Mysterious Monster Lab

Background Information: Genes are the units that determine inherited characteristics, such as hair color or blood type. Genes are a segment of the DNA molecule that determines the structure of polypeptides (proteins) and thus a specific trait. The sequence of nucleotides in the DNA determines the sequence of amino acids in the polypeptides, and thus the structure of the proteins.

In a process called transcription, which takes place in the nucleus of the cell, messenger RNA (mRNA) reads and copies the DNA’s nucleotide sequence in the form of a complementary RNA molecule. Then the mRNA carries this information in the form of a code out of the nucleus and to the ribosome, where protein synthesis takes place. The code in, DNA and RNA, specifies the order in which amino acids are joined together to form a polypeptide. The code words in mRNA, however are not directly recognized by the corresponding amino acids. Another type of RNA called transfer RNA (tRNA) is needed to bring the mRNA and amino acids together. As the code carried by the mRNA is “read” on a ribosome, the proper tRNAs arrive in turn and give up amino acids they carry to the growing polypeptide chain. The process by which information from DNA is transferred into the language of proteins is known as translation.

In this investigation, the student will simulate the mechanism of protein synthesis and thereby determine the traits inherited by their fictitious organism called the Mysterious Monster (MM) whose cells contain 7 genes. Each of which is responsible for a certain trait.

Instructions: Transcribe the DNA sequence (gene) into mRNA. Do not take the DNA from the “nucleus.” Take the mRNA to your ribosome (desk). Separate the mRNA into codons. Translate the mRNA into amino acids using the amino acid chart. Use the amino acid sequence to determine the seven traits of your monster.
Procedure:

1) To determine the trait for each gene, fill in the information for each gene on the sheet below. Write the sequence of nucleotides for the mRNA that are complementary to the DNA. Then on the line provided write the sequence of anticodons for tRNA that are complementary to the mRNA. REMEMBER, THERE IS NO “T” IN RNA. (5 points per gene)

2) In order to determine the sequence of amino acids, match the mRNA codon with the specific amino acid using the genetic code table. Use a hyphen to separate each amino acid, and then record the proper amino acid sequence on the line provided.

3) Using the chart provided, match the proper trait with the amino acid sequence and record the trait in the line provided. If you do not find your amino acid sequence, then you made a mutation and need to go back and correct your mistake.

4) Repeat the above procedures for the rest of the monster traits.

5) Using the inherited traits, sketch the MM on a piece of computer paper. (10 points)

Problem Questions: (3 points each)

1. After analysis of your traits, what is determined by the DNA sequence in a chromosome?

2. Explain how the amino acid sequence determines the characteristics of an organism?

3. If there is a change in the DNA sequence, what are the possible outcomes? Explain and justify your answer.

4. Explain how the DNA sequence in your monster is similar to your DNA sequences? Justify your answer.

5. If the monster has a mutation and a nitrogen base is inserted after the third base in the hair gene, predict the result?
Hair Gene
DNA: _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ -
mRNA: _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - tRNA: _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - Amino Acid Sequence: ___________________________________________________________

Trait: ____________________________________________________________

Leg Gene
DNA: _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ -
mRNA: _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ -
tRNA: _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ -
Amino Acid Sequence: __________________________________________________________

Trait: ____________________________________________________________

Skin Gene
DNA: _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ -
mRNA: _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ -
tRNA: _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ _ _ -
Amino Acid Sequence: __________________________________________________________
Trait:__________________________________________________________

**Eyes Gene**
DNA: _ _ _-_ _ _ - _ _ _-_ _ _ - _ _ _-_ _ _ - _ _ _-_ _ _ - _ _ _-

mRNA: _ _ _ -_ _ _ - _ _ _-_ _ _ - _ _ _ - _ _ _-_ _ _ - _ _ _-_ _ _ - _ _ _-
tRNA: _ _ _-_ _ _ -_ _ _-_ _ _ -_ _ _ -_ _ _-_ _ _-_ _ _-_ _ _ - _ _ _-
Amino Acid Sequence:

Trait:__________________________________________________________

**Hair Texture Gene**
DNA: _ _ _-_ _ _ - _ _ _-_ _ _ - _ _ _-_ _ _ - _ _ _-_ _ _ - _ _ _-

mRNA: _ _ _ -_ _ _ - _ _ _-_ _ _ - _ _ _ - _ _ _-_ _ _ - _ _ _-_ _ _ - _ _ _-
tRNA: _ _ _-_ _ _ -_ _ _-_ _ _ - _ _ _ - _ _ _-_ _ _-_ _ _-_ _ _ - _ _ _-
Amino Acid Sequence:

Trait:__________________________________________________________

**Special Feature Gene**
DNA: _ _ _-_ _ _ - _ _ _-_ _ _ - _ _ _-_ _ _ - _ _ _-_ _ _ - _ _ _-

mRNA: _ _ _ -_ _ _ - _ _ _-_ _ _ - _ _ _ - _ _ _-_ _ _ - _ _ _-_ _ _ - _ _ _-
tRNA: _ _ _-_ _ _ -_ _ _-_ _ _ - _ _ _ - _ _ _-_ _ _-_ _ _-_ _ _ - _ _ _-
Amino Acid Sequence:
**Arms Gene**

