**Brownie Synthesis Activity - STUDENT INSTRUCTIONS**

**Objective:** Your team’s task is to use DNA and protein synthesis rules to find out what steps you need to take to accurately “express” the characteristics of a brownie, which will represent a protein in this activity.

**PART 1 - DNA Replication and mRNA Transcription**

**Step 1)** Your team is assigned to a certain color of gene within the DNA code.  Remember - DNA CANNOT LEAVE THE NUCLEUS, so you must not remove the DNA from its designated nucleus location (your desk).

You will be given a copy of the Non-Template DNA representing the gene to which you are assigned. You will need to copy down the **Non-Template DNA** Code onto your Brownie Synthesis Worksheet in the appropriate column.  You should double-check your work to make sure you copy this down accurately. Mistakes = mutations.

**Step 2)** Making the Template Strand - While you are in the nucleus (at your desk), you will now use the DNA base-pairing rules to create the **Template DNA strand** in the appropriate column for your section.

**Step 3)** mRNA Transcription - Still in the nucleus, use the rules of **transcription** to transcribe the **TEMPLATE** strand of your DNA to create **mRNA** and complete your part of the mRNA column.

**PART 2 - Translation of Codons into Amino Acids**

**Step 4)**  Now that you have created mRNA from step 3, you can leave the nucleus, however you must leave the copy of the DNA that you were given behind.  You will go out of your desk and into the “cytoplasm” to find a “ribosome” (your assigned lab station).

**Step 5)**  All of your team members who have also completed Part 1 for your assigned gene will meet together at your “**ribosome**” (lab station).  Once there, you should double check each other and look for any errors. Next, you will look up your mRNA letters grouped into 3 letters, called **codons** by using a codon chart to look up the appropriate amino acid. Write down each amino acid on your section in the appropriate column.

**Step 6)**  In order for an actual cell to gather appropriate amino acids to the ribosome, little molecules called **tRNA** (transfer RNA) carry and transfer the amino acids to the proper mRNA codon, which is waiting at the ribosome.  You will use the RNA base-pairing rules to match the mRNA (codons) to create the tRNA (anti-codons). **Anti-codons** are the opposite of codons, so if you see a “G” on the mRNA, it will be a “C” on tRNA.  Don’t forget that there are *NO* **T’s** in any kind of RNA, including mRNA and tRNA.

**Step 7)**  Now that you have completed all of the steps of DNA replication and protein synthesis, you need to use the Amino Acid Key on the back of this sheet to look up the amino acids in your column and write out the corresponding brownie construction instructions so you can follow them in the proper order.

**Step 8)** Reflect on your progress. Does anything not make sense? Did someone make an error (mutation)?  Fix it if you detect this since you will be required to follow your group’s instructions! When you are ready to begin, go ahead and follow your set of instructions. Present the finished product to your teacher to see how you did BEFORE you eat the brownies!

**Brownie Synthesis Activity - AMINO ACID KEY**

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| **Amino Acid (abbreviation)** | **Amino Acid** **(full name)** | **Brownie construction instructions (you may paraphrase these on your sheet)** |
| **ALA** | Alanine | Go to the vacuole and pick up chocolate sprinkles. Bring back to the ribosome. |
| **ARG** | Arginine | Go to the vacuole and get a bag of bread crumbs. Return to ribosome. Sprinkle bread crumbs onto frosting. |
| **ASN** | Asparagine | Go to vacuole, pick up 1 container of chocolate chips. Return to ribosome; add & stir chocolate chips into frosting. |
| **ASP** | Aspartic Acid | Cut brownies into equal squares – one for each group member. |
| **CYS** | Cysteine | Place each brownie on a napkin. |
| **GLN** | Glutamine | Sprinkle the sprinkles evenly over the frosting. |
| **GLU** | Glutamic Acid | Show the brownies to your teacher and meow like a cat. |
| **GLY** | Glysine | Go to vacuole and pick up container of vanilla frosting. Return to ribosome. |
| **HIS** | Histidine | Spread frosting on the brownies. |
| **ISO** | Isoleucine | Go to vacuole and get a cup of salt. Sprinkle it on top of the brownies. |
| **LEU** | Leucine | Go to the vacuole and pick up a container of chocolate frosting. Take it back to the ribosome. |
| **LYS** | Lysine | Go to the vacuole and pick up green food coloring to take back to ribosome. Add 3 drops to the frosting cup and stir it in with the knife. |
| **MET** | Methionine | This is the first instruction. Go to vacuole and pick up a plate of brownies. Bring back to ribosome. |
| **PHE** | Phenylalanine | Get a knife from the vacuole. Bring back to ribosome. |
| **PRO** | Proline | Go to vacuole and get 1 napkin. Bring back to the ribosome. |
| **SER** | Serine | Everyone in group must wash hands with soap & water. Return to ribosome. |
| **STOP** |  | Show the finished product to your teacher. Clean up station and all materials. |
| **THR** | Threonine | Go to vacuole and pick up rainbow sprinkles. Bring back to ribosome. |
| **TRP** | Tryptophan | Go to vacuole and pick up red food coloring and bring back to ribosome. Add 3 drops of red food coloring to frosting cup and stir it in with the knife. |
| **TYR** | Tyrosine | Go to vacuole and get some soy sauce. Add soy sauce to frosting and stir it in with knife. |
| **VAL** | Valine | Cut brownies into equal triangles (enough for each member of your group). |