STO-141

Taste Blind

Teacher Information

Summary

Why can some people taste PTC (a bitter substance) while others cannot? Students use taste paper to determine if they are PTC tasters or non-tasters. They match diagrams with a reading about the parts of the nervous system involved in tasting. They interpret a pedigree and a simulated electrophoresis gel to determine the genotypes of ten family members. Optional extension activities relate PTC tasting to Hardy-Weinberg principles.

Core Concepts

- Receptors, nerve cell pathways, and taste areas of the brain are involved in the ability to taste PTC (a bitter substance).
- Individual differences in abilities to taste PTC can be inherited.
- Pedigrees and gel electrophoresis can be used to determine genotypes.

Time Required

Two 40-minute class periods

Kit contains

- Bag containing a PTC taste paper strip and a control taste paper strip.
- **Taste and the Nervous System** diagrams
- Simulated electrophoresis gel
- Tube of "DNA Stain"
- Plastic plate
- Small measuring cup
- Stirrer

Teacher Provides

- Cup of water or hard candy that students can use to get rid of the bitter taste of PTC paper
- Water
- Safety goggles
- Paper towels for clean up

Warning: Choking Hazard

This Science Take-Out kit contains small parts. Do not allow children under the age of seven to have access to any kit components.

Reusing kits

Kits may be refilled and reused. Allow approximately 15-30 minutes for refilling 10 student kits. Teachers will need to instruct students on how to handle clean-up and return of the re-usable kit materials. For example, teachers might provide the following information for students:

Discard	Return to kit
• Used PTC taste paper strip • Used control taste paper strip • Used simulated electrophoresis gel	• "DNA Stain" tube • Stirrer • Measuring cup • Plastic plate (rinse with water and dry with a paper towel)

Refills for kits are available at www.sciencetakeout.com. The **10 Kit Refill Pack** includes the following materials:

- Instructions and Quick Guide for refilling kits
- 10 strips of PTC taste paper
- 10 strips of control taste paper
- "DNA Stain"
- 10 simulated electrophoresis gels

Additional Teacher Resources

Part 6 and Part 7 on the following pages are **optional** activities. These may be used as extensions for students to relate PTC tasting to Hardy-Weinberg equations and principles.

Want to learn more about the genetics of PTC tasting? Explore the **Online Mendelian Inheritance in Man** website at http://omim.org/entry/171200.

Part 6: PTC Population Genetics

Students counted the number of tasters and non-tasters in the biology classes at one school. They found that there were 128 tasters and 72 non-tasters in these classes.

Frequency of trait = number of student with trait/total number of students

1. Calculate the frequency of tasters in the classes.

2. Calculate the frequency of non-tasters in the classes.

Hardy-Weinberg equations:

$p^2 + 2pq + q^2 = 1$

$p + q = 1$

p = frequency of dominant allele

q = frequency of recessive allele

$\mathbf{p^2}$ = frequency of homozygous dominant individuals

$\mathbf{q^2}$ = frequency of homozygous recessive individuals

2pq = frequency of heterozygous individuals

3. What is $\mathbf{q^2}$ (the frequency of non-tasters in the classes)? ____________________

   Explain how you arrived at your answer.

4. What is **q** (the frequency of the non-taster allele in the classes)? ____________________

   Explain how you arrived at your answer.

5. What is **p** (the frequency of the taster allele in the classes)? ___________________

   Explain how you arrived at your answer.

6. What is **p^2** (the frequency of homozygous tasters in the classes)? ___________________

   Explain how you arrived at your answer.

7. What is **2pq** (the frequency of heterozygous tasters in the classes)? ___________________

   Explain how you arrived at your answer.

8. What is **$p^2 + 2pq$** (the frequency of tasters in the classes)? ___________________

   Explain how you arrived at your answer.

9. Explain how is it possible to have more tasters than non-tasters in the classes when the allele frequency for non-tasters is higher than the allele frequency for tasters.

   ____

   ____

Part 7: PTC Population Genetics and Evolution

Godfrey Hardy (an English mathematician) and Wilhelm Weinberg (a German physician), two scientists who studied population genetics and evolution in the early 1900s, proposed that evolution will **<u>not</u>** occur in a population when these seven conditions are met:

- Mutations are not occurring
- Natural selection is not occurring
- The population is infinitely large
- All members of the population breed
- All mating is totally random
- All members produce the same number of offspring
- There is no migration into or out of the population

However, because it is highly unlikely that any of these seven conditions will happen in the real world, evolution is the inevitable result. In other words, **evolution will occur when the seven conditions are <u>not</u> met**.

Describe a **fictitious scenario** or write a **science fiction story** that explains the **rapid evolution** of a human population in which the allele for non-tasting is NOT present. This population would consist of ONLY homozygous dominant (TT) tasters.

Part 6: PTC Population Genetics - ANSWER KEY

Students counted the number of tasters and non-tasters in the biology classes at one school. They found that there were 128 tasters and 72 non-tasters in these classes.

