Protein Synthesis Simulation

Name(s) _______________________________ Date ________

Period ______

Benchmark:
SC.912.L.16.5 as AA: Explain the basic processes of transcription and translation, and how they result in the expression of genes. (Assessed as SC.912.L.16.3 AA)

Background:
DNA carries the information for the synthesis of all the proteins of an organism. Protein molecules are large and complex, composed of hundreds of amino acids. The sequence of amino acids in a protein molecule is determined by the sequence of the nucleotides in the DNA of an organism.

In the first step of protein synthesis, the nucleotide sequence of the DNA is transcribed (the process is transcription) into a long single-stranded molecule of mRNA (messenger). The mRNA moves through pores in the nuclear membrane to the cytoplasm where it will attach to a ribosome. The genetic code on mRNA is read three “letters or bases” at time, each group of three bases on mRNA is called a codon which correspond to a specific amino acid. When the mRNA is attached to a ribosome, the tRNA (transfer) will bring amino acids into place according to the codons on mRNA. Each tRNA has three unpaired bases called anti-codons. The tRNA anticodon is complementary to the mRNA codon. The decoding of the mRNA message into a protein is a process called translation. The amino acids then link together by forming peptide bonds and become a protein molecule.

Purpose:
To simulate the roles of mRNA, ribosomes, and tRNA in the synthesis of proteins.

Protein Synthesis Simulation:

1. Obtain your DNA strand and write the number of the DNA strand here: _______________________________

2. Staying at your seat, transcribe the DNA into mRNA codons. Write the mRNA sequence here:

3. Write the tRNA sequence that corresponds to your mRNA here: (group them as anti-codons)

4. Move around the room looking for the tRNA cards that match your anti-codons. Write down the words in order:

   ______________________________________  ______________________________________

If you complete this activity correctly #5 should be a sentence. If it does not make a sense, you have made a mistake and need to go back and start over.
Questions:

1. Where in the cell do steps 1 and 2 above occur?

2. Where in the cell do steps 3-4 occur?

3. Which step of this activity represents transcription?

4. Which step of this activity represents translation?

5. What does your final sentence represent?

6. What does each of your words represent?

7. Each DNA sequence started with ATG and ended with TAG. WHY?

8. When we are talking about errors in DNA, and protein synthesis, what do we call any mistakes?

9. Explain two ways a “mistake” could occur in this activity:

10. Would these “mistakes” affect individuals or an entire species?

11. What role did you play in this activity?

12. What role does your paper play in this activity?
### tRNA Cards with words (that go on BACK of the card)

<table>
<thead>
<tr>
<th>UAG - Stop</th>
<th>CCG - is</th>
<th>CGC - water</th>
<th>AUG- Start</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCU -subject</td>
<td>CGG - every</td>
<td>AAA - Your</td>
<td>CGA - drink</td>
</tr>
<tr>
<td>CGU - day</td>
<td>AAC - mother</td>
<td>AAG - wears</td>
<td>AAU - dresses</td>
</tr>
<tr>
<td>ACG - funny</td>
<td>ACC - have</td>
<td>ACU - dog</td>
<td>ACA - breath</td>
</tr>
<tr>
<td>AGA - the</td>
<td>AGG - are</td>
<td>AGU - Beatles</td>
<td>AGC - best</td>
</tr>
<tr>
<td>AUA - rock</td>
<td>AUC - band</td>
<td>AUU - an</td>
<td>CAA - old</td>
</tr>
<tr>
<td>CAC - rubber</td>
<td>CAG - breaks</td>
<td>CAU - pulled</td>
<td>CCA - when</td>
</tr>
<tr>
<td>CCC - Biology</td>
<td>CUA - I</td>
<td>CUC - love</td>
<td>CUG - roll</td>
</tr>
<tr>
<td>CUU - music</td>
<td>GAA - all</td>
<td>GAC - demented</td>
<td>GAG - puppies</td>
</tr>
<tr>
<td>GAU - and</td>
<td>GCA - so</td>
<td>GCC - much</td>
<td>GCCG - fun</td>
</tr>
<tr>
<td>GCU - education</td>
<td>GGA - door</td>
<td>GGC - to</td>
<td>GGG - future</td>
</tr>
<tr>
<td>GGU - father</td>
<td>GUA - a</td>
<td>GUC - dress</td>
<td>GUG - brother</td>
</tr>
<tr>
<td>GUU - nothing</td>
<td>UAA - we</td>
<td>UAC - in</td>
<td>UAU - this</td>
</tr>
<tr>
<td>UCA - together</td>
<td>UCC - must</td>
<td>UCG - be</td>
<td>UCU - informed</td>
</tr>
<tr>
<td>UGA - around</td>
<td>UGC - you</td>
<td>UGG - read</td>
<td>UGU - little</td>
</tr>
<tr>
<td>UUA - DNA</td>
<td>UUC - code</td>
<td>UUG - for</td>
<td>UUU - life</td>
</tr>
</tbody>
</table>

