**Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Monstrous Mutations**

***Introduction:***

Mutations are caused by changes in DNA. Knowing a few basic types of mutations can help you understand why some mutations have major effects and some may have no effect at all. The following are some of the types of mutations that can occur.

**Substitution**
A **substitution** is a **mutation** that exchanges one **base** for another (i.e., a change in a single “chemical letter” such as switching an A to a G). Such a substitution could:

1. Change a codon to one that encodes a different amino acid and cause a small change in the protein produced. For example, **sickle cell anemia** is caused by a substitution in the beta-hemoglobin **gene**, which alters a single **amino acid** in the protein produced.
2. Change a codon to one that encodes the same amino acid and causes no change in the protein produced. These are called **silent mutations**.
3. Change an amino-acid-coding codon to a single “stop” codon and cause an incomplete protein. This can have serious effects since the incomplete **protein** probably won’t function.



**Insertion**
**Insertions** are mutations in which extra base pairs are inserted into a new place in the **DNA**.

**Deletion**

**Deletions** are mutations in which a section of DNA is lost, or deleted.



**Frameshift**
Since protein-coding DNA is divided into codons three bases long, insertions and deletions can alter a gene so that its message is no longer correctly parsed. These changes are called **frameshifts**.
For example, consider the sentence, “The fat cat sat.” Each word represents a codon. If we delete the first letter and parse the sentence in the same way, it doesn’t make sense.
In frameshifts, a similar error occurs at the DNA level, causing the codons to be parsed incorrectly. This usually generates proteins that are as useless as “hef atc ats at” is uninformative.



***Procedure:***

1. Students should form groups of threes. Each student will simulate an animal that can only digest peanuts as its food source.
2. Unfortunately, random mutations have produced some unusual characteristics in recent offspring. Each group will find out what mutation they represent by selecting a letter from the paper bag.
3. The letter drawn will correspond to the characteristics listed in Chart 1. This letter will also represent the letter of each group’s home location and storage cup. Letter I = No mutation.

**Chart 1**

|  |  |
| --- | --- |
| Letter drawn by groups | Characteristic produced by mutation |
| A | Long fingernails (produced by plastic knives taped to fingers with tape) |
| B | No fingers (produced by taping each hand closed) |
| C | Lack of peripheral vision (produced by putting on goggles and stuffing cotton in the sides to prevent viewing from the side) |
| D | Hands fused together in front of body (produced by placing hands together in front of body and taping them together) |
| E | Feet and ankles fused together (produced by taping the ankles tightly together with tape) |
| F | No arms (produced by taping the arms down to the side of the body with tape) |
| G | Arms fused together behind the back at the wrists (produced by placing arms behind the back and taping tightly at the wrists) |
| H | Blind (produced by using goggles taped over securely with tape) |

Each group should attain the proper materials and prepare itself to represent the characteristic produced by the letter of the mutation selected from the paper bag.

5. Each group should begin the activity at the specified location in Figure A. The goals of each group are to:

A. Gather the food (nine peanuts per group)

B. Store the food for later use (place the nine peanuts in your letter-designated container).

C. Retrieve the food at a later time (remove the nine peanuts from the container and return with the peanuts to the home location).

D. Process and consume the food (remove the peanuts from the nine shells and consume these peanuts).

6. To begin the activity, each group should position itself at its specified home location. The teacher will start the stopwatch and each group will begin with food gathering. Group members should proceed to the blanket containing the peanuts and gather nine peanuts per group. These nine peanuts should then be transported to a container. The three group members should return to their home location. At this point, the group will proceed back to the plastic container to retrieve its food. Once the group has removed all nine peanuts, it will return to the home location. The group will open the peanut shells and remove the contents. Each group member will consume the contents of three of the peanut shells at the completion of this process, the amount of time required to achieve this will be recorded.

7. Each group will continue until the peanuts have been consumed and time has been recorded.

8. Record the time required to complete the feeding process for each mutation.

|  |  |
| --- | --- |
| Mutation | Time |
| A |  |
| B |  |
| C |  |
| D |  |
| E |  |
| F |  |
| G |  |
| H |  |
| I |  |