Frequency of trait = number of student with trait/total number of students

1. Calculate the frequency of tasters in the classes = ***128 / 200 = 0.64***

2. Calculate the frequency of non-tasters in the classes = ***72 / 200 = 0.36***

3. What is q^2 (the frequency of non-tasters in the classes)? ______***0.36***__________

   This was already calculated for question 2.

4. What is q (the frequency of the non-taster allele in the classes)? _____***0.6***_________

   q^2 = .36
   the square root of q^2 = q
   q = the frequency of homozygous recessive people (non-tasters) = .6

5. What is p (the frequency of the taster allele in the classes)? ______***0.4***_________

   p + q = 1
   p = 1-q = 1 - .6 = 0.4

6. What is p^2 (the frequency of homozygous tasters in the classes)? ____***0.16***________

   $p^2 = 0.4^2 = 0.16$

7. What is 2pq (the frequency of heterozygous tasters in the classes)?_____ ***0.48*** ________

   2pq =2 X 0.4 X 0.6= 0.48

8. What is $p^2 + 2pq$ (the frequency of tasters in the classes)? ______***0.64***__________

   2pq + p^2 = 0.16 +0 .48 = 0.64

9. Explain how is it possible to have more tasters than non-tasters in the classes when the allele frequency for non-tasters is higher than the allele frequency for tasters.

   Because some of the non-taster alleles are hidden in the heterozygotes (or alternative explanations).

Part 7: PTC Population Genetics and Evolution – ANSWER KEY

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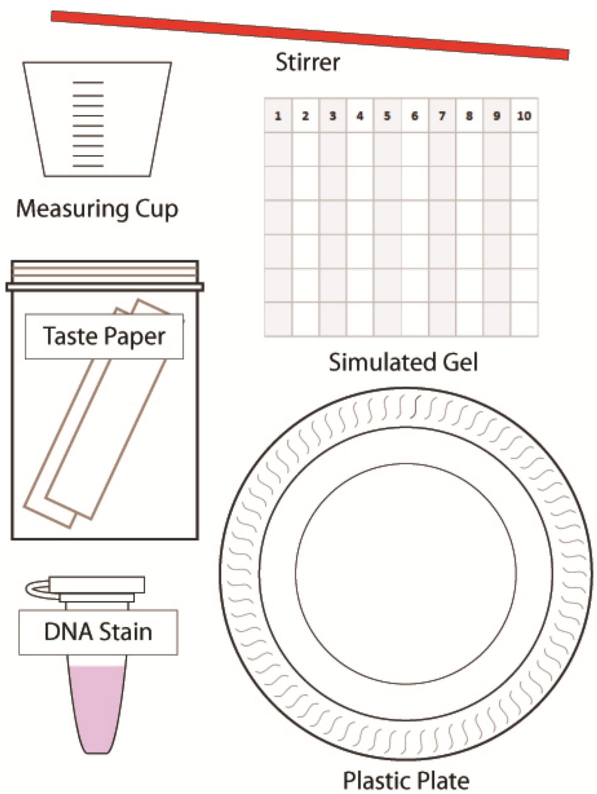
However, because it is highly unlikely that any of these seven conditions will happen in the real world, evolution is the inevitable result. In other words, **evolution will occur when the seven conditions are not met**.

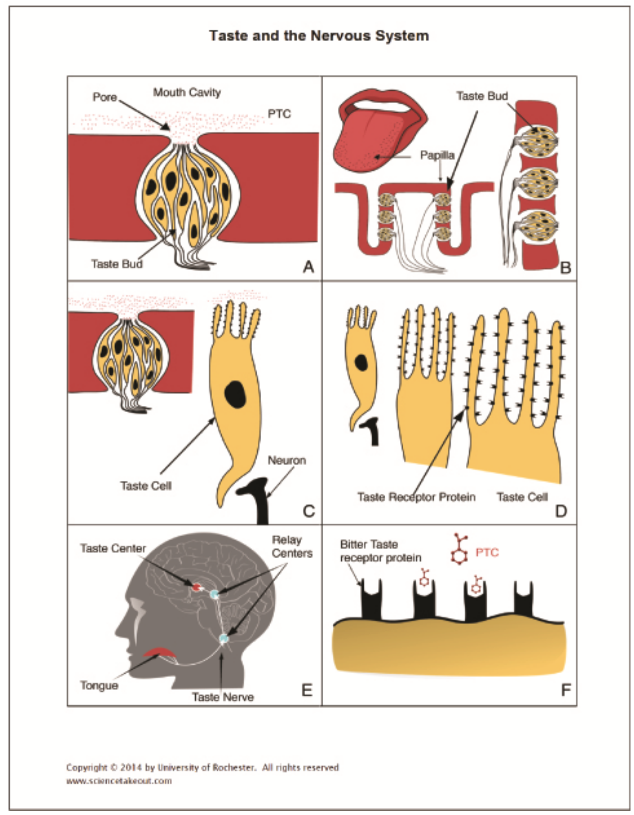
Describe a **fictitious scenario** or write a **science fiction story** that explains the **rapid evolution** of a human population in which the allele for non-tasting is NOT present. This population would consist of ONLY homozygous dominant (TT) tasters.

