can do that DNA polymerases apparently cannot do.