STO-132

Testing for Genetic Disorders that Cause Brain Damage

Teacher Information

science take-out just add students™

Summary

Students follow the case of twins who have newborn screening for genetic disorders. They conduct simulated newborn screening tests and follow-up blood tests that reveal that one of the twins has phenylketonuria (PKU). They learn how brain damage from PKU can be prevented. They explore inheritance of the gene that causes PKU using a Punnett square. A simulated genetic test is used to determine if the other twin has inherited the gene for PKU.

Core Concepts

- Some brain disorders may be inherited.
- Exposure to or lack of specific chemicals can interfere with the normal development of the nervous system.
- Biochemical testing and genetic testing can be used to identify genetic disorders.

Time Required

Two to three 40-minute class periods for activities.

Kit contains

- Newborn screening test cards for Anna and Cody
- Test solutions for four genetic disorders
- Toothpick stirrers
- Tube of Anna Wentler's blood plasma
- Phenylalanine test paper
- Phenylalanine color chart
- Tube of DNA stain
- Stirrer
- White plastic tray
- Graduated measuring cup
- **P** and **p** stickers (to represent genes)
- Simulated paper gel for genetic testing
- Newborn screening brochure
- PKU factsheet

Teacher Provides

- Safety goggles
- Paper towels for cleanup

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

Teacher Information

- Part 3 may be completed in class or for homework. It may be done after Part 2, Part 4, or Part 5.
- Some of your students may have PKU. Children with PKU who receive the appropriate diet will develop normally.
- If you have access to a computer, you may also want to view the video on newborn screening at: www.marchofdimes.com/baby/bringinghome_recommendedtests.html
- For more detailed information including videos and animations on PKU, consider a follow-up visit to the Your Genes Your Health website at: http://www.ygyh.org/pku/whatisit.htm Click on the topics in the sidebar on the left.
- Possible question for a quiz:

> A child with a genetic disorder is born to parents who do not show any symptoms of the disorder. Explain the types of information a genetic counselor might provide to these parents. In your answer, be sure to:
>
> - Identify one genetic disorder.
> - Explain how the child can have the disorder even though the parents do not.
> - Identify one technique that could be used to detect a genetic disorder.

Reusing kits

Kits may be refilled and reused. Allow approximately 20-30 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	Rinse with water	Return to kit bag
• Used newborn screening cards for Cody and Anna • Used toothpicks • Used phenylalanine test paper • Used simulated genetic testing gel	• White plastic tray	• All labeled droppers • All labeled microtubes • Bag for phenylalanine test paper • White plastic tray • Graduated measuring cup • Unused **P** and **p** stickers • *A Parent's Guide to Newborn Screening* * • *Parent Guide: Understanding PKU* * • Phenylalanine color chart *

