Supertasters – Teacher Handout
Genetics & Genomics Teaching Team

Introduction
Take a moment and think about the foods you absolutely love to eat and those you could certainly do without. If you turn to your lab partner, you will probably find that you have at least one difference in food preferences. There are multiple reasons for differences in food preferences, but one important contributor is taste perception. In humans (and many other species), certain chemicals in food stimulate taste cells on our tongue, which in turn send messages to a specific region of our brain. The central nervous system then interprets what these messages mean and determines the appropriate response (continue chewing OR spit it out).

In 2003, the discovery of a gene on human chromosome 7 helped explain why humans perceive PTC (phenylthiocarbamide, which tastes bitter) differently. There are several known alleles for the PTC gene, but two of these are more common in the human population. This genetic variation creates at least three different phenotypes. Today, you will test your own ability to taste several flavors found in many foods that we eat.

Materials
Quantities per student/demonstration. Multiply by expected number of students.

Paper Cup
Thiourea Test Paper
PTC Test Paper
Control Paper
Sodium Benzoate Test Paper

Safety Concerns
Phenylthiocarbamide (PTC) and thiourea may be toxic in high quantities, but these test strips contain very small amounts. The amount licked off the paper is even lower. Since this activity involves ingestion, consider checking for any allergies to food preservatives (sodium benzoate).

Methods/Protocol
1. Start with control paper: Rinse mouth with water. Have students place the test strip to their tongues and have them describe the taste in their notebooks/on paper. Rinse with water between each tasting strip.
2. Thiourea Test paper. Same as above. Most students will experience a bitter taste, some may have no taste. Ability to taste thiourea is inherited independently from the PTC taste.
3. Sodium Benzoate paper. Repeat as above. Varied response to the taste: some experience sweet, salty, bitter, or no taste.
4. PTC test paper. Known genetic contribution to this taste from the TAS2R38 gene: “tasters” will experience bitter taste, “non-tasters” will have no taste.

Discussion Questions

1. Elementary: Colorful animals, like poison dart frogs use their coloration to warn predators that they are poisonous. Why might have plants evolved to taste super bitter to humans? Why may some humans have different abilities to taste things?

2. Middle: Colorful animals, like poison dart frogs use their coloration to warn predators that they are poisonous. Why might have plants evolved to taste super bitter to humans? Why may some humans have different abilities to taste things—explain the concept of genetic drift. Not every mutation is due to “selective pressure.”

3. High school:

Classroom Data Collection

1. PTC perception: What percentage of your classmates are considered:
    a. Tasters?
    b. Mild tasters?
    c. Non-tasters?

2. Thiourea perception: What percentage of your classmates are considered:
    a. Tasters?
    b. Mild tasters?
    c. Non-tasters?

3. Sodium benzoate perception: What percentage of your classmates are considered:
    a. Tasters?
    b. Non-tasters?

4. Of those sodium benzoate tasters, how many perceived the paper to be:
    a. Salty?
    b. Sweet?
    c. Bitter?

Analysis of Taste Perception

1. Of those students who tasted PTC, were they more likely to taste thiourea?

2. Of those students who tasted PTC, were they more likely to think sodium benzoate tasted bitter?

3. Do you think the same protein that recognizes and binds to the chemical PTC can recognize and bind to thiourea or sodium benzoate? Why or why not?

Supertasters - Student Handout
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Introduction

Many human traits are controlled by more than one gene, including our sense of taste. Think about the foods you absolutely love and those you could do without. Some of those preferences, such as whether you like bitter foods, are due to how your genes influence your taste receptors. Today, each of you will test your ability to taste several flavors based on your genetic sequence.

Methods

1. Taste a control paper test strip. This is the “baseline” for our next experiments. Anything that tastes like this paper should be scored as “no taste”.

2. Taste the thiourea paper. Record your perception of the taste in the worksheet below.

3. Taste a sodium benzoate paper and record your perception of its taste in the worksheet.

4. Taste the PTC paper. First, touch it briefly to your tongue. If you do not taste anything, put it in your mouth and chew it. Do not swallow the paper. Record your perception of the taste of PTC in the box below.

Results

Thiourea	Sodium Benzoate	PTC

Classroom Data Collection

1. PTC perception: What percentage of your classmates are considered:
    a. Tasters?
    b. Mild tasters?
    c. Non-tasters?
2. Thiourea perception: What percentage of your classmates are considered:
    a. Tasters?
    b. Mild tasters?
    c. Non-tasters?
3. Sodium benzoate perception: What percentage of your classmates are considered:
    a. Tasters?
    b. Non-tasters?
4. Of those sodium benzoate tasters, how many perceived the paper to be:
    a. Salty?
    b. Sweet?
    c. Bitter?

PTC
The ability to taste PTC is inherited and determined by a pair of alleles. Normally, the allele for tasting is dominant over that for non-tasting. In the United States, about 70% of the people are tasters and most of them taste it as bitter.

Note that the genotype of the non-taster is recessive (tt). The taster is dominant and could be either TT or Tt. The allele that allows one to taste it immediately may be different from the one which requires chewing and a bit more time before tasting the chemical. “In one series of studies, tasters were more sensitive to spicy and sweet foods and found fatty foods less appealing. They tended to avoid broccoli and grapefruit juice, found spicy food painful, and shunned fat”

Interestingly, it has been shown that you can only taste PTC if it is dissolved in your own saliva, not in water or someone else's saliva. That says that this receptor recognizes the chemical only if it is bound to something in your own saliva - a very complex phenomenon!

Sodium benzoate
Sodium benzoate is often used as a preservative in foods we eat, usually at a concentration of 0.1% (pretty low). It can taste sweet, salty, bitter or sour. Some people are so sensitive to its taste that they can taste it over the food they are eating.

Thiourea
Thiourea is closely related chemically to PTC, but the ability to taste it is inherited independently. Thus, although most people can taste thiourea (as in the case of PTC), the taster and non-taster groups for the two substances need not be the same.

Additive effects
The ability to taste sodium benzoate is inherited independently of the sensitivity to PTC, but the two taste characters apparently interact markedly in their effect on a person's reaction to various foods. For example, those tasting PTC as bitter and sodium benzoate as salty tend to like such foods as sauerkraut, buttermilk, turnips and spinach more than the average person. People who taste these two chemicals both as bitter like those foods less than the average person.