PTC Taste Tests
Instructor's Notes

Tons of Background Information

Back in 1931, Arthur Fox, a research chemist, sat at his DuPont Company lab bench where he was mixing a powdered chemical. He accidentally released a small quantity of the powder into the air around him. Several of the scientists got some of the chemical into their mouths. One of Dr. Fox's colleagues immediately remarked that the chemical was very bitter, which surprised Fox. He had been much closer to the chemical, but tasted nothing at all. Curious, they tasted the chemical again. Fox said the chemical was still tasteless, and his lab partner still insisted it was very bitter. So they expanded their sample size and handed out crystals of the chemical, which were not poisonous, to friends, family members, and fellow scientists and asked them if they tasted anything. Some folks, like Fox, tasted nothing; others found the chemical somewhat to very bitter.

70 years later, a single gene underlying this variation was discovered and reported by Un-kyung Kim and colleagues from the National Institute on Deafness and Other Communication Disorders. This was a bit of a surprise, because for many years, scientists believed that more than one gene were responsible for PTC taste sensitivity.

Using molecular genetics techniques with a variety of families, Kim isolated an area on chromosome 7 that was likely to contain a gene affecting PTC tasting ability. This region, however, also contained more than 150 other genes. Of these, nine were known to produce proteins for bitter taste receptors on the tongue. To narrow down their search, the researchers figured out the DNA sequences of all nine of these genes. They looked to see if different people had different versions of the same gene for any of these, and, if so, if any gene variations correlated with PTC sensitivity. Sounds a bit complicated, but it's all in a day's work for these folks.

The researchers found *a single gene* for a bitter taste receptor that completely explains different PTC tasting abilities. There are actually three versions of this gene that differ from one another only slightly. This small difference in the gene, and in the protein that it makes, eventually forms a tongue taste receptor that has a different shape from a "normal" bitter taste receptor. This altered shape means that the person's receptors will not respond to PTC and the person will not think the PTC tastes bitter. Since all people have two copies of every gene, different combinations of the bitter taste gene (two copies of form 1; one copy of form 1 and one of form 2; two copies of form 3; etc.) determine whether someone finds PTC intensely bitter, somewhat bitter, or without taste at all. You can now grab your Punnett Square and map that one for fun.

Some scientists are now interested in potential health applications of genetic taste studies. For example, people who find PTC bitter are suspected to find the taste of cigarettes bitter, which could make strong tasters less likely to smoke. Not liking the taste of liver has to figure into this somewhere.

PTC Taste Tests
Instructor's Notes

Content Correlations and Vocabulary

Heredity
- Traits
- Acquired vs. Inherited
- Dominant
- Recessive

Genetics
- Genes
- Characteristics

Objective

The student will use the PTC taste test to identify an inherited trait in humans and use the test to determine where the trait came from in their immediate genetic pool.

Time Line

20-25 Minutes

Safety Concerns

Not a one. Some folks worry that they will have a reaction to the PTC. If that happens please contact us immediately. We would like to be your agent since you will be the first person in the world, probably the galaxy, to experience a reaction.

Answers to Questions

1. Answers will vary.
2. Answers will vary.
3. Inherited. It is a gene that is passed on to you at conception.
4. Carbon/6 Sulfur/1 Nitrogen/2 Hydrogen/8
5. 7
6. Answers will vary.
7. cigarettes, tea.
8. Answers will vary.

Extra Credit and Extension Ideas

1. Create a family tree following a different inherited trait. For example, if red hair is in your family, trace it from you or the sibling that has it to each of the next three generations. Keep in mind that traits are not always present in every generation. Quite often they jump a generation.

2. Write a poem about your ability to taste or not taste PTC.

Congruent Labs

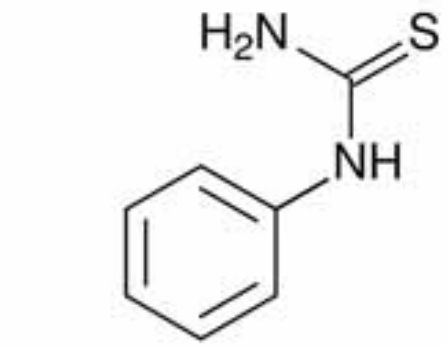
Frankenstein's Phenotype Factory
Nature vs. Nurture
Punnet Square Puzzles
Tracking Traits
Building DNA Ladders
Banana Mash DNA

PTC Taste Tests
Lab Instructions

Overview

In this activity, you are going to perform a test that will tell if you have a dominant or recessive gene for a single characteristic. PTC is an abbreviation for a chemical called *phenylthiocarbamide*. This chemical has an interesting property: 7 out of 10 people can taste it. If you are a "taster" you will quickly detect a bitter taste that is definitely unpleasant. If you are a "non-taster," you will simply think that you are sucking on a piece of paper. The illustration of the two guys on the next page pretty much sums up your two choices. Another interesting observation is that people that are tasters also tend to think that cigarettes taste bitter and they usually prefer not to drink coffee or tea for the same reason.

If you are a non-taster, don't worry. All it really means is that you don't have the ability to taste a really bitter, nasty chemical soaked into a piece of paper.