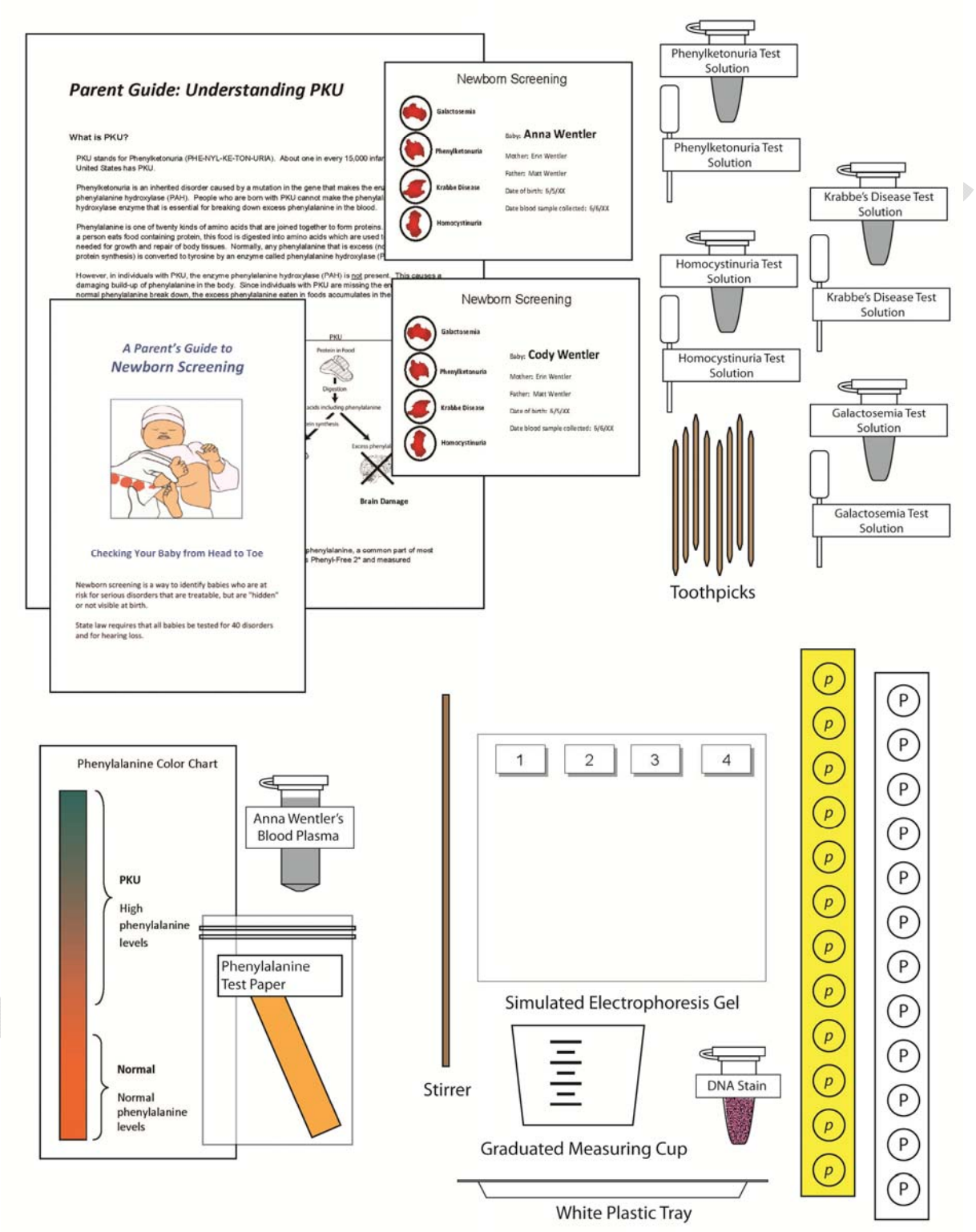
***** Consider laminating printed parts of the kits (such as colored graphics or instruction cards) that will be reused.

Note: It is <u>not</u> necessary to rinse or wash the droppers after use. Because the droppers are labeled, there is little chance for contamination. Washing the droppers may make the labels difficult to read. Simply ask students to squirt out any extra liquid from the droppers.

Refills for *Testing for Genetic Disorders that Cause Brain Damage* kits are available at www.sciencetakeout.com. The **10 Kit Refill Pack** includes the following materials:

- graduated transfer pipets (to refill the solutions)
- Newborn screening test cards for Anna and Cody
- Test solutions for: Phenylkentonuria, Krabbe's Disease, Homocystinuria, Galactosemia
- Toothpicks
- Anna Wentler's blood plasma
- Phenylalanine test paper
- DNA stain
- Small white plastic scoop (to refill the DNA stain)
- Simulated gels for genetic testing
- Strips of white uppercase **P** stickers
- Strips of yellow lowercase **p** stickers

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

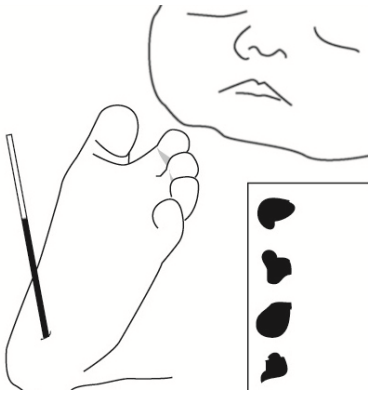
1. Work in a clean, uncluttered area. Cover the work area to protect the work surface.
2. Read and follow all instructions carefully.
3. Pay particular attention to following the specific safety precautions included in the kit activity instructions.
4. Goggles and gloves should be worn while performing 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, apply make-up 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.

