**Brownie Synthesis - Teacher Instructions**

*Be sure to review any potential food allergies that your students may have and plan accordingly to change items in this activity according to your students’ needs.*

**Materials**

* 2 trays of brownies per class – cut them so you have equal amounts of brownies for 8 groups of 4 students, but do NOT cut individual brownies out…students will have to do this based on their instructions (brownie mix, 9x13 baking trays)
* 1 can of chocolate frosting (good for 2 classes)
* 1 can of vanilla frosting (good for 2 classes)
* 1 bottle of chocolate sprinkles (make it last for all classes)
* 1 bottle of rainbow sprinkles (make it last for all classes)
* 1 bag of chocolate chips (make it last for all classes)
* \*Bread crumbs
* \*Soy sauce packets or a bottle of soy sauce
* \*Salt
* Red and green food coloring
* Dixie cups
* Napkins
* 1 butter knife per group (these can be washed and reused each period)
* 1 copy of the blue gene, green gene, orange gene, pink gene - [here is a spreadsheet containing the genes and their answer keys](https://docs.google.com/spreadsheets/d/1_4VVyrU_KvHzOiwtu1iaqtJzCq0K2GP-Z1ploy3AwkE/edit#gid=1243860751)
* [Class set of Student Instructions with Amino Acid Key](https://docs.google.com/document/d/1WAreT6T2zjJnjowEd-jJylBYFeR4cfzEEPI6xV-c0gU/edit) on the back (reuse these from class to class)
* Copies of the [student worksheet and reflection](https://docs.google.com/document/d/1PPe4zS-RUrRG3B-GLDmPohYy1HUbpyE9h4PxJ4zn-ZU/edit) sheet for each student
* **\*NOTE:** You shouldn’t have to use the bread crumbs, soy sauce, or salt because they represent mutations.

**Preparing for the Activity**

* Prepare (or have students sign up to bring in) the brownies and divide the 9x13 trays in half so that you have 4 halves – one for each group. Putting half of the brownies on the lids to the tray works well.
* Label the teacher lab bench the “Vacuole”
* Student desks will represent the nucleus.
* Divide students evenly into teams of about 4 students. Assign each team to a specific gene color (There are four options, so some groups will be doing the same gene color. However, you could make more gene color options so each group has a unique gene if you wish).
* The lab tables will represent the ribosome where each of the groups will meet when they get to the translation parts of the activity.
* Prepare enough Dixie cups containing chocolate chips, chocolate sprinkles, or rainbow sprinkles for students to easily take to their “ribosome” when they are ready to get items. Keep all food materials at the designated “Vacuole” until student groups are ready to come retrieve them (when students retrieve the foods, the foods represent the amino acids and the students represent the tRNA coming to pick up an amino acid. Some students will try to collect more than one item at a time and I tell them that tRNA can only hold one amino acid, so they can only do their designated instruction and will need to come back for other items or send a different student for an item).
* Set some empty Dixie cups aside in case students come to you asking for soy sauce or bread crumbs.
* Have the food coloring and frosting handy. I like to spoon out the frosting into Dixie cups, too, so students can grab-and-go when they are collecting materials.

**Giving Directions to Students**

1. Pass out student handouts and have them read through the instructions for Parts 1 and 2. Inform them of the layout of the classroom. Answer clarifying questions, if they have them
2. Hand out one copy of the gene per student (making sure to give students who are on the same team the same gene color). Remind students they cannot remove the gene from their desk/nucleus, so they must finish part 1 before they can find their designated ribosome.

NOTE: The genes are broken up visibly into sections (1, 2, 3, and 4). I normally have my students do all parts since it provides them with more practice, but teachers could differentiate by reducing the workload for certain students, having them only do one specific section of the gene or having each member of the team do a different section and come together as a group with their information.

1. When students do Part 2, be sure you let them know where their team ribosome is located and enforce that all members of the team must be ready with all parts of the student worksheet done before they can actually begin to carry out the collection of their items. This motivates students to help each other and encourages 100% engagement since no one wants to let down their team.
2. Tell the students that they should be reading their instructions to know what their tasks are and that ALL of the student sheets in the group must prove that their individual sheets have been completed before you will allow them to carry out the brownie-making instructions.

**I find that this activity really reinforces the locations of transcription, translation, and the base-pairing rules as well as the jobs of the various molecules involved. I always hear several “a-ha” moments and students thoroughly enjoy this activity.**

**Have fun!**

**-Emily Tombleson**