Student answers will vary but may include:

- ***Non-taster genes are more likely to mutate to form taster genes***
- ***Natural selection - People who are tasters survive better than non-tasters***
- ***Natural selection - People who are tasters are more likely to reproduce***
- ***The population is very small - Genetic drift***
- ***Tasters more likely to breed than non-tasters***
- ***Tasters prefer breeding with other tasters or do not breed with non-tasters***
- ***Tasters have more offspring than non-tasters***
- ***Tasters chase non-tasters out of the area***
- ***Or, a creative student might suggest gene testing and only allowing homozygous tasters to reproduce.***

Kit Contents Quick Guide





Read these instructions before using Science Take-Out kits

Parental or Adult Supervision Required
This kit should be used only under the supervision of an adult who is committed to ensuring that the safety precautions below, and in the specific laboratory activity, are followed.

Safety Goggles and Gloves Strongly Recommended
We encourage students to adopt safe lab practices, and wear safety goggles and gloves when performing laboratory activities involving chemicals. Safety goggles and gloves are not provided in Science Take-Out kits. They may be purchased from a local hardware store or pharmacy.

Warning: Choking and Chemical Hazard
Science Take-Out kits contain small parts that could pose a choking hazard and chemicals that could be hazardous if ingested. Do not allow children under the age of seven to have access to any kit components. Material Safety Data Sheets (MSDS) provide specific safety information regarding the chemical contents of the kits. MSDS information for each kit is provided in the accompanying teacher instructions.

Chemicals Used in Science Take-Out Kits
Every effort has been made to reduce the use of hazardous chemicals in Science Take-Out kits. Most kits contain common household chemicals or chemicals that pose little or no risk.

General Safety Precautions
1. Work in a clean, uncluttered area. Cover the work area to protect the work surface.
2. Read and follow all instructions carefully.
3. Pay particular attention to following the specific safety precautions included in the kit activity instructions.
4. Goggles and gloves should be worn while performing experiments using chemicals.
5. Do not use the contents of this kit for any other purpose beyond those described in the kit instructions.
6. Do not leave experiment parts or kits where they could be used inappropriately by others.
7. Never taste or ingest any chemicals provided in the kit – they may be toxic.*
8. Do not eat, drink, or apply makeup or contact lenses while performing experiments.
9. Wash your hands before and after performing experiments.
10. Chemicals used in Science Take-Out experiments may stain or damage skin, clothing or work surfaces. If spills occur, wash the area immediately and thoroughly.
11. At the end of the experiment, return ALL kit components to the kit plastic bag. Dispose of the plastic bag and contents in your regular household trash.

*NOTE: Students are instructed that they may taste the 2 paper strips provided in this kit.

No blood or body fluids from humans or animals are used in Science Take-Out kits.
Chemical mixtures are substituted as simulations of these substances.

Taste Blind: *Teacher Answer Key*

Part 1: Are you PTC taste blind?

You might have heard of red-green colorblindness, but I bet you haven't heard of "taste blindness." Just as there are people who can't tell the difference between the colors red and green, there are people who can't taste a certain type of bitter flavor. And just like color blindness, taste blindness can be genetic.

1. You have a small bag containing two strips of taste paper:
   - One strip of PTC paper (with a bitter chemical called PTC)
   - One strip of control paper (with no PTC)

2. <u>One at a time</u>, touch each of the paper strips to the tip of your tongue.

3. If both papers just taste like paper, you are a **non-taster** for PTC. If only one has a bitter taste and the other tastes like paper, you are a **taster.**

4. Are you a taster or a non-taster? ______________________________

Part 2: PTC Tasting and the Nervous System

1. Below is a description of what happens in the body when people taste bitter substances such as PTC. For each of the statements below, write the letter of the picture from the **Taste and the Nervous System** diagram sheet that best illustrates the statement.

   B The tongue is covered with bumps called papillae. Each papilla contains many microscopic taste buds.

   A When PTC molecules enter the mouth, they dissolve in saliva (spit) and enter the taste buds through a pore.

   C Each taste bud is filled with taste cells—the cells that can tell when PTC is dissolved in a person's saliva.

   D The tips of the taste cells are covered with bitter taste receptor proteins. The dominant taster gene (T) makes a receptor protein that has the correct shape to match with the PTC molecules. People who are tasters have PTC receptors that fit with PTC molecules.

   F When a PTC molecule fits into the receptor proteins, it will excite that taste cell and cause it to send an impulse (electrical signal) to other cells in the nervous system.

   E Nerves conduct the impulses from the taste cells to relay areas and then to the taste center of the brain. The taste center is the part of the brain that is responsible for the conscious sensation of BITTER!

2. In the box below, make a drawing that illustrates how Diagram F could be changed to represent bitter taste receptor proteins in a non-taster.

Your Drawing

Non-tasters have a version of the taste receptor that cannot detect PTC because the PTC molecule will not fit into it.

