Name _____ Pd _____ Date _____

Biology 1R
Gametogenesis Modeling
Performance Assessment

Objective:
- construct a model of a homologous pair of chromosomes
- demonstrate the movements of DNA during gametogenesis.
- relate these movements to reduction division.
- explain the differences between oogenesis and spermatogenesis.

Materials: construction paper backgrounds, 2 homologous pairs of doubled chromosomes (2 pink and 2 blue pipecleaners), chromatin (2 pink and 2 blue pieces of thread)

Procedure:
- students will work in teams of 2
- students will have short time to prepare
- students will demonstrate how DNA moves during each stage of meiosis (for the teacher)
- students will answer questions (orally for the teacher) related to reduction division and the differences between spermatogenesis and oogenesis

Scoring Rubric:

One point/item:
- ☐ correctly constructs a model of a homologous pair of chromosomes
- ☐ uses correct form of DNA in the various phases
- ☐ uses correct terminology
- ☐ shows correct movement of DNA
- ☐ relates DNA movement to correct stage
- ☐ explains the role of meiosis I in reducing the number chromosomes
- ☐ explains the role of meiosis II in reducing the amount of DNA
- ☐ correctly relates the need for meiosis

Total Score: _____ out of 8

Transcription Lego Lab

How does the order of DNA bases (genetic code) determine our traits?

Prelab:

- What's mRNA and why do we need it?
- Introduction to transcription using overhead illustrations

Part I: Build a gene

- Explain the One Gene - One Polypeptide hypothesis
- Give each table a bag containing their part of the DNA code, two index cards, and the appropriate lego assortment as follows:

Number of Legos Needed by Each Group

	Group #					
Molecule/Legos	One	Two	Three	Four	Five	Six
DNA Code	TACGCG	GACTTC	CAGACA	AAGCCT	TAGCTC	CGAATC
Deoxyribose large red lego	6	6	6	6	6	6
DNA phosphate small red lego	6	6	6	6	6	6
Ribose large blue lego	6	6	6	6	6	6
RNA phosphate small blue lego	6	6	6	6	6	6
Thymine	1	2	0	1	2	1
Uracil	1	1	3	2	1	2
Cytoseine	4	3	3	3	3	3
Guanine	4	3	3	3	3	3
Adenine	2	3	3	3	3	3

- Each group builds its 6 DNA nucleotides.
- Each table builds a DNA strand to match the assigned DNA code.
- Teacher checks the accuracy of each groups model, coaching students through any necessary adjustments.
- Teacher explains that we won't build the second DNA strand since transcription uses only one DNA strand as a template (unlike replication which requires two DNA strands as templates).

- Each group will bring their model to the front table (one group at a time, in number order) in order to assemble a gene. Teacher explains that genes can be hundreds to thousands of DNA bases long.

Part II: Build RNA nucleotides
- Each group builds 6 RNA nucleotides using the remaining legos.

Part III: Transcribe the gene to make m-RNA
- Each group will bring their RNA nucleotides to the gene (one group at a time, in number order).
- Beginning with the first DNA nucleotide of the gene, make mRNA (one nucleotide at a time).

Part IV: Learn how to "read" the mRNA to determine the order of amino acids in the protein
- Teacher explains codon concept.
- Teacher distributes the Wobble Table WS and explains how to use the table.
- Students work through a practice problem using the wobble table while teacher circulates and assists where needed.

Part IV: Build the protein
- Each group (one group at a time, in number order) will bring the two index cards to the mRNA.
- Using the wobble table, they will figure out which amino acids are coded for in their segment of the gene. Then they will write the names of the amino acids on the index cards (one amino acid per card). The teacher will verify that the genetic code has been properly translated.
- Before sitting down, each group will place their index cards (in proper order) on the chalkboard using funtak.
- When the sixth group has placed their index cards on the board, the teacher will draw lines between index cards while explaining peptide bonds.

Next Question: How are amino acids assemble in the correct order during protein synthesis? (translation)

Homework: Complete the wobble table worksheet.

