

# Breast Cancer Risk: Genes and the Environment

## Teacher Information



just add students™

### Summary

Explore environmental and genetic risk factors for developing breast cancer. Students complete pedigree-based cancer occurrence and BRCA1 DNA tests for a family. They complete a survey on risk factors associated with breast cancer and then analyze their survey responses based on information in a *Breast Cancer Risks* poster. They analyze models to determine if childhood exposure to DDT increases risks of breast cancer.

### Core Concepts

- An individual's risk of developing breast cancer is influenced by a number of factors such as specific genes, lifestyle choices, hormonal factors, and environmental exposures.
- People's perception of breast cancer risks may, or may not, be supported by scientific evidences.
- Exposure to DDT before birth or during childhood may increase risks for breast cancer.

### Time Required

Two 40-minute class periods + homework

### Kit contains

- Simulated BRCA1 Genetic Test sheet in plastic bag used for staining
- Tube of DNA stain
- Graduated measuring cup
- Plastic stirrer
- 3 plastic bags and beads to model effects of DDT insecticide exposure: no exposure, exposure before puberty, exposure after puberty
- *My Family Pedigree*
- *Breast Cancer Risks* poster

### Teacher Provides

- Tap 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.

## Suggested Resources

***Breast Cancer Risk and Environmental Factors*** by the National Institute of Environmental Health Sciences describes research being done on environmental risk factors related to breast cancer. [http://www.niehs.nih.gov/health/assets/docs\\_a\\_e/environmental\\_factors\\_and\\_breast\\_cancer\\_risk.pdf](http://www.niehs.nih.gov/health/assets/docs_a_e/environmental_factors_and_breast_cancer_risk.pdf)

The National Geographic article **DDT Linked to Fourfold Increase in Breast Cancer Risk** provides a summary of research that links prenatal DDT exposure and breast cancer. Particularly interesting is the researchers’ analysis of the limitations of the research study that clearly indicates the need for additional environmental health research. <http://news.nationalgeographic.com/2015/06/15616-breast-cancer-ddt-pesticide-environment/>

## Reusing *Breast Cancer Risk: Genes and the Environment* kits

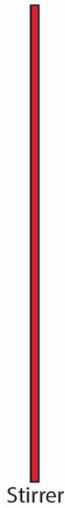
Teachers will need to instruct students on how to handle clean-up and return of the reusable kit materials. For example, teachers might provide the following information for students:

Discard	Rinse with water and dry with paper towel	Return to kit
<ul style="list-style-type: none"> <li>• Bag containing used BRCA1 Genetic Test and DNA stain solution</li> </ul> <p>Note: Students may keep the <i>My Family Pedigree</i></p>	<ul style="list-style-type: none"> <li>• Graduated measuring cup</li> <li>• Stirrer</li> </ul>	<ul style="list-style-type: none"> <li>• Graduated measuring cup</li> <li>• All bags with labels and/or beads</li> <li>• Tube labeled “DNA Stain”</li> <li>• Stirrer</li> <li>• <i>Breast Cancer Risks</i> poster</li> </ul>

Refills for *Breast Cancer Risk: Genes and the Environment* kits are available at [www.sciencetakeout.com](http://www.sciencetakeout.com). The **10 Kit Refill Pack** includes the following materials:

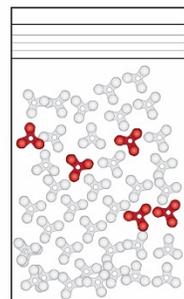
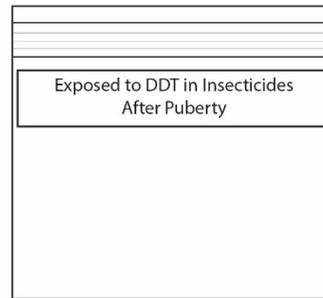
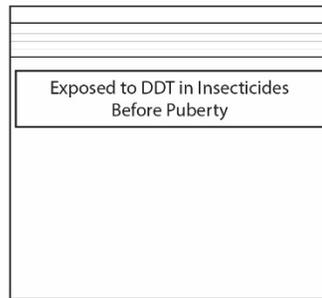
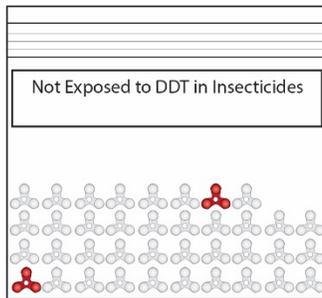
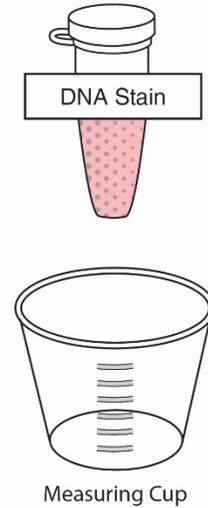
- DNA Stain
- Scoop for refilling DNA Stain tubes
- 10 simulated BRCA1 Genetic Tests sheets
- 10 plastic bags for BRCA1 Genetic Tests
- 10 copies of *My Family Pedigree*

# Kit Contents Quick Guide



Me (Sue)	Kathy	Jim	Margie
Gary	Shelly	Jen	Fred
Bill	Alice	Mary	

BRCA 1 Genetic Test



### BREAST CANCER RISKS

**Known Risk Factors**  
Multiple genetic, hormonal, lifestyle, and environmental factors increase the risk of breast cancer. The following are some of the most common factors that increase the risk of breast cancer.

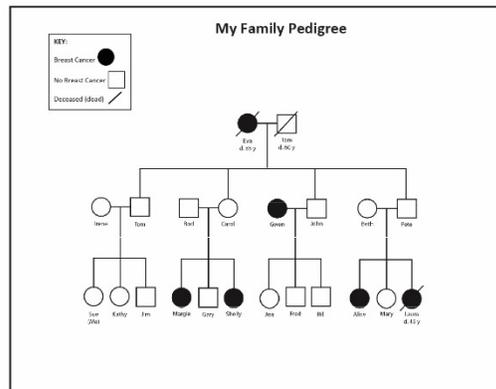
- Gender:** Females are more likely to develop breast cancer than males.
- Age:** The risk of developing breast cancer increases with age.
- Family History:** Women with a family history of breast cancer have a higher risk of developing the disease.
- Reproductive History:** Women who start menstruating early, have late menopause, or have never had children have a higher risk of breast cancer.
- Breast Density:** Women with dense breasts have a higher risk of breast cancer.
- Drinking Alcohol:** Drinking alcohol increases the risk of breast cancer.
- Lack of Exercise:** Women who do not exercise have a higher risk of breast cancer.
- Smoking:** Smoking increases the risk of breast cancer.
- Estrogen Hormone Medication:** Women who use estrogen hormone medication have a higher risk of breast cancer.

**Possible Risk Factors**  
The following are some of the most common factors that increase the risk of breast cancer.

- Low Vitamin D Levels:** Low levels of vitamin D may increase the risk of breast cancer.
- Exposure to Light or Night Shifts:** Exposure to light or night shifts may increase the risk of breast cancer.
- Chemicals in Cosmetics:** Some chemicals in cosmetics may increase the risk of breast cancer.
- Chemicals in Food:** Some chemicals in food may increase the risk of breast cancer.
- Chemicals for Lanes and Cardboard:** Some chemicals in lanes and cardboard may increase the risk of breast cancer.
- Chemicals in Plastic:** Some chemicals in plastic may increase the risk of breast cancer.

**Not Risk Factors**  
Multiple genetic, hormonal, lifestyle, and environmental factors increase the risk of breast cancer. The following are some of the most common factors that do not increase the risk of breast cancer.