3. Explain why a person might be able to taste some flavors but not be able to taste PTC.

   They do not have PTC receptors that fit with PTC molecules.

4. Some people gradually or suddenly lose their ability to taste some foods or all foods. Explain two possible changes in the nervous system that could result in a change in the ability to taste.

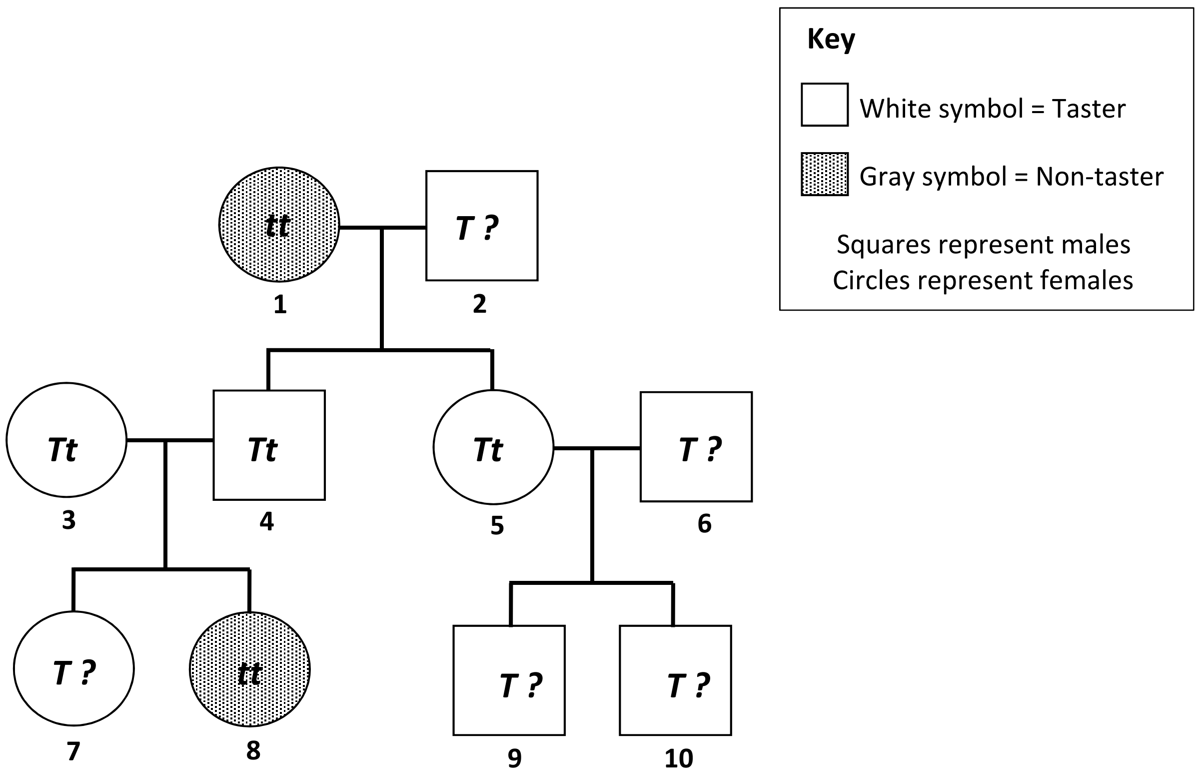
   Change in shape of receptors, damage or loss of taste buds, damage to the nerves that conduct impulses to the brain, damage to the brain relay area or brain taste areas, change in pH of mouth, stroke, etc. (Encourage students to share their answers.)

Part 3: PTC Inheritance - A Family Pedigree Chart

The family pedigree below shows the pattern of inheritance for PTC tasting in a family.
There are two versions of the PTC tasting gene—a dominant **T** allele and a recessive **t** allele.

- The **T** allele codes for the production of a taste receptor that can attach to PTC.
- The **t** allele codes for the production of a taste receptor that cannot attach to PTC.

Individuals with one or two dominant **T** alleles (**TT** or **Tt** genotypes) have the "**taster**" phenotype.
Individuals with two recessive alleles (**tt** genotype) have the "**non-taster**" phenotype.



1. Write the **genotype** inside the symbol for each person in the pedigree. If you cannot be certain whether the person is **TT** or **Tt**, write T?.

   Hints for completing the genotypes on the pedigree:
   - *Because non-taster is a recessive trait, all non-tasters are **tt**.*
   - *Because taster is a dominant trait, all tasters have at least one **T** gene.*
   - *If a taster has a non-taster parent (tt) or a non-taster child, the taster also has a **t** gene.*
   - *Mark all other tasters as **T ?***

Homozygous = has two identical alleles

Heterozygous = has two different alleles

2. Write the numbers (shown under the each symbol) for each individual in the pedigree who:

- is homozygous recessive. _____***1 and 8***______
- is homozygous dominant. _______***none for certain***_______
- is heterozygous. _____***3, 4, and 5*** _________
- could be either homozygous dominant or heterozygous. ___***2, 6, 7, 9, and 10***________

Part 4: PTC Inheritance - Genetic Testing for the Family

Notice that you could not use the pedigree to determine the genotypes of all members of the family. Genetic testing can be used to determine a person's genotype for the PTC tasting alleles.