### DNA Fragments (that go on the cards):

1. ATGAAAAAACAAAGGTACACATCTAG  
2. ATGAAAAACAAATTGCACGTAG  
3. ATGTAACCAACTACATAG  
4. ATGAGGACTGAGAAGCAATCTCAG  
5. ATGATTCAACACATCCAGCCACATTAG  
6. ATGCCCCCGAGAGGCCTTAG  
7. ATGCGAGGGCCGCGTGTAG  
8. ATGCTACTCATAGATCTGCTTCTAG  
9. ATGTAACGAGGAAGCAGATGAG  
10. ATGCCGCCGACGCGCGCTTAG  
11. ATGGCTCCGAGAGGAGGCAGAGGTAG  
12. ATGGCTCCGAGAGGAGGCAGAGGTAG  
13. ATGAAAGTGAAGGTGTAG  
14. ATGTAAGGGAATACTATCTCATAG  
15. ATGTAAATCCTCGTCTCGGCGTGTAG  
16. ATGATAGGATCTGCTTCCGAGAAGCTAG  
17. ATGCCCCCGAATGATGCTAG  
18. ATGTGGGTATGTCGGCGTGTAG  
19. ATGTGGGTATGTCGGCGTGTAG  
20. ATGGCTACTCATAGATCTGCTTCTAG  
21. ATGGCTACTCATAGATCTGCTTCTAG  
22. ATGGCTACTCATAGATCTGCTTCTAG  
23. ATGGCTACTCATAGATCTGCTTCTAG  
24. ATGGGGCTACAAATTTCCGCCGTTAG  
25. ATGAAAAACAGATGGAAGGTGTAG
KEY to the 25 Sentences:

1. Your mother wears a rubber band.
2. Your mother dresses you funny.
3. We have dog breath.
4. The Beatles are the best rock band.
5. An old rubber band breaks when pulled.
6. Biology is the best subject.
7. Drink water every day.
8. I love rock and roll music.
9. We are all demented puppies.
10. Biology is so much fun.
11. Education is the door to the future.
12. Your father wears a dress.
14. We are all in this together.
15. We must be informed every day.
16. Rock and roll music is the best.
17. Biology is all around you.
18. Read a little every day.
19. DNA is the code of life.
20. DNA must be read for life.
21. I love the Beatles and Biology.
22. Your mother wears funny dresses.
23. Puppies drink water everyday.
24. Biology is in your life every day.
25. Your mother and father are the best.

ANSWERS TO QUESTIONS:

1. Nucleus
2. Ribosome
3. Transcribing DNA into mRNA or step #2
4. Finding the words and building the sentence or step #4
5. Protein
6. Amino Acid
7. To Start and Stop the process
8. Mutations
9. Mistakes: transcribing DNA into mRNA; mRNA to tRNA; dividing up bases into threes; finding words.
10. Individuals because mistake occurring in a body cell NOT a gamete.
11. tRNA
12. Ribosome
1. ATGAAAAAACAAAGGTACACACATCTAG

2. ATGAAAAAACAAATTGCACGCACGTAG
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3.</strong></td>
<td>ATGTAAACCACTACATAG</td>
</tr>
<tr>
<td><strong>4.</strong></td>
<td>ATGAGAAGTAGGAGAAGCATAATCTTAG</td>
</tr>
</tbody>
</table>
5. ATGATTCAACACATCCAGCCACATTAG

6. ATGCCCCCCGAGAAGAAGGCCCTTTAG
7. ATGCGACGCGCCGGCTAG

8. ATGCTACTCATAGATCTGCTTTTAG
9. ATGTAAGGGGAAGACGAGTAG

10. ATGCCCCCGGGGCAAGCCGCGTAG
11. ATGGCTCCGAGAGGAGGCAGAGGGTAG

12. ATGAAAGGTAAGGTTAGTCTTAG
13. ATGAAAAGTGAAAGGTTTAG

14. ATGTAAAGGGAATATACTATTTCATAG
17.

ATGCCCCCGGAATGATGCTAG

18.