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.

Testing for Genetic Disorders that Cause Brain Damage

Teacher Answer Key

Part 1: Newborn Screening Tests



Matt is watching his twins, Anna and Cody, in the newborn nursery. The nurse pokes the babies' heels, collects drops of blood on a card, and then puts tiny Band-Aids® on their heels.

When Matt asks the nurse why she did that, she explains "State law requires that all babies get newborn screening tests for a variety of genetic (inherited) disorders. The blood spots from Anna and Cody will be sent to a laboratory to be tested to determine if they have any rare genetic disorders."
The nurse gives Matt a brochure, ***A Parent's Guide to Newborn Screening***.

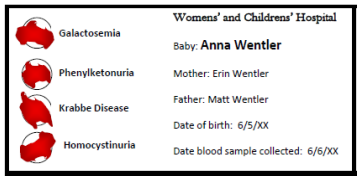
Use the information in the *A Parent's Guide to Newborn Screening* brochure to answer questions 1 through 3.

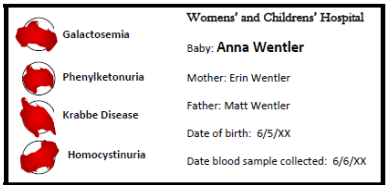
1. Why is it important to test the blood of babies who appear to be healthy for disorders that could affect their brain development?

2. What might happen if a disorder that affects brain development is not detected and treated promptly and properly?

3. A genetic disorder is a disease caused by a change in a gene, called a mutation. Genetic brain disorders specifically affect the development and function of the brain. Based on the information in the brochure, list at least three types of genetic brain disorders that can be diagnosed by newborn screening tests.

Your lab kit contains two newborn screening cards with dried drops of Anna's and Cody's blood and four test solutions to test for four different disorders—galactosemia, phenyketonuria, homocystinuria disease, and Krabbe's disease.





4. Follow these instructions to test Anna's and Cody's blood to determine if they have one of the four different disorders.

   - Add 2 drops of the appropriate test solution to each of the dried blood spots. *For example, add 2 drops of Galactosemia Test Solution to the circles labeled Galactosemia on each card.*
   - Use a toothpick to **gently** stir the test solutions around in each circle that contains the dried blood. *Use a different toothpick for each blood sample.*
   - If the test solution turns pink, the baby's blood contains a biochemical that indicates the baby may have the genetic disorder.

5. What can you conclude from the result of the twins' newborn screening tests? Support your answer with evidence from the blood tests.

Part 2: Follow-up Tests to Confirm the Diagnosis

A pediatrician meets with Matt and Erin in the hospital. He tells them that Anna's newborn screening test indicates that she may have a genetic (inherited) disease called phenylketonuria, or PKU. Children with PKU have dangerously high levels of an amino acid called phenylalanine in their blood. High levels of phenylalanine can poison brain cells, leading to mental retardation. He explains that it is very important to bring Anna back to the hospital in a week so that the hospital lab can test the level of phenylalanine in her blood.

1. Your lab kit contains a tube of Anna's blood plasma (the clear liquid part of blood) collected when her parents brought her in for follow-up testing. Use the phenylalanine test paper in your kit to determine the concentration of phenylalanine in the blood sample.
    - Dip one end of a strip of phenylalanine test paper into Anna's blood plasma.
    - Use the Phenylalanine Color Chart in your kit to determine the concentration of phenylalanine in Anna's blood plasma.

2. What can you conclude based on the results of Anna's phenylalanine test?

Part 3: What is PKU?

Matt and Erin (Anna's parents) are really worried about Anna. The doctor assures them that with immediate and proper treatment, PKU is not a life-threatening disease. He explains that babies with PKU are born with normal brains. Because brains continue to develop during childhood, high levels of phenylalanine in the blood can poison brain cells leading to mental retardation, small head size, behavioral problems, seizures, tremors, and jerking movements of arms and legs.

To prevent damage to Anna's developing brain, she will need to go on a special diet to reduce the phenylalanine in her blood. The doctor makes an appointment for Matt and Erin to meet with a team of specialists who will help them understand how to care for Anna and answer any questions that they have.

