Teacher Notes: Picky Eaters

Background Information

Our sense of taste is rooted in our tongue, which is covered with taste buds. Each taste bud is a cluster of taste cells. Each taste cell has specific proteins on its surface that act as taste receptors, detecting sweet, bitter, sour, salty, or umami, a savory taste sometimes described as "meaty." These taste receptors are shaped in such a way that food molecules can fit into them. When a food molecule fits properly into a receptor, a signal is sent to our brain, and we experience a particular flavor.

Scientists are still teasing apart the many factors that can influence our sense of taste, but genes play a key role. Genes, segments of DNA, are transcribed into messenger RNA (mRNA) and then translated into amino acids. Hundreds of amino acids, linked in a specific order, fold into particular 3-D structures to create proteins. Differences in taste-receptor genes can result in different amino acid sequences that give taste-receptor proteins different shapes. Because the sense of taste depends on food molecules fitting into taste-receptor proteins that send signals to the brain, differences in receptor shapes can result in differences in taste perception.

Genetic differences might render specific taste receptors ineffective or prevent them from forming in the first place. Individual genetic make-up determines, for example, the number of sweet receptors, the sensitivity of bitter receptors, and the brain's ability to convert sour sensory information. Genetic variation might make you crave sweets as a child, but enjoy bitter flavors as an adult. Scientists are still sorting out the details.

Taste is different from flavor perception. Our sense of taste is centered on our tongue, but our perception of flavor is strongly influenced by smell. Food temperature and texture, as well as moisture in the mouth and the residual taste of food we just ate, all affect how we experience food.

Taste and flavor perception are examples of how genetics can influence our behavior. Someone with the gene for the bitter taste receptor will likely avoid bitter foods. In other words, that person's genetic make-up is influencing his or her choice to avoid broccoli. However, genes do not entirely direct our behavior. We still choose what we eat, based on cultural practices, available food choices, marketing, and knowledge of what's healthy and what's not. The same is true of other genetic links to behavior. For example, specific genes are linked to drug addiction, but family stability and peer groups also influence whether or not someone becomes addicted to drugs.

Student Handout Answer Key

Procedure

1. Predictions will vary.
2. Descriptions will vary. Some students will describe a strong bitter taste, whereas others will taste nothing at all. A few will describe tasting a mild bitter taste.

3. The class might categorize their responses as "tasters" and "non-tasters" or include categories that address the strength of the taste. In general, about 75% of the class should be tasters.
4. The Taster allele is dominant, and tasters are more common in the class. If a student can taste PTC, then the student can deduce that he or she probably has the dominant taster allele, but likely cannot distinguish the second allele. If a student is a non-taster, then he or she probably has two recessive alleles (homozygous recessive). Note that a person's alleles cannot be determined with absolute certainty unless a DNA test is done.
5. Answers will vary.
6. Possible statement: "Taste is sensed by our tongues, whereas flavor is constructed by the brain, based on stimuli from the tongue and nose."

Questions

1. The chart in step 4 shows only the two most common alleles for the PTC receptor gene. There are also several rare alleles. Do you think that anyone in your class has the rare alleles? Why or why not?
   - Yes, it is possible that students in the class have rare alleles. In particular, a taste described as other than bitter may indicate the presence of rare alleles. However, we cannot know a person's alleles with certainty unless a DNA test is done.
2. List three reasons that can help explain why it is important to distinguish different tastes.
   - Different flavors give us different information about our food. For example, sweet flavors signal the presence of sugar, which provides energy. Bitter flavors might warn us that a plant is toxic. Sour might tell us that fruit is not ripe. Salt provides electrolytes. Depending on our needs, certain foods might be more nutritionally valuable than others. Also, having a diminished sense of taste may let a person eat a wider array of food. Evolutionarily, having a plentiful food supply is an advantage.
3. How did holding your nose and smelling the mint affect the flavor of the food sample?
   - Blocking the nose and smelling the mint made it difficult to identify the food, demonstrating that our senses of smell and taste work together to develop our perception of how food tastes. Our brain combines the taste and smell signals to construct our perception of a food's flavor.
4. Genes are only one factor that determine your food preferences. What else might affect food preferences?
   - Answers may include culture, age, food choices available, what foods you're accustomed to eating, and marketing and advertising.

Rubric

Task	Excellent	Satisfactory	Needs Improvement
PTC taste test and completing questions on the Picky Eaters Student Handout	• Student can define taste receptor and explain how genes influence some aspects of behavior. • Student shows ability to independently integrate information from multiple resources.	• Student needs assistance answering questions. • Student interprets information from charts and diagrams.	• Student has difficulty answering or makes little effort with follow-up questions. • Student cannot integrate information from charts and diagrams.