DNA: __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __

mRNA: __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __

tRNA: __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __

Amino Acid Sequence:

Trait: ____________________________________________________________

Trait: ____________________________________________________________
Hair 1: TAC AGA AAG AAT CTG GTT GTA ATC

Hair 2: TAC CAC ACC ATG CTG ACT

Hair 3: TAC CAA ACC GTA GAT GGC ATT

Hair 4: TAC TCG CGT GCC GAT CTG ATC
Legs 1:  TAC GAG CCC ACC AGT ACT

Legs 2:  TAC TAT AGC ACC GGG ACT

Legs 3:  TAC CAA TTT TAT ACA AGG ATC

Legs 4:  TAC ACC GGT CTA GTC ATC
Skin 1: TAC CAA CGT GTA GAG GGG TCT ATT

Skin 2: TAC GAG CTA TAA ACG GAC TGG ATT

Skin 3: TAC GGA CGC TCT TCA ATC

Skin 4: TAC GGA GCG CGA TTA ATT
Eyes 1: TAC AAT CTG CGT GCG AGT GTA ACT

Eyes 2: TAC CAC TAG ACA GAG TGT GTA ACT

Eyes 3: TAC TCG ACC CTC ATA CTA ATT

Eyes 4: TAC GGG TCC GCG TTT ATC
Hair texture 1:  TAC AGC CGG GTA GAA GGA GCT CAC ATT

Hair Texture 2: TAC ACC ACG TAT ATC

Hair Texture 3:  TAC GAG CTA ACC TTG CAA ACT

Hair Texture 4:  TAC CAA ACC CTT ATA CCA ATT
Feature 1: TAC AAC CTG ACC GTG GAG GGA ATC

Feature 2: TAC AGA TTC TAT ACG GAA TGC ATT

Feature 3: TAC CAA AAA AGA GTT GTA AAT GGT ACT

Feature 4: TAC CAG TAG ACA GAC TGG ATC
Arms 1: TAC AAC TGG ACC GTG GAT GGC ATT

Arms 2: TAC ATG CCC TTG AGA AAA ATG CTG TTA CAC GTT ATT
<table>
<thead>
<tr>
<th>Amino Acid Sequence</th>
<th>Trait</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serine – Phenylalanine – Leucine – Aspartic Acid – Glutamine – Histidine</td>
<td>purple hair</td>
</tr>
<tr>
<td>Valine – Tryptophan – Tyrosine – Aspartic Acid</td>
<td>green hair</td>
</tr>
<tr>
<td>Valine – Tryptophan – Histidine – Leucine – Proline</td>
<td>orange hair</td>
</tr>
<tr>
<td>Serine – Alanine – Arginine – Leucine – Aspartic Acid</td>
<td>blue hair</td>
</tr>
<tr>
<td>Leucine – Glycine – Tryptophan – Serine</td>
<td>1 Leg</td>
</tr>
<tr>
<td>Isoleucine – Serine – Tryptophan – Proline</td>
<td>2 Legs</td>
</tr>
<tr>
<td>Valine – Lysine – Isoleucine – Cysteine– Serine</td>
<td>3 Legs</td>
</tr>
<tr>
<td>Tryptophan – Proline – Aspartic Acid - Glycine</td>
<td>4 Legs</td>
</tr>
<tr>
<td>Valine – Alanine – Histidine – Leucine – Proline – Arginine</td>
<td>yellow skin</td>
</tr>
<tr>
<td>Leucine – Aspartic Acid – Isoleucine – Cysteine – Leucine – Threonine</td>
<td>green skin</td>
</tr>
<tr>
<td>Proline – Alanine – Arginine – Serine</td>
<td>pink skin</td>
</tr>
<tr>
<td>Proline – Arginine – Alanine – Asparagine</td>
<td>orange skin</td>
</tr>
<tr>
<td>Leucine – Aspartic Acid – Alanine – Arginine – Serine – Histidine</td>
<td>2 eyes</td>
</tr>
<tr>
<td>Valine – Isoleucine – Cysteine – Leucine – Threonine – Histidine</td>
<td>3 eyes</td>
</tr>
<tr>
<td>Serine – Tryptophan – Glutamic Acid – Tyrosine – Aspartic Acid</td>
<td>4 eyes</td>
</tr>
<tr>
<td>Proline – Arginine – Arginine – Lysine</td>
<td>5 eyes</td>
</tr>
<tr>
<td>Serine – Alanine – Histidine – Leucine – Proline – Arginine – Valine</td>
<td>Straight Hair</td>
</tr>
<tr>
<td>Tryptophan – Cysteine – Isoleucine</td>
<td>Curly Hair</td>
</tr>
<tr>
<td>Leucine – Aspartic Acid – Tryptophan – Asparagine – Valine</td>
<td>Kinky Hair</td>
</tr>
<tr>
<td>Valine – Tryptophan- Glutamic Acid – Tyrosine - Glycine</td>
<td>Wavy Hair</td>
</tr>
<tr>
<td>Leucine – Aspartic Acid – Tryptophan – Histidine – Leucine – Proline</td>
<td>Tusks</td>
</tr>
<tr>
<td>Serine – Lysine – Isoleucine – Cysteine – Leucine – Threonine</td>
<td>Scales</td>
</tr>
<tr>
<td>Valine – Phenylalanine – Serine – Glutamine – Histidine – Leucine – Proline</td>
<td>Horns</td>
</tr>
<tr>
<td>Valine – Isoleucine – Cysteine – Leucine – Threonine</td>
<td>Warty</td>
</tr>
<tr>
<td>Leucine – Threonine – Tryptophan – Histidine – Leucine – Proline</td>
<td>2 Arms</td>
</tr>
</tbody>
</table>
KEY