- Cellphones
- Exposure to electromagnetic fields
- Cellular towers
- Cell phone use while driving
- Shower and antiperspirants
- Wearing bras
- Breast implants



## 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. Safety Data Sheets (SDS) provide specific safety information regarding the chemical contents of the kits. SDS 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 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.*

# Breast Cancer Risk: Genes and the Environment

## *Teacher Answer Key*

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### Part 1: A Family History of Breast Cancer

My family reunion began with a memorial service for my cousin Laura, who died from breast cancer when she was only 45 years old. After the service, three of my cousins (Margie, Shelly and Alice) revealed that they had breast cancer.

My cousin Margie explained that she had a genetic test that showed she has a mutated BRCA1 gene that increases the risk for breast and ovarian cancer. Once my cousins and I realized that we might have inherited the mutated BRCA1 gene, all of my cousins agreed to be tested for the BRCA1 gene mutation.

#### **BRCA1 Gene and Cancer Risk**

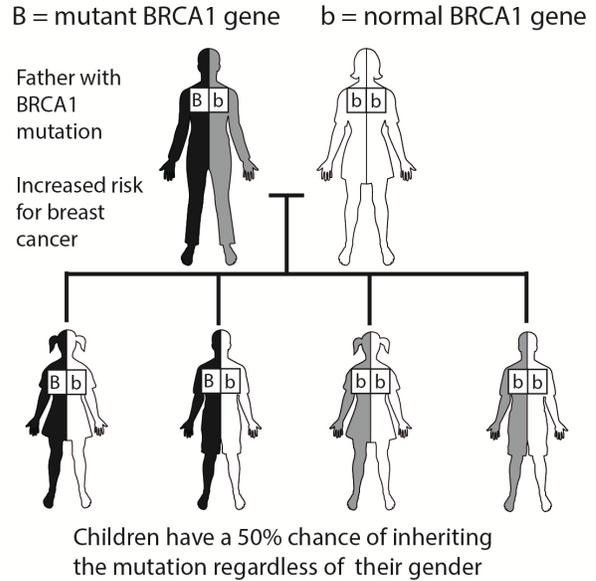
Mutations in the BRCA1 gene are known to increase the risk of breast and ovarian cancers in women. Approximately 50% to 65% of women born with a mutation in the BRCA1 gene will develop breast cancer by age 70, and 35% to 46% will develop ovarian cancer by age 70. For males, a BRCA1 gene mutation increases their risk for breast cancer and prostate cancer.

1. Your lab kit contains a pedigree for my family. List the names of family members who have or had breast cancer.

***Eva, Gwen, Margie, Shelly, Alice, Laura***

### BRCA1 Gene and Inheritance

Because the BRCA1 gene mutation is dominant, it only takes one copy of the mutant gene to increase a person's risk for breast cancer. The BRCA1 gene is located on chromosome 17 which is an autosome, not a sex (X or Y) chromosome. This means that the mutated BRCA1 gene can be inherited from either your mother or your father.



- Does having one normal BRCA gene and one mutated BRCA1 gene increase a person's risk for developing breast cancer? Support your answer with information from the text and diagram above.

***Yes, the BRCA1 gene mutation is dominant which means only one copy of the mutated BRCA1 gene is needed for increased risk of breast cancer.***

- Explain how a woman could inherit a mutated BRCA1 gene from her father.

***The BRCA1 mutation is on an autosome. It is not located on the sex chromosomes. This means the mutated BRCA1 gene can be inherited from either a father or a mother.***

- Your lab kit contains a bag with a **BRCA1 Genetic Test** sheet that has been spotted with DNA (gene) samples from my family. You will analyze the genetic test to determine which family members inherited the mutated BRCA1 gene. *Note: Leave the test sheet in the bag.*

BRCA1 Genetic Test			
Me (Sue)	Kathy	Jim	Margie
○	○	○	○
Gary	Shelly	Jen	Fred
○	○	○	○
Bill	Alice	Mary	
○	○	○	

Each circle contains a DNA (gene) sample from a family member.

5. To make the DNA visible on the genetic test, you need to stain the BRCA1 Genetic Test with a DNA stain:
  - a) Fill the plastic measuring cup with 20 ml of tap water.
  - b) Pour the contents of the **DNA Stain** tube into the water in the cup.
  - c) Stir until the DNA stain has dissolved.
  - d) Pour the DNA stain solution from the cup into the plastic bag that contains the BRCA1 Genetic Test.
  - e) Close the bag completely then lay the bag flat on your desk or table so that the DNA stain comes in contact with all parts of the BRCA1 Genetic Test paper.
  