Read the *Parent Guide: Understanding PKU* fact sheet in your kit and use the information in the fact sheet to answer the following questions.

1. What causes PKU?

2. What is phenylalanine?

3. Circle the letter of the statement that best describes children with PKU.
   A. They lack a gene for the enzyme phenylalanine hydroxylase (PAH)
   B. They need extra phenylalanine added to their diet
   C. They produce an excess of phenylalanine hydroxylase (PAH)
   D. They do <u>not</u> need phenylalanine to make proteins

4. What is the function of the phenylalanine hydroxylase (PAH) enzyme?

5. A person who does not have the PAH (phenylalanine hydroxylase) enzyme will _____ (have/not have) PKU.

6. How does a missing phenylalanine hydroxylase (PAH) enzyme lead to high blood phenylalanine levels?

7. How will excess phenylalanine in Anna's blood affect her brain if she doesn't get prompt and appropriate treatment?

8. What must Anna's parents do to be certain that her brain develops normally?

9. List five foods which should be avoided in Anna's diet to prevent brain damage and mental retardation? Be specific.

Optional: To learn more about PKU, visit Your Genes Your Health at: www.ygyh.org/pku/whatisit.htm
To see videos and animations, be sure to click on the words in the list on the left side of the screen.

Part 4: Inheritance and PKU

Matt and Erin don't understand how Anna can have PKU when she has healthy parents and a healthy twin brother. No other family members have PKU. They are worried that Cody or their future children may develop PKU. The doctor suggests they meet with a genetic counselor. Genetic counselors are trained specialists who help people understand the information about inherited diseases that run in their families.

The genetic counselor explains that the gene involved in PKU comes in two forms or alleles:

- One form of the PKU gene is a dominant allele (**P**) that makes a normal enzyme to break down phenylalanine.
- The other form of the PKU gene is a recessive allele (**p**) that makes an enzyme which does not work properly.

People with at least one dominant allele (P) do NOT have PKU. People, like Anna, who have two recessive alleles (pp) will have PKU.

The genetic counselor uses simple sticker models to illustrate how PKU is inherited. Here is a KEY to what the stickers represent.

Allele = alternate forms of a gene

Dominant = Dominant alleles show their effect even if there is only one copy of that allele in a pair. For example, **PP** or **Pp**

Recessive =Recessive alleles show their effect only if there are two copies of the alleles in a pair. For example, **pp**

P sticker (white) = dominant allele makes normal enzyme

p sticker (yellow) = recessive allele makes an enzyme that does not work properly

Homozygous = pair of identical alleles (**PP** or **pp**)

Heterozygous = pair of alleles not identical (**Pp**)

Phenotype = traits or characteristics that an individual shows (PKU or no PKU)

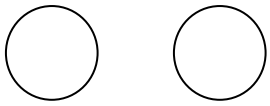
Genotype = alleles that an individual has inherited (**PP**, **Pp, or pp**)

1. Complete the "Phenotype" column in the table below by writing either "Has PKU" or "Does not have PKU.

Genotype	Phenotype
PP	
Pp	
pp	

Your kit contains sheets of stickers. Use these stickers and the information above to answer the following questions. ***Note: If you are working with other students, one student should use the stickers and other students should write letters in the circles. Be sure to clearly show the difference between a P and a p.***

2. What two stickers would you select to represent Anna who has PKU? Apply the appropriate stickers or write the letters in the circles below.



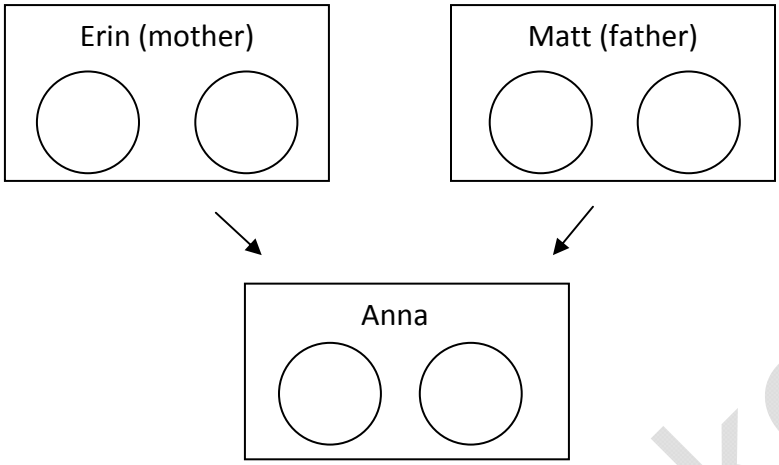
3. Circle Anna's genotype. **PP** **Pp** **pp**