Genes

Hair 1:  TAC AGA AAG AAT CTG GTT GTA ATC

Start – Serine – Phenylalanine – Leucine – Aspartic Acid – Glutamine – Histidine – Stop

Hair 2:  TAC CAC ACC ATG CTG ACT

Start – Valine – Tryptophan – Tyrosine – Aspartic Acid – Stop

Hair 3:  TAC CAA ACC GTA GAT GGC ATT

Start – Valine – Tryptophan – Histidine – Leucine – Proline – Stop

Hair 4:  TAC TCG CGT GCC GAT CTG ATC

Start – Serine – Alanine – Arginine – Leucine – Aspartic Acid – Stop

Legs 1:  TAC GAG CCC ACC AGT ACT

Start – Leucine – Glycine – Tryptophan – Serine – Stop

Legs 2:  TAC TAT AGC ACC GGG ACT
Start – Isoleucine – Serine – Tryptophan – Proline - Stop

Legs 3: TAC CAA TTT TAT ACA AGG ATC
Start – Valine – Lysine – Isoleucine – Cysteine- Serine - Stop

Legs 4: TAC ACC GGT CTA CCT ATC
Start – Tryptophan – Proline – Aspartic Acid - Glycine - Stop

Skin 1: TAC CAA CGT GTA GAG GGG TCT ATT
Start – Valine – Alanine – Histidine – Leucine – Proline – Arginine - Stop

Skin 2: TAC GAG CTA TAA ACG GAC TGG ATT
Start – Leucine – Aspartic Acid – Isoleucine – Cysteine – Leucine – Threonine – Stop

Skin 3: TAC GGA CGC TCT TCA ATC
Start – Proline – Alanine – Arginine – Serine - Stop

Skin 4: TAC GGA GCG CGA TTA ATT
Start – Proline – Arginine – Alanine – Asparagine - Stop

Eyes 1: TAC AAT CTG CGT GCG AGT GTA ACT
Start – Leucine – Aspartic Acid – Alanine – Arginine – Serine – Histidine - Stop

Eyes 2: TAC CAC TAG ACA GAG TGT GTA ACT
Start – Valine – Isoleucine – Cysteine – Leucine – Threonine – Histidine - stop

Eyes 3: TAC TCG ACC CTC ATA CTA ATT
Start – Serine – Tryptophan – Glutamic Acid – Tyrosine – Aspartic Acid - Stop

Eyes 4: TAC GGG TCC GCG TTT ATC
Start – Proline – Arginine – Arginine – Lysine - Stop

Hair texture 1: TAC AGC CGG GTA GAA GGA GCT CAC ATT
Start – Serine – Alanine – Histidine – Leucine – Proline – Arginine – Valine - Stop

Hair Texture 2: TAC ACC ACG TAT ATC
Start – Tryptophan – Cysteine. – Isoleucine - Stop

Hair Texture 3: TAC GAG CTA ACC TTG CAA ACT
Start – Leucine – Aspartic Acid – Tryptophan – Asparagine – Valine - Stop
Hair Texture 4: TAC CAA ACC CTT ATA CCA ATT
Start – Valine – Tryptophan- Glutamic Acid – Tyrosine – Glycine - Stop

Feature 1: TAC AAC CTG ACC GTG GAG GGA ATC
Start – Leucine – Aspartic Acid – Tryptophan – Histidine – Leucine – Proline - Stop

Feature 2: TAC AGA TTC TAT ACG GAA TGC ATT
Start – Serine – Lysine – Isoleucine – Cysteine – Leucine – Threonine- Stop

Feature 3: TAC CAA AAA AGA GTT GTA AAT GGT ACT
Start – Valine – Phenylalanine – Serine – Glutamine – Histidine – Leucine – Proline - Stop

Feature 4: TAC CAG TAG ACA GAC TGG ATC
Start – Valine – Isoleucine – Cysteine – Leucine – Threonine - Stop

Arms: TAC AAC TGG ACC GTG GAT GGC ATT
Start – Leucine – Threonine – Tryptophan – Histidine – Leucine – Proline - Stop

Arms: TAC ATG CCC TTG AGA AAA ATG CTG TTA CAC GTT ATT