A scientist collected DNA samples from **each member of the family (1-10) shown in the pedigree on Part 4.** The scientist followed these steps to test the DNA samples for the PTC tasting alleles:

- A special laboratory technique was used to make copies of the PTC gene alleles (pieces of DNA) in the DNA samples from each family member.
- The PTC gene allele copies (pieces of DNA) were then placed into different wells (1-10) of an electrophoresis gel.
- The gel was placed into an electrophoresis chamber and an electrical current was turned on. The electrical current caused the pieces of DNA to move through the electrophoresis gel. The small (shorter) DNA pieces moved further through the electrophoresis gel than the large (longer) DNA pieces.

Your lab kit contains a simulated paper gel that is like the one that the scientist made. The alleles (which are made of DNA) are not visible unless the gel is stained. You will need to stain the DNA (the PTC gene alleles) to make it visible.

1. Add 40 ml of water to the plastic plate (use the small measuring cup to measure out the water).

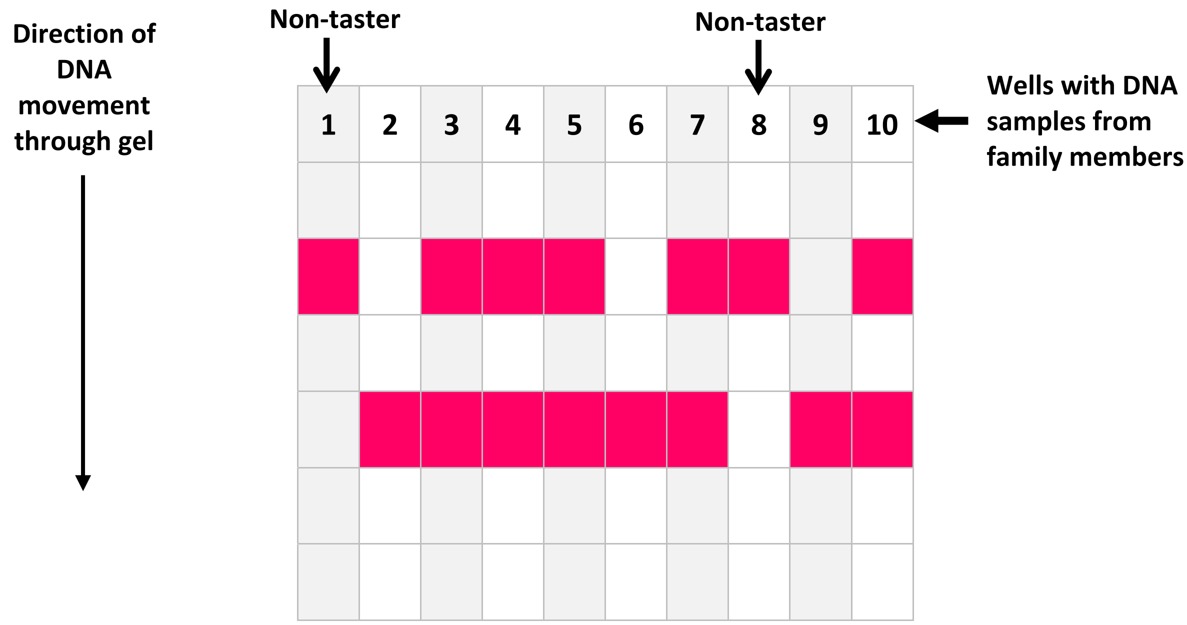
2. Pour the contents of the DNA Stain tube into the water in the plate.

3. Use the plastic stirrer to stir the water until the DNA Stain is completely dissolved.

4. Submerge the paper gel into the DNA Stain solution. If the paper gel floats, use the stirrer to gently push the paper gel into the DNA Stain solution.

5. The DNA Stain will bind to the DNA pieces (PTC gene alleles) and turn them pink. You will see pink bands appear on the paper gel.

6. Draw the pattern of pink bands on the picture of the gel below.



Remember that the gene for non-taster is recessive. That means that family members 1 and 8 on the pedigree and the simulated gel are homozygous recessive and have the **tt** genotype.

7. **Shorter DNA pieces move further in the gel than longer DNA pieces.** According to the gel, which piece is shorter – the **T** allele (taster) or the **t** allele (non-taster)?

Circle one choice below. *Hint: Refer to both the pedigree and the electrophoresis gel.*

T = taster allele that makes a PTC receptor that works

t = non-taster allele that makes a PTC receptor that does not work

Support your answer with information from the electrophoresis gel and the pedigree.

The dominant T allele for PTC tasting is shorter because it moves further through the gel than the T allele.

8. According to the gel, which individuals (1–10) are **homozygous** dominant for the PTC gene?

___2, 6 and 9____

Support your answer with information from the electrophoresis gel and the pedigree.

These individuals have only one short DNA band.