6. Look at the BRCA1 Genetic Test paper in the bag. Do not remove the paper from the bag.
  - A pink spot indicates the presence of a BRCA1 gene mutation that increases the risk for breast cancer.
  - Lack of a pink spot indicates that the BRCA1 gene mutation is not present.
  
7. Darken the circles in the diagram below to show the pink spots that indicate the family members who have a BRCA1 gene mutation.

<b>Me (Sue)</b> 	<b>Kathy</b> 	<b>Jim</b> 	<b>Margie</b> 
<b>Gary</b> 	<b>Shelly</b> 	<b>Jen</b> 	<b>Fred</b> 
<b>Bill</b> 	<b>Alice</b> 	<b>Mary</b> 	

8. Discard the bag that contains the BRCA1 Genetic Test paper.
  
9. On the **My Family Pedigree** sheet, write "X" under the name of each cousin (the bottom row of symbols) who has the BRCA1 gene mutation. *Note: Laura had not been tested for the BRCA1 gene mutation.*

**Students should put Xs under Kathy, Jim, Margie, Gary, Jen, Fred, and Mary**

10. Is it possible to have a mutated BRCA1 gene and not have breast cancer? Support your answer with evidence from the pedigree and results of the genetic tests.

***Yes, Kathy, Jim, Gary, Jen, Fred, and Mary have a mutated BRCA1 gene and they do not have breast cancer. Students may also note that people in generation 2 must have had the gene and most did not have breast cancer.***

11. Which males on the pedigree have an increased risk for breast cancer and prostate cancer?

***Jim, Gary, and Fred have the BRCA1 gene mutation that increases their risk for breast and prostate cancer.***

12. List TWO reasons why it might be important that both males and females get tested to determine if they inherited the BRCA1 gene mutation.

***They have an increased risk for breast cancer and ovarian or prostate cancer. They could pass the mutated BRCA1 gene on to their children.***

13. Is it possible to have breast cancer and not have a mutated BRCA1 gene? Support your answer with evidence from the pedigree and results of the genetic tests.

***Yes, Shelly and Alice have breast cancer and they do not have the BRCA1 gene mutation.***

## Part 2: A Survey - Risk Factors for Breast Cancer

Although genetics is a contributor to breast cancer development, scientific studies have estimated that inherited genes account for only 5–10% of breast cancers. Other risk factors, such as those listed in Column 1 of the chart below, may increase a woman’s chance of developing breast cancer.

1. In Column 2 of the chart below (**What Do YOU Think?**), write **Yes**, **No**, or **Possibly** to indicate whether you think each risk factor increases a woman’s risk of developing breast cancer.

Column 1	Column 2	Column 3
<b>Possible Risk Factors for Breast Cancer</b>	<b>What Do YOU Think?</b> Is it a breast cancer risk factor? Yes, No, or Possibly	<b>Scientific Evidence?</b> Is it a breast cancer risk factor? Yes, No, or Possibly
Aging	<i>Student answers will vary</i>	<b>Yes</b>
Cell phones		<b>No</b>
Being overweight or obese		<b>Yes</b>
High dose estrogen birth control		<b>Yes</b>
Chemicals in plastics and cosmetics		<b>Possibly</b>
Drinking alcohol		<b>Yes</b>
Gender		<b>Yes</b>
Heredity (family history)		<b>Yes</b>
Caffeine		<b>No</b>
Lack of physical activity		<b>Yes</b>
Night work		<b>Possibly</b>
Pesticides such as DDT		<b>Possibly</b>
Race/Ethnicity		<b>Yes</b>
Smoking or second-hand smoke		<b>Yes</b>

2. Use the information in the **Breast Cancer Risks** poster to complete Column 3 of the chart above. Write **Yes**, **No**, or **Possibly** to indicate whether scientific research provides evidence that each risk factor increases breast cancer risk.