ATGTGGGGTATGTCGGGCCTTAG
19. ATGTTACCGAGATTCTTGTTTTAG

20. ATGTTATCCTCGTGTTGTTTTTAG
21. ATGCTACTCAGAAGTGATCCCTAG

22. ATGCTACTCAGAAGTGATCCCTAG
23. ATGGAGCGACGCGCCGCGTTAG

24. ATGCCCCCGTACAAATTTTCGGCGTTAG
25.

ATGAAAAACGATGGTAGGAGAAGCTAG

COPY THE FOLLOWING PAGES FRONT TO BACK...KEEPING THEM IN ORDER—THESE ARE YOUR RNA/WORD CARDS—suggestion: make copies on card stock paper!
IS

STOP

START

WATER

EVERY

SUBJECT
<table>
<thead>
<tr>
<th>AAA</th>
<th>CGA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CGU</td>
<td>AAC</td>
</tr>
<tr>
<td>AAG</td>
<td>AAU</td>
</tr>
<tr>
<td>DRINK YOUR</td>
<td>MOTHER DAY</td>
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<tr>
<td>------------</td>
<td>------------</td>
</tr>
<tr>
<td>DRESSES WEARS</td>
<td></td>
</tr>
</tbody>
</table>
HAVE

FUNNY

BREATH

DOG

ARE

THE
<table>
<thead>
<tr>
<th>AGU</th>
<th>AGC</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUA</td>
<td>AUC</td>
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<tr>
<td>AUU</td>
<td>CAA</td>
</tr>
</tbody>
</table>
BEST  BEATLES
BAND  ROCK
OLD    AN
<table>
<thead>
<tr>
<th>CAC</th>
<th>CAG</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAU</td>
<td>CCA</td>
</tr>
<tr>
<td>CCC</td>
<td>CUA</td>
</tr>
<tr>
<td>BREAKS</td>
<td>RUBBER</td>
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<tr>
<td>WHEN</td>
<td>PULLED</td>
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<tr>
<td>I</td>
<td>BIOLOGY</td>
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<tr>
<td>CUC</td>
<td>CUG</td>
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<td>CUU</td>
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<td>GAC</td>
<td>GAG</td>
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<td>ROLL</td>
<td>LOVE</td>
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<tr>
<td>ALL</td>
<td>MUSIC</td>
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<tr>
<td>PUPPIES</td>
<td>DEMENTED</td>
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<td>GAU</td>
<td>GCA</td>
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<td>GCC</td>
<td>GCG</td>
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<td>GCU</td>
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<td>AND</td>
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<td>EDUCATION</td>
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<tr>
<td>GGU</td>
<td>GUA</td>
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<td>GUC</td>
<td>GUG</td>
</tr>
</tbody>
</table>
FUTURE  TO  A  FATHER
BROTHER  DRESS
<table>
<thead>
<tr>
<th>GUU</th>
<th>UAA</th>
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</thead>
<tbody>
<tr>
<td>UAC</td>
<td>UAU</td>
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<tr>
<td>UCA</td>
<td>UCC</td>
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<tr>
<td>WE</td>
<td>NOTHING</td>
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<tr>
<td>THIS</td>
<td>IN</td>
</tr>
<tr>
<td>MUST</td>
<td>TOGETHER</td>
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<td>UCG</td>
<td>UCU</td>
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<td>UGA</td>
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<td>UGG</td>
<td>UGU</td>
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<tr>
<td>INFORMED</td>
<td>BE</td>
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<tr>
<td>YOU</td>
<td>AROUND</td>
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<td>LITTLE</td>
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<td>UUA</td>
<td>UUC</td>
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<tr>
<td>UUG</td>
<td>UUU</td>
</tr>
<tr>
<td>CODE</td>
<td>DNA</td>
</tr>
<tr>
<td>------</td>
<td>-----</td>
</tr>
<tr>
<td>LIFE</td>
<td>FOR</td>
</tr>
</tbody>
</table>
DNA EXTRACTION USING STRAWBERRIES