4. Circle Anna's phenotype. **Has PKU** **Does not have PKU**

5. Is Anna heterozygous or homozygous for this trait? **Homozygous** **Heterozygous**

6. Anna has PKU. Both of her parents do NOT have PKU. Arrange the stickers (or write letters) to show how two healthy parents can have a child with PKU. *Remember that a child gets one allele for this trait from EACH parent.*

(or write letters)



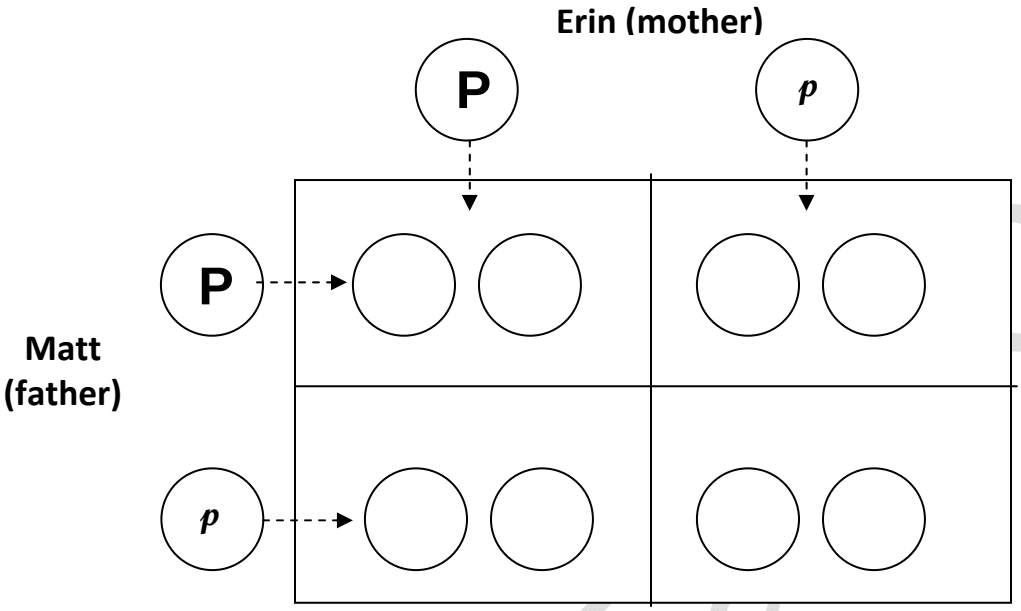
7. Circle Erin's (mother) genotype. **PP** **Pp** **pp**

8. Circle Erin's (mother) phenotype. **Has PKU** **Does not have PKU**

9. Circle Matt's (father) phenotype. **Has PKU** **Does not have PKU**

10. Are Anna's parents heterozygous or homozygous for this trait? **Homozygous** **Heterozygous**

11. Matt and Erin hope to have more children. They want to know what the chances are that future children could have PKU. The genetic counselor showed them how to set up a Punnett square. Complete the Punnett square by placing stickers (or writing letters) in the boxes.



12. If Matt and Erin have another child, what is the probability (chance) that the child will have PKU?

13. If Matt and Erin have another child, what is the probability (chance) that the child will NOT have PKU?

14. A carrier is a person who shows the dominant trait, but carries a recessive allele that can be passed to their offspring. What is the probability that Matt and Erin could have a child who is healthy but is a carrier for the PKU allele?

15. Cody (twin brother) does not have PKU. Matt and Erin want to know if Cody is a carrier for the recessive **p** allele that causes PKU. Can you tell from this Punnett square whether Cody is a carrier for the PKU allele? Explain why or why not.