9. According to the gel, which individuals are **heterozygous** for the PTC gene?

____3, 4, 5, 7, 10_____

Support your answer with information from the electrophoresis gel and the pedigree.

These individuals have two different kinds of DNA bands—both long and short.

10. If couple 5 and 6 has another child, what is the probability that the child could be a non–taster? Support your answer with an explanation or a Punnett square.

0 % probability because individual 6 is TT or homozygous dominant. All of this person's children will get at least one T gene so all will be tasters.

	T	*T*
T	*TT*	*TT*
t	*Tt*	*Tt*

0% of offspring are non-tasters

11. If person 8 and a person who is heterozygous for the PTC trait have a child, what is the probability that the child could be a non–taster? Support your answer with an explanation or a Punnett square.

50 % probability because individual 8 is tt or homozygous recessive and could only contribute a t allele. The person who is heterozygous could contribute either a T allele or a little t allele.

	t	*t*
T	*Tt*	*Tt*
t	*tt*	*tt*

50% of offspring are nontasters

Part 5: Taste Receptors and Evolution

PTC is not found in nature, but people who can taste PTC are likely to taste other bitter substances that occur naturally. These bitter substances share the potential of being toxic. Some plants produce bitter tasting toxic chemicals in order to protect themselves from being eaten. Human's ability to taste bitter flavors offered a survival advantage by protecting ancient people from poisonous plants.

About 25 percent of people are unable to taste PTC (non-tasters) while 75 percent of people find it bitter (tasters). In studies of families, taste-blindness was found to be inherited as a recessive trait. Animal studies have shown that all apes are "PTC tasters," therefore human non-tasters are thought to have appeared when the gene for PTC tasting mutated so that it no longer functioned properly.

A bitter taste sensation triggers unlearned behaviors in human newborns and many animal species – such as gaping, tongue thrusting, and oral ejection (spitting out the bitter item). People and animals who taste a bitter food also may learn to avoid that food in the future.

Today, bitter taste sensitivity may have harmful consequences for human health by causing people to avoid bitter-tasting vegetables or medicines, some of which might lower the risk of cancer and heart disease.

1. What change might have caused the appearance of human non-tasters?

   A mutation in the gene for PTC tasting or the PTC receptor gene.

2. What might be an evolutionary <u>advantage</u> to being a bitter taster?

   The bitter taste warns people that a plant or substance might be toxic.

3. What might be an evolutionary <u>disadvantage</u> of being a bitter taster?

   The bitter taste might cause people to avoid a healthy diet or needed medicines.

4. How could scientists and the medical and food industries use an understanding of the biology of bitter taste sensations to help improve human health?

   They may find ways to make healthy foods or medicines taste better.

MATERIAL SAFETY DATA SHEET

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name (as printed on the label): "DNA Stain" (simulated)

Product identity: ARM & HAMMER® Super Washing Soda

Manufacturer: Church & Dwight Company, Inc.,
469 North Harrison Street
Princeton, New Jersey 08543-5297
Phone (609) 683-5900

Telephone number for information: (585)764-5400
Medical emergency phone number (Chemtrec): (800) 424-9300

Preparation date of this MSDS: 8/18/10

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2. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Ingredient	% By Weight	CAS Number
Sodium Carbonate	≥ 85%	497-19-8
Water	≤ 15%	7732-18-5

Exempt from OSHA and WHMIS as a packaged consumer household product.

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3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW
Avoid eye and skin contact.

Potential Health Effects: EYES: will cause severe irritation. SKIN: May cause irritation.
INGESTION and INHALATION: May be harmful if swallowed or inhaled

HMIS Rating: Health 2 Fire 0 Reactivity 0

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4. FIRST AID MEASURES

EYES: Check for and remove contact lenses. Immediately flush eyes with clean flowing water, low pressure and lukewarm if possible, occasionally lifting upper and lower eyelids. Get medical attention immediately.

SKIN: Wash affected area with soap or mild detergent and large amounts of water. Seek medical attention if irritation develops.

INHALATION: Remove from area of exposure. Treat symptomatically. Seek medical attention if irritation develops or if person has difficulty breathing.

INGESTION: Do not induce vomiting. If patient is conscious and can swallow, give two glasses of water to drink. **Do not attempt to give anything orally to an unconscious person**. Seek medical attention.

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5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES
FLASHPOINT: Not flammable
METHOD USED: Not applicable

FLAMMABLE LIMITS
LFL: Not applicable
UFL: Not applicable

EXTINGUISHING MEDIA: None combustible material. Use extinguishing media appropriate for surrounding fire.

FIRE-FIGHTING INSTRUCTIONS: Carbon dioxide and irritating dusts may be generated by thermal decomposition. Wear a self-contained breathing apparatus (SCBA) and full protective equipment (Bunker Gear).

UNUSUAL FIRE AND EXPLOSION HAZARDS: None known.

