Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Record Sheet:**  **The Genetics of Human Bitter Taste Perception**

Modified from Amy Rice Doetsch & Alex Doetsch, CSI Biology

**#1:   INDIVIDUAL ACTIVITY:   Are you a taster or a non-taster?**

Record the class results:

|  |  |  |
| --- | --- | --- |
| Phenotype (taste perception) | Genotype | # Students |
|  |  |  |
|  |  |  |
|  |  |  |

1) What percent of the class is a Strong Taster, Intermediate Taster, and a Non-Taster, respectively?

2) If there are 2 alleles but 3 possible phenotypes, what kind of inheritance pattern does that suggest to you?

3) Provide another example (it doesn't have to be in humans) of the type of inheritance pattern you listed in Question #1.

**#2: GROUP/TABLE ACTIVITY: Comparing alleles of the TAS2R38 receptor gene**

4) How many nucleotide differences can you find between the two DNA sequences?

Table 2 - Human PTC alleles Total length of gene sequence: \_\_\_\_\_\_\_\_\_\_

|  |  |  |  |
| --- | --- | --- | --- |
|  | 1st difference | 2nd difference | 3rd difference |
| Position (example: 475) |  |  |  |
| Taster nucleotide (ex. A,C,T,G) |  |  |  |
| Non-taster nucleotide (ex. T, G, A, C) |  |  |  |

5) Now think back to what you know about macromolecules & answer the following questions:

* 1. What role does DNA play in the cell?
  2. What type of macromolecule would typically be referred to as a receptor (lipid, DNA etc.)?
  3. Is the molecule you listed in “b” a polymer?  If yes, what monomers is it composed of?
  4. If the DNA nucleotide sequence is altered, what **specific** effect would this have on the receptor?

**#3 GROUP/TABLE ACTIVITY:   Comparing isoforms of the TAS2R38 receptor protein**

6) How many amino acid differences can you find between the two proteins? Is it fewer, greater, or the same as the number of nucleotide differences?

Table #3 - Human PTC receptor protein isoforms Total length of protein sequence: \_\_\_\_\_\_\_\_\_\_

|  |  |  |  |
| --- | --- | --- | --- |
|  | 1st difference | 2nd difference | 3rd difference |
| Position (example: 68) |  |  |  |
| Taster amino acid (ex. M,L,T) |  |  |  |
| Non-taster amino acid (ex. M,L,T) |  |  |  |

**#4:   GROUP/TABLE ACTIVITY:   Relating TAS2R38 allele sequences to protein isoforms**

Table #4 - Human PTC allele mRNA codons Total number of codons: \_\_\_\_\_\_\_\_\_\_

|  |  |  |  |
| --- | --- | --- | --- |
|  | 1st difference | 2nd difference | 3rd difference |
| Position (example: 68) |  |  |  |
| Taster codon (ex. TCA) |  |  |  |
| Non-taster codon (ex. ACG) |  |  |  |

7) What nucleotide change between the two alleles occurred in each codon that accounts for the differences between the isoforms of the proteins? Use Figure 2 and Table 1 as a guide.

8) How do you think the amino acid differences you listed in the table affect the interaction between PTC & the receptor? Use Figure 3 as a guide.

**#5: GROUP/TABLE ACTIVITY: Predicting whether chimpanzees & gorillas can taste PTC**

9) Are there fewer, the same number, or greater number of amino acid differences between these 4 sequences than between the 2 human isoforms? Which of these differences are likely to play a role in the ability or inability to taste bitterness?

10) Based on the amino acids present in the chimpanzee & gorilla proteins, would you predict these primates would be tasters or non-tasters? Why or why not?

**Additional QUESTIONS**

1. The non-taster allele encodes a protein isoform that is not capable of detecting PTC. Do you think that this isoform is non-functional? Why or why not? If it is still functional, what function(s) do you hypothesize it is capable of performing?
2. You inherit chromosomes, and therefore genes, from your parents. Yet it’s the proteins that your cells make that determine your phenotype (eye color, attached earlobes etc.). In your own words, explain the relationship between the genes you inherit and the proteins produced by your cells.
3. What is the probability that a non-taster mother and an intermediate taster father will have a strong taster child?
4. What is the probability that a strong taster mother and a non-taster father will have a non-taster child?
5. Bitter taste is usually associated with poisonous, or toxic, compounds. Recognizing bitter taste helps prevent us from ingesting a potentially deadly substance. If recognizing bitter compounds is such a crucial mechanism of self-preservation, why are approximately 25% of people unable to recognize PTC as bitter? Formulate a hypothesis that addresses why you think the non-taster allele has been maintained throughout human evolution.