Part 5: Genetic Testing for the Gene that Causes PKU

The genetic counselor explains that, when Cody grows up, he should know whether he is a carrier for the recessive allele that causes PKU. She explains that it is possible to test Cody's DNA to determine if he carries the recessive "**p**" allele that causes PKU. This genetic testing could be done now or when Cody is older. Matt and Erin decide to have the testing done now.

1. Why is it important that Cody know whether he is homozygous or heterozygous for the PKU gene?

The DNA copies from each family member are treated with a restriction enzyme that cuts DNA at specific base sequences. This restriction enzyme:

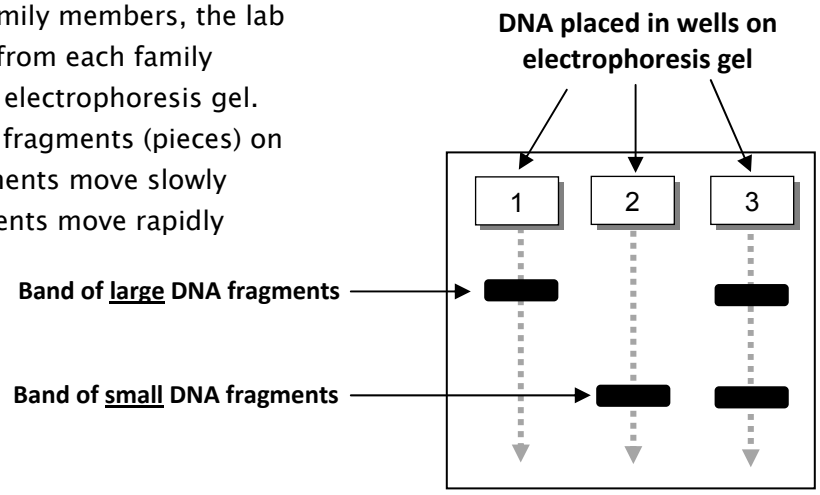
- Does NOT cut the DNA for the normal **P** allele.
- Cuts the DNA for the **p** allele to make two equal-sized, small fragments.

2. Circle the genotype that will result in all large pieces of DNA: **PP** **Pp** **pp**

3. Circle the genotype that will result in all small pieces of DNA: **PP** **Pp** **pp**

4. Circle the genotype that will result in both large and small pieces of DNA: **PP** **Pp** **pp**

To test the DNA samples for the family members, the lab technician placed samples of DNA from each family member into a different well on an electrophoresis gel. **Gel electrophoresis** separates DNA fragments (pieces) on the basis of size. Large DNA fragments move slowly through the gel. Small DNA fragments move rapidly through the gel.

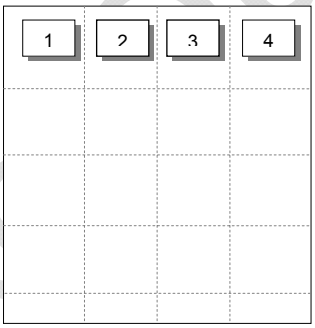


5. A person with the PKU who has the **pp** genotype would have only <u>small</u> DNA fragments. Which pattern of bands (1, 2 or 3) would represent a person with the **pp** genotype that causes PKU? _____

6. A healthy person with the **PP** genotype would have only <u>large</u> DNA fragments. Which pattern of bands (1, 2 or 3) would represent a person with the **PP** genotype? ____

7. A healthy person with the **Pp** genotype would have <u>both large and small</u> DNA fragments. Which pattern of bands (1, 2 or 3) would represent a person with the **Pp** genotype? ____

Your lab kit contains a <u>simulated</u> paper version of the electrophoresis gel that the lab technician made for the family.



You can't see the DNA pieces on this gel because DNA is colorless. To see the DNA, you will need to add a DNA stain to the gel. This stain will attach to the DNA fragments on the gel and turn them pink.