Transcription Lego Lab
Answer Key

Group #	DNA	mRNA	Amino Acid
1	TAC	AUG	start
	GCG	CGC	arginine
2	GAC	CUG	leucine
	TTC	AAG	lysine
3	CAG	GUC	valine
	ACA	UGU	cysteine
4	AAG	UUC	phenylalanine
	CCT	GGA	glycine
5	TAG	AUC	isoleucine
	CTC	GAG	glutamate
6	CGA	GCU	alanine
	ATC	UAG	stop

Biochemical Evidence for Evolution Set-Up

Each group of 3 needs:
snack size resealable plastic bags each containing a minimum of a single, unique color bead and labeled with an amino acid name, three 30-cm pipe cleaners with one end inserted through a hole in a note card (labeled human, horse, gorilla) secured to card by a twist.

Each student needs: the assessment handout (next two pages)

Biology 1R
Biochemical Evidence for Evolution
Performance Assessment

Introduction: If two organisms have similar DNA molecules, they have similar proteins. Similar proteins have similar amino acids sequences (orders). Thus, if amino acid sequences are similar, DNA of the organisms is similar.

Scientists believe that similar DNA sequences indicate a common origin. The more similar the DNA of two living organisms, the more closely related they may be to one another.

Hemoglobin, a protein in red blood cells, has been studied. Scientists know the specific amino acids and their arrangements in hemoglobin molecules of humans, gorillas, and horses.

Problem: How many differences are there in the amino acid sequences in similar portions of human, gorilla, and horse hemoglobin? How does this data support or refute the theory of evolution?

Procedure:

- Each group will be given 10 labeled bags, each with a different color bead inside. Each color represents a different amino acid (as labeled on the bag).
- Construct a model of the partial amino acid sequence of human, gorilla, and horse hemoglobin using the information below.

Human: gly lys val asp val asp glu val gly gly glu lys leu his val asp pro glu asp phe arg leu
Gorilla: gly lys val asp val asp glu val gly gly glu lys leu his val asp pro glu asp phe leu leu
Horse: asp lys val asp glu glu glu val gly gly glu lys leu his val asp pro glu asp phe arg leu

Data Collection: Count and record (in the table below) the number of differences in the sequence of amino acids in the partial hemoglobin molecules models you've constructed.

Number of Differences as a Function of Organisms	
Organisms	**Number of Differences**
Gorilla and Human	
Horse and human	
Gorilla and horse	

Conclusion and Analysis: Answer the following questions using the data and your prior knowledge.

1. Which two organisms have the most similar amino acid sequence for this part of their hemoglobin molecule?

2. What ultimately determines the amino acid sequence during protein synthesis?

3. Give reasons for supporting or rejecting the following statement. Upon examination, the segments of human and gorilla DNA responsible for inheritance of hemoglobin should have nearly identical nucleotide base sequences.

4. Where do we get our DNA from? Where did our parents get their DNA from?

5. If a change occurs in the DNA in an egg or sperm cell, the resulting offspring could be affected and will pass on this genetic change to their offspring (and so on, and so on). What do we call such a change in the base sequence of DNA? (HINT: think about the Protein Synthesis Performance Assessment and Hugo DeVries' explanation about the reason there is variation within species).

6. It has been determined that random changes in DNA occur naturally over time. The more time that has passed, the more random changes there will be. Based on this reasoning explain why you support or reject the following statement. Organisms which have close biochemical similarities (such as human and gorilla hemoglobin) have a more recent common ancestor than organisms which do not have close biochemical similarities.

Biology 1R
Biochemical Evidence for Evolution
Performance Assessment Rubric

Construction of hemoglobin: (one point each) ___ of 6

	Human	Gorilla	Horse
correct # of amino acids			
correct order of amino acids			

Data Collection: (one point each) ___ of 3

	Correct # of differences
gorilla and human	
horse and human	
gorilla and horse	

Conclusion and Analysis: ___ of 9

Question 1:
1 pt for "gorilla and human"

Question 2:
1 pt for "DNA" or "gene/allele"
2 pts for "nucleotide/base sequence of DNA"

Question 3:
1 pt for supporting
2 pts. For supporting with "similar amino acid sequence thus similar nucleotide base sequence"

Question 4:
1 pt for "our parents/their parents/our ancestors"

Question 5:
1 pt for "mutation"

Question 6:
1 pt for "the more recent the common ancestor the fewer differences in nucleotide base sequence"
2 pts for above and "thus difference amino acid sequence"

Total: ___ of 18