Vocabulary

Traits

Traits are qualities, features, or other things that distinguish an organism. They can include things like hair color, tooth shape, beak shape, bone size, or muscle structure. Traits come in two varieties: acquired and inherited.

Acquired Traits

Animals can and do acquire useful abilities to survive in this world. These acquired traits can not be passed on genetically.

Inherited Traits

Some traits can be inherited. Inherited traits are the expression of a gene and must come directly from a parent or other ancestor. A trait may seem to skip a generation or even two or three, but if a trait shows up it must have been present in an ancestor and was simply tucked away in your DNA until the right combination of genes came along and it popped out of the proverbial cake.

Gene: Each chromosome has hundreds to thousands of genes packed into it. Kind of like sections of the library. A gene is a section of a chromosome that is responsible for a specific trait or characteristic. As examples, your height, skin color, tendency for your hair to curl, and the speed with which you run are all physical characteristics that can linked to the genes in your body.

Dominant Gene: Over time, scientists have observed certain organisms and noticed that, from generation to generation, certain physical characteristics appear to show up. A brown-eyed and blue-eyed couple have babies and most of them are brown-eyed. That is a dominant gene. PTC tasters are dominant over non-tasters.

Genetic Test: A test that identifies if a person has a dominant gene present. In the case of this lab, tasting PTC is considered a dominant gene.

PTC Taste Tests
Lab Instructions

Materials

1 Vial of PTC paper

Procedure

1. Place the paper in your mouth. If you have the dominant gene for tasting in your genetic make up, it usually tastes bitter, but it may also taste sour or even a little sweet. If you are recessive for this gene, you will not taste anything at all; it will taste just like a piece of paper.

When taking the test, some folks will pause, think for a moment, hmm and hah, and then say something like, "Um, maybe, wait … um … yeah, I think I taste it." They are NOT tasters. It would be like saying that you are sort of pregnant. Either you are or you aren't, either you do or you don't. If you can taste the chemical, you will know it.

2. Once you have tasted the paper, mark your response in Question 1 on the next page.

3. Test at least 5 to 7 other people in your family and fill in the data table. If you have enough of the PTC paper, you can create a genetic tree by testing each person in your family or extended family.

As the data is collected, place the mom and dad in the middle. Write the names of your siblings (brothers and sisters) on the lines below mom and dad and the names of your grandparents on the lines above your parents' names.

4. Circle the name of the person if he or she tests positive and leave it uncircled if he or she tests negative. Then add the names of each of the kids in the family, test them, and circle the appropriate names. Use the outline as a guide.

5. Once you have tested everyone, it is very easy to see where the gene comes from, who it is passed to, and where it is going in the next generation.

How Come, Huh?

Dr. Fox's chemical, called phenylthiocarbamide (PTC), has been used widely since its discovery to detect genetic variation in tasting abilities. Studies soon after the incident in Fox's lab showed that there is a genetic component that influences how PTC tastes. Scientists found that people were much more likely to find PTC bitter if other members of their family also found it bitter. The evidence was so strong for a genetic link that PTC tasting ability was used (speaking of being pregnant or not) as evidence in paternity tests before DNA tests were available.

PTC Taste Tests
Data and Observations

Name :_____ Date: _____

Teacher: _____ Period: _____

Data and Observations

1. Are you a taster or non-taster? _____

2. Do have have a dominant or recessive gene set for PTC tasting? _____

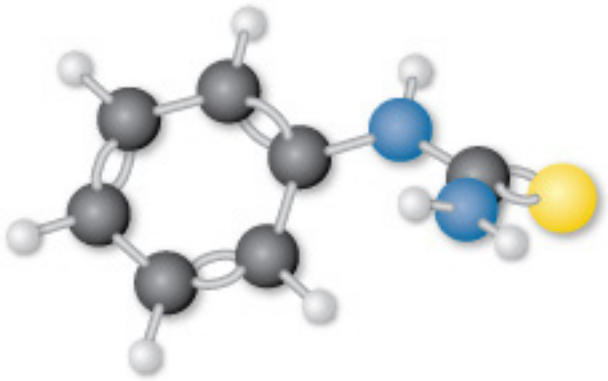
3. Is the ability to taste PTC an inherited or acquired trait? Explain. _____

_____

_____

4. Look at the drawing of a PTC molecule. Identify the numbers and kinds of atoms that compose this molecule by filling in the blanks on the data table below.

Symbol	Names of Atoms	Number
H	_____	8
_____	Carbon	6
S	_____	_____
N	_____	2



5. According to research _____ out of 10 people can taste PTC.

6. In your class, _____ out of _____ people could taste PTC. That's _____ %.

7. If you can taste PTC, you also tend to think that _____,

coffee, and _____ also taste bitter.

8. Administer the taste test to members of your family and fill in the data table on the next page. Be sure to write their names in the tree and circle the names of those folks who can taste PTC.

PTC Taste Tests
Data and Observations

Taster's Name	Dominant	Recessive	Relationship to You
1			
2			
3			
4			
5			
6			

PTC Genetic Tree