Name(s) _______________________________ Date __________

Period _______

BENCHMARK:

SC.912.L.16.10 AA: Evaluate the impact of biotechnology on the individual, society and the environment, including medical and ethical issues.

SC.912.L.16.9 as AA: Explain how and why the genetic code is universal and is common to almost all organisms. (Assessed as SC.912.L.16.3 AA [in different benchmark group])

Background:
DNA isolation is one of the most basic and essential techniques in the study of DNA. The extraction of DNA from cells and its purification are of primary importance to the field of biotechnology and forensics. Extraction and purification of DNA are the first steps in the analysis and manipulation of DNA that allow scientists to detect genetic disorders, produce DNA fingerprints of individuals, and even create genetically engineered organisms that can produce beneficial products such as insulin, antibiotics, and hormones.

DNA can be extracted from many types of cells. The first step is to lyse or break open the cell. This can be done by grinding a piece of tissue in a blender. After the cells have broken open, a salt solution such as NaCl and a detergent solution is added. These solutions break down and emulsify the fat & proteins that make up a cell membrane. Finally, alcohol is added because DNA is soluble in water. The alcohol causes the DNA to precipitate, or settle out of the solution, leaving behind all the cellular components that aren't soluble in alcohol. The DNA can be spooled (wound) on a stirring rod and pulled from the solution at this point.

WHY USE STRAWBERRIES? Because strawberries have eight times the amount of DNA of normal cells.

Purpose: To extract DNA from plant cells.

Materials: (for each group of 4)
- 1-3 strawberries; Frozen strawberries should be thawed at room temperature.
- 20 ml graduated cylinder
- 10 ml DNA Extraction Buffer (see procedure)
- Ice cold 91% isopropyl alcohol
- 1 Ziploc® bag
- 1 test tube
- 1 funnel lined with a moistened paper towel or cheesecloth
- Transfer pipette
- Stirring rod or coffee stirrer
Procedure:
1. Prepare the extraction buffer:

   **Extraction buffer:**
   - 100 ml liquid detergent *(Dawn ®)*
   - 900 distilled water
   - 15 grams NaCl

2. Put the rubbing alcohol in the freezer to chill. (You'll need it later.)
3. Put the strawberries in the plastic bag and push out all the extra air. Seal it tightly.
4. With your fingers, squeeze and smash the strawberry mixture for 2 minutes.
5. **Add 10 ml DNA Extraction buffer to your bag. Remove air and seal.**
6. **Mash for 1 minute.**
7. Pour the strawberry mixture from the bag into the filtered funnel. Let it drip into the test tube until there is no liquid left in the funnel. This separates the cells from each other, so you now have a really thin strawberry-cell soup.
8. Let the mixture sit for 5-10 minutes.
9. Tilt the test tube and very slowly pour the cold rubbing alcohol (6 mL) down the side. The alcohol should form a layer on top of the strawberry liquid. Pour until you have about the same amount of alcohol in the tube as strawberry mixture. (Don't let the alcohol and strawberry liquid mix. The DNA collects between the two layers!)
10. Dip the stirring rod into the test tube where the alcohol and strawberry layers meet. Slowly turning the stirring rod will spool (wrap) the DNA around the rod so it can be removed from the liquid. Pull up the rod. The whitish, stringy material is DNA containing strawberry genes!