1. Place the simulated paper electrophoresis gel into the white plastic tray.

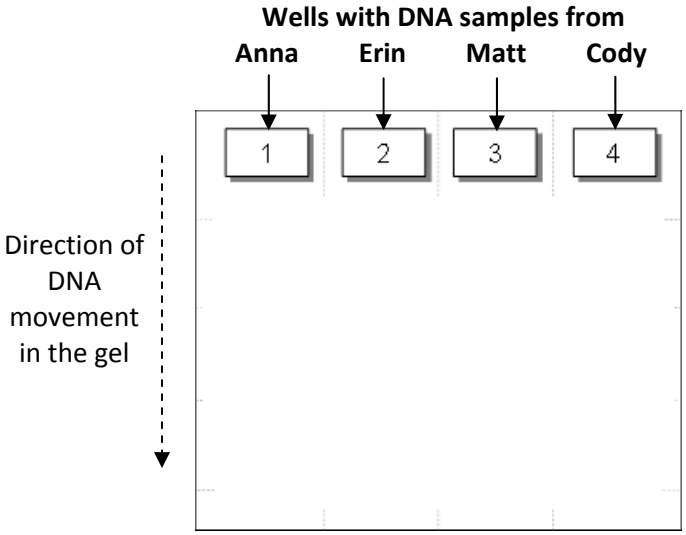
2. Add 10 ml of water to the small measuring cup.

3. Pour the entire contents of the tube of **DNA stain** into the water in the measuring cup.

4. Use the stirrer to mix the DNA stain until it dissolves.

5. Pour the DNA stain solution into the white plastic tray.

6. Observe the pink DNA bands on the gel. Record the banding pattern on the diagram of the electrophoresis gel below.



Answer the following questions based on your observation of the pattern of bands on the gel. (Circle the correct answers.)

7. The DNA sample from Anna was placed in **Well 1.**
   - What DNA fragments do you observe for Anna? **Large** **Small** **Both large and small**
   - What is Anna's genotype? **PP** **Pp** **pp**
   - Is Anna heterozygous or homozygous? **Heterozygous** **Homozygous**

8. The DNA sample from Erin (mother) was placed in **Well 2.**
   - What DNA fragments do you observe for Erin? **Large** **Small** **Both large and small**
   - What is Erin's genotype? **PP** **Pp** **pp**
   - Is Erin heterozygous or homozygous? **Heterozygous** **Homozygous**

9. The DNA sample from Matt (father) was placed in **Well 3.**

   - What DNA fragments do you observe for Matt? **Large** **Small** **Both large and small**
   - What is Matt's genotype? **PP** **Pp** **pp**
   - Is Matt heterozygous or homozygous? **Heterozygous** **Homozygous**

10. The DNA sample from Cody was placed in **Well 4.**

   - What DNA fragments do you observe for Cody? **Large** **Small** **Both large and small**
   - What is Cody's genotype? **PP** **Pp** **pp**
   - Is Cody heterozygous or homozygous? **Heterozygous** **Homozygous**

11. Will it be possible for Cody to have a child who has PKU? Explain why or why not.

MATERIAL SAFETY DATA SHEET

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name (as printed on the label)	Product Identity
Phenylketonuria Test Solution	pH 10 buffer*
Krabbe's Disease Test Solution	water
Homocystinuria Test Solution	water
Galactosemia Test Solution	water
Anna Wentler Blood Plasma	pH 9 buffer*

*Distributor: Wards Natural Sciences, 5100 West Henrietta Road. PO Box 92912, West Henrietta, NY 14692-9102

Telephone number for information: (800) 962-2660

Date of this MSDS: 5/13/13

Medical emergency phone number (Chemtrec): (800) 424-9300

2. COMPOSITION/INFORMATION ON INGREDIENTS

Product	Ingredients	CAS Numbers	% Weight/Volume (balance is water)
pH 9 buffer	Sodium carbonate Sodium bicarbonate	497-19-8 144-55-8	0.10% 0.35%
pH 10 buffer	Sodium carbonate Sodium bicarbonate	497-19-8 144-55-8	0.25% 0.15%

For all the ingredients

OSHA PEL: TWA – none estab. STEL – none estab.
ACGIH TLV: TWA – none estab. STEL – none estab.
NIOSH REL: TWA – none estab. STEL – none estab.
NIOSH ILDH: none estab.

3. HAZARDS IDENTIFICATION – for all pH buffer products

EMERGENCY OVERVIEW
Do not ingest. Avoid skin and eye contact. Avoid exposure to vapor or mists.