6. SPILL OR LEAK PROCEDURES

Scoop up into clean, dry waste container. Avoid stirring up dusts. Neutralize residue with dilute muriatic acid and flush residue to sewer or waste water system. Wash area with large amounts of water. Prevent eye and skin contact and inhalation of dusts by wearing appropriate protective equipment (See Section 8).

7. HANDLING AND STORAGE

Store in cool, dry areas and away from incompatible substances (acids). Super Washing Soda will react with acids to yield carbon dioxide gas which can accumulate in confined spaces. Do not enter confined spaces until they have been well ventilated and carbon dioxide levels have been determined to be safe.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

RECOMMENDED EXPOSURE LIMIT: 10 mg/m^3 as a nuisance dust (ACGIH).
RESPIRATORY PROTECTION: Wear a NIOSH approved dust respirator if dust level exceeds recommended exposure limit. Respiratory protection is recommended for any level of dust generation.
PROTECTIVE GLOVES: General purpose for handling dry material.
EYE PROTECTION: Safety glasses with side shields or chemical safety goggles, if excessive dust is generated. Do not wear contact lenses.
OTHER PROTECTIVE CLOTHING OR EQUIPMENT: Full cover clothing. Local eye wash is recommended.
ENGINEERING CONTROLS: Use local exhaust if total dust level exceeds 10 mg/m^3.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: White granular powder
ODOR: None
PHYSICAL STATE: Solid
pH AS IS: Not applicable
pH (1% SOLN. w/v): 11.4
VAPOR PRESSURE: Not applicable
VAPOR DENSITY: Not applicable
BOILING POINT: Not applicable
FREEZING/MELTING POINT: Not applicable
SOLUBILITY IN WATER: Readily soluble in water. 7.1% @ 20°C
SPECIFIC GRAVITY (Water = 1): 2.25
APPARENT DENSITY (g/cc): Approximately 1.1 at 20°C.
% VOLATILE: Not applicable
VOLATILE ORGANIC COMPOUNDS: Not applicable
MOLECULAR WEIGHT: 124

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable
CONDITIONS TO AVOID: Loses all water of hydration at temperatures above 228°F.
INCOMPATIBILITY WITH OTHER MATERIALS: Reacts with acids to form carbon dioxide. May yield corrosive caustic soda if mixed with lime dust and water.
HAZARDOUS DECOMPOSITION PRODUCTS: Yields sodium oxide if exposed to temperatures above 1564°F.
HAZARDOUS POLYMERIZATION: Will not occur.

11. TOXICOLOGICAL INFORMATION

EYE EFFECTS: A severe eye irritant.
SKIN EFFECTS: A moderate skin irritant. May produce various severities of irritation on prolonged, repeated or occluded contact.
ACUTE ORAL EFFECTS: Although low in toxicity (LD_{50} ~ 3000 - 4000 mg/kg), may cause corrosion of gastric mucosa and gastrointestinal disturbances such as heaves, vomiting, abdominal pain.
INHALATION EFFECTS: Dusts either inhaled or aspirated during ingestion may cause mucous membrane and upper respiratory irritation.

12. ECOLOGICAL INFORMATION No data

13. DISPOSAL CONSIDERATIONS Can be disposed of in the trash or down the sink.

14. TRANSPORTATION INFORMATION

D.O.T. SHIPPING NAME: Not regulated
TECHNICAL SHIPPING NAME: ARM & HAMMER® Super Washing Soda Detergent Booster
D.O.T. HAZARD CLASS: None
U.N./N.A. NUMBER: None
HAZARDOUS SUBSTANCE/RQ: None
D.O.T. LABEL: None
D.O.T. PLACARD: None

15. REGULATORY INFORMATION

The components of this material are reported in the U.S. EPA TSCA Inventory and appear on the Canadian DSL. This material is not listed as a carcinogen or potential carcinogen by NTP Annual Report, IARC Group I or II, OSHA 29 CFR Part 1910 Subpart Z, or ACG1H Appendix A.

16. ADDITIONAL INFORMATION

The information provided in this Material Safety Data Sheet represents data from the manufacturer and/or vendor and is accurate to the best of our knowledge. By providing this information, Science Take-Out LLC makes no guarantee or warranty, expressed or implied, concerning the safe use, storage, handling, precautions, and/or disposal of the products covered or the accuracy of the information contained in this fact sheet. It is the responsibility of the user to comply with local, state, and federal laws and regulations concerning the safe use, storage, handling, precautions, and/or disposal of products covered in this fact sheet

MATERIAL SAFETY DATA SHEET

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name (as printed on the label): PTC Paper

Product identity: Phenyl Thiocarbamide Paper (PTC Paper)

Manufacturer: Precision Laboratories, Inc.
415 Airpark Drive Cottonwood, AZ 86326
1-800-733-0266

Telephone number for information: (585)764-5400
Medical emergency phone number (Chemtrec): (800) 424-9300

Preparation date of this MSDS: 12/17/13

2. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Ingredient	% By Weight	CAS Number
Phenyl Thiocarbamide	>0.01%	103-85-5

3. HAZARDS IDENTIFICATION

White test paper, no odor

Phenyl thiocarbamide is toxic, but it has been calculated that each PTC paper test strip contains less than 0.3 mg of phenyl thiocarbamide, far below the toxicity level. Target organs: None known.