Questions:

1. **DNA Extraction Summary Chart**

<table>
<thead>
<tr>
<th>Questions:</th>
<th>Strawberry Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prokaryote or Eukaryote?</td>
<td></td>
</tr>
<tr>
<td>Autotroph or Heterotroph?</td>
<td></td>
</tr>
<tr>
<td>What lyses the cell?</td>
<td></td>
</tr>
<tr>
<td>What protects the DNA?</td>
<td></td>
</tr>
<tr>
<td>What precipitates the DNA?</td>
<td></td>
</tr>
<tr>
<td>Description of DNA Precipitate</td>
<td></td>
</tr>
<tr>
<td>Does it Spool?</td>
<td></td>
</tr>
</tbody>
</table>

2. Which of the following identifies the **CORRECT** sequence of steps for isolating the DNA:
   A. Collect cells, separate the DNA from proteins and cellular debris, and lyse the nuclear membrane to release DNA, precipitate the DNA.
   B. Collect cells, lyse the nuclear membrane to release DNA, precipitate the DNA, and separate the DNA from proteins and cellular debris.
   C. Precipitate the DNA, collect the cells, separate the DNA from proteins and cellular debris, lyse the nuclear membrane to release DNA from proteins and cellular debris.
D. Collect cells, lyse the nuclear membrane to release DNA, separate the DNA from proteins and cellular debris, and precipitate the DNA.

3. Why didn’t the alcohol freeze when you put it in the freezer? ____________________________________________

4. Explain what happened in the final step when you added alcohol to your strawberry extract:
   ______________________________________________________________________________________
   ______________________________________________________________________________________
   ______________________________________________________________________________________

5. If one strand of DNA reads: ATTCCCAT; what is the complementary strand after replication?
   ______________________________________________________________________________________

6. Discuss 2 reasons why is it important for scientists to be able to remove DNA from an organism.
   ______________________________________________________________________________________
   ______________________________________________________________________________________
   ______________________________________________________________________________________
   ______________________________________________________________________________________

7. The use of DNA technology is moving forward faster than any other area of biology.
   Identify and discuss ONE ethical and ONE social issue associated with the use of biotechnology.
   ______________________________________________________________________________________
   ______________________________________________________________________________________
   ______________________________________________________________________________________
   ______________________________________________________________________________________
   ______________________________________________________________________________________

8. Draw a diagram of DNA containing 5 sets of nucleotide bases labeling the base pairs, hydrogen bonds and sugars.
Lab: Thumbs Up, Thumbs Down

Name __________________________ Date __________________
Period_____________

Benchmark:
SC.912.L.15.1 AA Explain how the scientific theory of evolution is supported by the fossil record, comparative anatomy, comparative embryology, biogeography, molecular biology, and observed evolutionary change.
SC.912.L.15.10 as AA Identify basic trends in hominid evolution from early ancestors six million years ago to modern humans, including brain size, jaw size, language, and manufacture of tools.
(Assessed as SC.912.L.15.1 AA)

Background:
Primates have hands capable of grasping objects. The grasp is made possible by the opposable thumb, so called because it can move opposite to the rest of the fingers. Human thumbs have the greatest range of motion of all primates. The opposable thumb has given humans many evolutionary advantages. In this experiment, you will compare your performance on a series of tasks using and not using your thumb.

1. Why do you think that having opposable thumbs would be beneficial to living organisms?
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

2. How are opposable thumbs different between humans and other primates?
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

Purpose:
To examine the benefits of the evolution of the opposable thumb.
To assess the difficulty of common tasks without the use of an opposable thumb.

Hypothesis:
Read through the procedures and develop a testable hypothesis. ______________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

Materials:
Roll of Packing or Masking Tape  Clothing with Zipper  Coins of Various sizes
Clothing with Buttons  Cell Phone  Pencil & Paper
Laced Shoes  Plastic Drinking Cup  Clock or stopwatch
Bottle with Screw Top
Procedure:
1. Observe your hand. Notice especially the relationship of your thumb to the rest of your fingers and the rest of your hand. Note that your thumb can move in a number of directions and angles.

2. Perform the following tasks as you would normally, using your thumb and fingers. Your partner will record how long each task takes (in seconds) on the Data Table.
   - **Write your name** – first, middle, & last name
   - **Buttons** – unbutton & button an article of clothing
   - **Zipper** – zip up an article of clothing
   - **Tie Shoes**
   - **Open Bottle**
   - **Pick Up Coins** – pick up 3 random coins & place them in the cup (cannot slide them off the table!)
   - **Text** – Send an email - text message to your friend that reads: "Biology is my favorite subject."

