

**MIDDLE SCHOOL**

**Biotechnology**

**Kitty Chromosome Cookies**

**Goals:**

* To show students that chromosomes pair up and that at times chromosomes can be mutated.
* For students to understand current and future uses of medical/pharmaceutical biotechnology.

**Objectives:** Students will…

* Build mutated cat chromosomes
* Begin to understand how genetic material can be manipulated to cure people

**Materials:**

* 1 bag milk chocolate chips
* 1 bag semi-sweet chocolate chips
* 1 bag dark chocolate chips
* 1 bag butterscotch
* 2 small cans Chow Mien noodles
* Rice Krispies
* Red M&Ms
* Blue M&Ms
* Yellow M&Ms
* Brown M&Ms
* Green M&Ms
* Orange M&Ms
* Raisins/grape
* Corn flakes
* Small pretzel sticks
* Small pieces of graham cracker
* 1 bag mini marshmallows /1 bag large marshmallows
* powdered sugar
* Pink Sprinkles
* At least 4 microwave ovens
* Microwave safe bowls, one per group
* Spoons
* Parchment paper
* Tsp measuring spoons
* Chromosome Cookie Mutation Types sheets

**Time Required:** 1 x 45-60 minute class period



**Standards Met:**

* Life Science Standards: Structure & function in living systems
* Life Science Standards: Reproduction & heredity

**Procedure:**

* Explain to students that to understand Lucky and Sparky’s kittens, they will build a scientific model of a kitten’s chromosomes.
* Show the students the ingredients they will use to make a model of the kitten’s chromosomes.
* Ask students to get into groups.
* Hand out the chromosome cookies student sheet
* Have students acquire their materials.
* Put the chromosome cookie mutation types overhead sheet on the projector.
* Read each mutation type one at a time and explain that these are the potential ways that Lucky’s genes could have been mutated. (remind them that the genes are on the chromosomes!)
* Explain and show the students how the deletion mutation works by snapping off a part of one of the students’ chow mein noodles.
* Explain and show the student show the duplication mutation works by adding one M&M to one of their cookies.
* Explain and show the students how the insertion mutation works by adding something that typically does not go in a cookie, for instance a green bean, brussel sprout….
* Explain and show the students how the translocation mutation works by splitting one of the chromosomes in half and put it with another pair.
* Have the students make the chromosome cookies according to their direction sheet.
* Hand out the Kitty Chromosome Data Table to each pair.
* Give the students time to analyze the results and answer the questions while eating their cookies.
* Lead a brief discussion with students about the test results to check for understanding.

**Chromosome Cookies – Mutation Types**

**Deletion**: loss of a piece of DNA from a chromosome. Deletion of a gene or part of a gene can lead to a disease or abnormality.

**Duplication**: production of one or more copies of any piece of DNA, including a gene or even an entire chromosome.

**Insertion**: a type of chromosomal abnormality in which a DNA sequence is inserted into a gene, disrupting the normal structure and function of that gene.

**Translocation**: breakage and removal of a large segment of DNA from one chromosome, followed by the segment's attachment to a different chromosome.

**Kitty Chromosome Cookies Student Sheet**

Follow the directions to set up your chromosomes.

1. Go to the supply area and collect the following ingredients.

1. 2 milk chocolate chips
2. 1 large marshmallow/one mini marshmallow
3. 2 semi-sweet chocolate chips
4. 2 dark chocolate chips
5. 2 butterscotch chips
6. 2 chow mein noodles
7. 2 rice Krispies
8. 2 red M&Ms
9. 2 blue M&Ms
10. 2 yellow M&Ms
11. 1 grape/1 raisin
12. 2 brown M&Ms
13. 2 green M&Ms
14. 2 orange M&Ms
15. 2 corn flakes
16. 2 small pretzel sticks
17. 2 small squares of graham cracker (1/4 inch square)
18. 2 ¼ teaspoons of powdered sugar
19. Get 2 sprinkles, at least 1 pink sprinkle

2. Lay the ingredients out on the desk in front of you in the order that they appear in the list. Set up the ingredients like a karyotype picture of chromosomes (pair up like ingredients).

3. Look at your karyotypes. Do any of the pairs look unusual to you? Fill in your data table.

4. Look at the overhead to learn about the different types of chromosome mutations.

5. Place all the chocolate chips and marshmallows in a microwave safe bowl and microwave on high for 30 seconds; if the chocolate and marshmallows are not melted, microwave for another 30 seconds. Add all the other ingredients to the melted chocolate and stir.

6. Make your mixture look like the shape of a kitten cookie and place to cool on parchment paper.

**Kitty Chromosome Data Table**

The following karyotypes look unusual in our cookie ingredients:

|  |  |  |
| --- | --- | --- |
| **Karyotype** | **Why does this karyotype look unusual?** | **What cat disease could this mutation cause? (see information below this chart if you are unsure!)** |
|  |  |  |
|  |  |  |

**Disease Information:**

* Lucky has PKD which is a disease that can be found on chromosome E3.
* Sparky has diabetes which is a disease that can be found on chromosome B2.

http://jasn.asnjournals.org/cgi/content/full/15/10/2548

http://home.ncifcrf.gov/ccr/lgd/staffInfo/staff/pdf/Yuhki/yuhki\_AnnuRevGenet\_2002\_36.pdf

While you are enjoying your cookie, consider the following:

**Sex Information:**

* A pink sprinkle = x (female). A blue sprinkle = y (male). What gender is your kitten cookie?

**If you have a male, why do you have a pink sprinkle?**

Biotechnicians now know where to find genetic disorders on chromosomes. They are working on being able to remove the mutated gene and replace it with a non-mutated gene. If you were able to do this with your Kitty Chromosome Cookie, **what mutated chromosome would you remove and what would you replace it with? Explain your thoughts. Do you think this is ethical?**

**Kitty Chromosome Data Table – Teacher key**

The following karyotypes look unusual in our cookie ingredients:

|  |  |  |
| --- | --- | --- |
| **Karyotype** | **Why does this karyotype look unusual?** | **What cat disease could this mutation cause? (see information below this chart if you are unsure!)** |
| marshmallows | One is big, and one is small. | PKD or diabetes |
| Raisin & grape | Size, shape, moisture content differ  It is the same item in a different form | PKD or diabetes |

**Disease Information:**

* Lucky has PKD which is a disease that can be found on chromosome E3.
* Sparky has diabetes which is a disease that can be found on chromosome B2.

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While you are enjoying your cookie, consider the following:

**Sex Information:**

* A pink sprinkle = x (female). A blue sprinkle = y (male). What gender is your kitten cookie?

**If you have a male, why do you have a pink sprinkle?**

*Males have both an XY chromosome. The pink represents the X, and blue represents the Y.*

Biotechnicians now know where to find genetic disorders on chromosomes. They are working on being able to remove the mutated gene and replace it with a non-mutated gene. If you were able to do this with your Kitty Chromosome Cookie, **what mutated chromosome would you remove and what would you replace it with? Explain your thoughts. Do you think this is ethical?**

*Answers will vary*