This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

HMIS Rating: Health 1 Fire 0 Reactivity 0

4. FIRST AID MEASURES

Always seek professional medical attention after first aid measures are provided.

Eyes: Immediately flush eyes with excess water for 15 minutes, lifting lower and upper eyelids occasionally.
Skin: Immediately flush skin with excess water for 15 minutes while removing contaminated clothing.
Ingestion: Call Poison Control immediately. Rinse mouth with cold water. Give victim 1-2 cups of water or milk to drink. Induce vomiting immediately.
Inhalation: Remove to fresh air. If not breathing, give artificial respiration.

5. FIRE FIGHTING MEASURES

Non-flammable solid. When heated to decomposition, emits acrid fumes.
Protective equipment and precautions for firefighters: Use foam or dry chemical to extinguish fire.
Firefighters should wear full firefighting turn-out gear and respiratory protection (SCBA). Cool container with water spray. Material is not sensitive to mechanical impact or static discharge.

6. SPILL OR LEAK PROCEDURES

Use personal protection recommended in Section 8. Isolate the hazard area and deny entry to unnecessary and unprotected personnel. Sweep up spill and place in sealed bag or container for disposal. Wash spill area after pickup is complete. See Section 13 for disposal information.

7. HANDLING AND STORAGE

Handling: Use with adequate ventilation and do not breathe dust or vapor. Avoid contact with skin, eyes, or clothing. Wash hands thoroughly after handling.
Storage: Store in general storage area with other items with no specific storage hazards. Store in a cool, dry, well-ventilated, locked store room away from incompatible materials.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Use ventilation to keep airborne concentrations below exposure limits. Have approved eyewash facility, safety shower, and fire extinguishers readily available. Wear chemical splash goggles and chemical resistant clothing such

as gloves and aprons. Wash hands thoroughly after handling material and before eating or drinking. Use NIOSH-approved respirator with a dust cartridge.
Exposure guidelines: Phenyl Thiocarbamide: OSHA PEL: N/A, ACGIH: TLV: N/A, STEL: N/A.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state: Solid.
Appearance: White paper strips.
Odor: No odor.
Molecular formula $C_6H_5NHCSNH_2$.
Molecular weight 152.22.
Specific Gravity 1.30 g/mL @ 20°C.
pH: N/A
Vapor pressure (mm Hg): N/A
Vapor Density (Air = 1): N/A
Evaporation rate (Butyl acetate = 1): N/A
Viscosity: N/A
Hazardous polymerization: Will not occur.
Boiling point: N/A
Freezing / Melting point: N/A
Decomposition temperature: N/A
Solubility: N/A
Percent volatile (%): N/A

10. STABILITY AND REACTIVITY

Stability: Stable under normal conditions of use and storage. Avoid heat and ignition sources.
Incompatibility: Strong oxidizers. **Shelf life:** Indefinite if stored properly.

11. TOXICOLOGICAL INFORMATION

Acute Symptoms/Signs of exposure:
Eyes: Redness, tearing, itching, burning, conjunctivitis. **Skin:** Redness, itching.
Ingestion: Irritation and burning sensations of mouth and throat, nausea, vomiting and abdominal pain.
Inhalation: Irritation of mucous membranes, coughing, wheezing, shortness of breath,
Chronic Effects: No information found. **Sensitization:** none expected
Phenyl Thiocarbamide: LD50 [oral, rat]; 3 mg/kg; LC50 [rat]; N/A; LD50 Dermal [rabbit]; N/A
Material has not been found to be a carcinogen nor produce genetic, reproductive, or developmental effects.

12. ECOLOGICAL INFORMATION

Toxic to terrestrial and aquatic plants and animals. Do not release large quantities to environment.

12. DISPOSAL CONSIDERATIONS

Individual PTC taste paper strips can be disposed of in the trash. Check with all applicable local, regional, and national laws and regulations. Local regulations may be more stringent than regional or national regulations. Use a licensed chemical waste disposal firm for proper disposal.

14. TRANSPORTATION INFORMATION

UN/NA number: N/A Shipping name: Not Regulated. Hazard class: N/A
Packing group: N/A Exceptions: N/A

15. REGULATORY INFORMATION

EINECS: Not listed. WHMIS Canada: Not WHMIS Controlled.
TSCA: All components are listed or are exempt. California Proposition 65: Not listed.

16. ADDITIONAL INFORMATION

The information provided in this Material Safety Data Sheet represents data from the manufacturer and/or vendor and is accurate to the best of our knowledge. By providing this information, Science Take-Out LLC makes no guarantee or warranty, expressed or implied, concerning the safe use, storage, handling, precautions, and/or disposal of the products covered or the accuracy of the information contained in this fact sheet. It is the responsibility of the user to comply with local, state, and federal laws and regulations concerning the safe use, storage, handling, precautions, and/or disposal of products covered in this fact sheet