3. Once you have completed ALL of the tasks using your thumb, raise your hand and your instructor will tape your thumbs to your palms (on both hands) with masking tape.

4. With your thumbs taped, repeat the tasks in Procedure #2. Allow a maximum of 1 minute for each task.

Data:

<table>
<thead>
<tr>
<th>Task</th>
<th>Using Thumb (Time in seconds)</th>
<th>Not Using Thumb (Time in seconds)</th>
<th>Difference (Time in seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing Name</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buttons</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zipper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tie Shoes</td>
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</tr>
<tr>
<td>Open Bottle</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Pick up Coins</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Text Message</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Bar Graph: Construct a bar graph of your data illustrating the relationship between time and task. Be sure to label your graph correctly. (Include a title, label each axis, and provide a key for the data bars)

Title: __________________________________________

Analysis Questions:
1. In general, what happened to the time needed to complete the tasks when your thumb was taped?
   _____________________________________________________________
   _____________________________________________________________

2. Rank the tasks from simplest to the most complex using the data collected when you were NOT using your thumb: ______________________________________________________
   _____________________________________________________________
   _____________________________________________________________

3. How did you determine which task was simplest and which task was the most complex?
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________

4. In our lab experiment, what was the control group? How did this differ from the experimental group?
   _____________________________________________________________
   _____________________________________________________________

5. As hominids evolved, what are 2 possible tasks the opposable thumb enabled them to perform that their ancestors’ might not have been able to perform? ___________________________________________________________
Conclusion:

1. Does your data support your hypothesis? Use your data to support your answer.

2. Identify 2 sources of error in this activity and describe 2 ways to eliminate each source of error.
Lab: Natural Selection in Goldfish

Name ____________________________ Date ________

Period________

Benchmark:
SC.912.L.15.13 AA: Describe the conditions required for natural selection, including: overproduction of offspring, inherited variation, and the struggle to survive, which result in differential reproductive success.

Background:
A predator feeds on a fish population made up of brown fish, which are slow and easily caught; and yellow fish, which are fast and not easily caught.

Purpose:
To simulate the process of natural selection.

Hypothesis: Read the entire investigation. Then work with your partner to develop a hypothesis for this activity.
If _____________________________________________________________, then ____________________________________________________________.

Materials:
Yellow “Goldfish”
Brown “Goldfish”

Procedure:
1. Obtain a RANDOM mixed population of goldfish from your teacher (10 fish).
2. Place your 10 fish on a paper towel and record the number of brown fish and yellow fish on the Data Table. This represents generation 1.
3. You are a predator that preys upon these fish. Remember, that the brown fish are slow and easily caught. The yellow fish are fast and not easily caught. Eat 3 brown fish. If you do not have three brown fish, then eat the remainder in yellow fish.
4. Each surviving brown fish produces one new brown fish, and each yellow fish produces one new yellow fish. Obtain the new generation of fish from the extras given to you. Record these numbers on the data table at the start of the next generation.
5. Repeat steps 3 and 4 for two more generations and record your data.
6. Create a line graph for the totals of both types of fish in each generation. Include: a Title, Axis Labels, and a Key for each data set.
Data:

Data Table: Goldfish Population

<table>
<thead>
<tr>
<th>Generation</th>
<th>Brown Fish</th>
<th>Yellow Fish</th>
<th>Total Fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Graph: Title: ________________________________

Analysis:

1. Use your knowledge of natural selection to explain what happened to each population of fish over the four generations?

__________________________________________________________________________________

__________________________________________________________________________________

__________________________________________________________________________________

__________________________________________________________________________________
2. Predict what you think will happen to each type of fish over 10 to 20 generations?

______________________________________________________________________________

______________________________________________________________________________

Why?

______________________________________________________________________________

Conclusion:

1. Using your data, was your hypothesis correct? If not, rewrite the hypothesis:

______________________________________________________________________________

______________________________________________________________________________

Extension:

1. A rare virus enters the ecosystem affecting only the fast swimming species causing them to swim extremely slowly. Explain how this might affect an ecosystem with both brown and yellow fish.

______________________________________________________________________________

______________________________________________________________________________

2. How might your results have varied if this scenario took place in murky water?

______________________________________________________________________________

______________________________________________________________________________