Potential Health Effects

EYES: May cause irritation. SKIN: May cause irritation. INHALATION: n/a
INGESTION: May cause gastrointestinal discomfort and mouth burns .

4. FIRST AID MEASURES – for all pH buffer products

EYES - Flush with water for at least 15 minutes, raising and lowering eyelids occasionally. Get medical attention if irritation persists.

SKIN - Thoroughly wash exposed area for at least 15 minutes. Remove contaminated clothing. Launder contaminated clothing before reuse. Get medical attention if irritation persists.

INGESTION - Do not induce vomiting. If swallowed, if conscious, give plenty of water immediately and call a physician or poison control center. Never give anything by mouth to an unconscious person.

5. FIRE FIGHTING MEASURES – for all pH buffer products

NFPA Rating: Health: 1 Fire: 0 Reactivity: 0

Extinguisher Media: Any means suitable for extinguishing surrounding fire

Special Firefighting Procedures: Firefighters should wear full protective equipment and NIOSH approved self-contained breathing apparatus.

Unusual Fire and Explosion Hazards: No data available

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6. SPILL OR LEAK PROCEDURES – for all pH buffer products

Ventilate area of spill. Clean-up personnel should wear proper protective equipment and clothing. Absorb material with suitable absorbent and containerize for disposal.

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7. HANDLING AND STORAGE – for all pH buffer products

Store in a cool dry place. This Material is not considered hazardous. Handle using safe laboratory practices.

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8. EXPOSURE CONTROLS/PERSONAL PROTECTION – for all pH buffer products

Respiratory Protection: n/a

Ventilation: Local Exhaust: Preferred
Mechanical(General): Acceptable
Special: No
Other: No

Protective Gloves: Natural rubber, Neoprene, PVC or equivalent.
Eye Protection: Splash proof chemical safety goggles should be worn.
Other Protective Clothing or Equipment: Lab coat, apron, eye wash, safety shower.

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9. PHYSICAL AND CHEMICAL PROPERTIES – for all pH buffer products

Melting Point: ~0°C Boiling Point: ~100°C

Vapor Pressure: information not available Vapor Density: information not available

Specific Gravity (H_2O=1): ~1 Percent Volatile by Volume: >99

Evaporation Rate: information not available Solubility in Water: soluble

Appearance and Odor: Clear colorless liquid

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10. STABILITY AND REACTIVITY – for all pH buffer products

Stability: Stable Materials to Avoid: strong acids and bases

Hazardous Decomposition Products: none known Hazardous Polymerization: will not occur

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11. TOXICOLOGICAL INFORMATION

Ingredient	Toxicity (oral-rat) LD_{50}
Sodium carbonate	4090 mg/kg
Sodium bicarbonate	4220 mg.kg

Effects of Overexposure (for all pH buffers):
Acute: Essentially non-hazardous. Possible irritation of eyes/skin/stomach
Chronic: None known.
Conditions aggravated/Target organs: none known

Target Organs: Eyes, skin, and gastrointestinal tract.

Primary Route(s) of Entry: Ingestion or skin contact.

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12. ECOLOGICAL INFORMATION – for all pH buffer products

No ecological data available

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13. DISPOSAL CONSIDERATIONS – for all pH buffer products

Waste Disposal Methods: Dispose in accordance with all applicable Federal, State and Local regulations.

Always contact a permitted waste disposer (TSD) to assure compliance.

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14. TRANSPORTATION INFORMATION

D.O.T. SHIPPING NAME: Not regulated

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15. REGULATORY INFORMATION – for all pH buffer products

EPA regulations:
RCRA Hazardous waste number (40 CFR 261.33) – not listed
RCRS Hazardous waste classification (40 CFR 261) – not classified
SARA Toxic Chemical (40 CFR 372.65) – not listed
SARA EHS (Extremely Hazardous Substance (40 CFR 355) – not listed

OSHA regulations:
Air Contaminant (29 CFR 1910.1000) – not listed

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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): "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
Preparation date of this MSDS: 8/18/10
Medical emergency phone number (Chemtrec): (800) 424-9300

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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