3. Some factors associated with breast cancer risk cannot be controlled (changed). List at least four risk factors for breast cancer that you cannot control.

***Gender, age, heredity (family history), and ethnicity/race***

4. Other factors associated with breast cancer risk can be controlled (changed) by making lifestyle choices. List four actions that people could take to reduce their exposure to known risk for breast cancer.

***Student answers will vary but should reflect the information in the Breast Cancer Risks poster.***

5. Many scientists recommend taking a “better safe than sorry” approach when considering exposure to possible environmental risk factors. List four things you might be cautious about using if you take the “better safe than sorry” approach to breast cancer risk factors.

***Cosmetics, plastics with BPA, lawn and garden products that contain pesticides, foods with antibiotics, pesticides or hormones.***

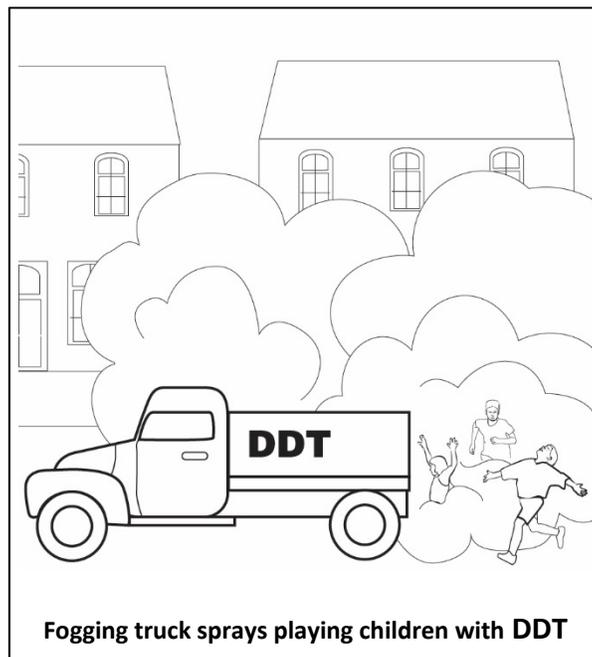
6. Do you think that avoiding all known risk factors will prevent breast cancer? Explain your answer.

***No, many people with breast cancer have no apparent risk factors (other than being a woman and growing older)***

### Part 3: DDT, Breast Cancer, and Windows of Susceptibility

Shelly and Alice both have breast cancer. They do not have the BRCA1 gene, so they both wonder what caused their breast cancer.

Shelly saw a news program about animal research on breast cancer. The research showed that rats exposed to the chemical DDT had higher rates of breast cancer than rats that were not exposed to DDT. Shelly thinks that her breast cancer and Alice's breast cancer were caused by DDT that was sprayed to kill mosquitos in the town where they lived when they were children. Shelly and Alice remember playing outdoors when the DDT fogging trucks came through their neighborhood. Alice even has a picture that her mother took of them playing in the DDT fog cloud.



Alice did some Internet research and the information below summarizes what she learned about DDT and breast cancer.

#### DDT and Breast Cancer

DDT (dichlorodiphenyltrichloroethane) is a chemical insecticide that was used during the 1940s through the 1960s. DDT spraying is an effective way to kill mosquitos that carry diseases such as malaria, encephalitis, and West Nile virus. However, the use of DDT in the United States was banned in 1972 because research showed that DDT persisted in the environment and had devastating effects on some wildlife. Many women were exposed to DDT spraying before DDT was banned. DDT is still sprayed in some countries where diseases caused by mosquitos are a serious health problem.

The chemical structure of DDT is similar to the chemical structure of estrogens (female sex hormones). Because of this, DDT can act as an **endocrine disruptor**. Endocrine disruptors are chemicals that interfere with the normal action of hormones produced by the body's endocrine system. Because estrogen has been associated with breast cancer risk, it was suggested that DDT exposure might also be a risk factor for breast cancer.

Until recently, most research studies found no evidence that DDT exposure increases the risk of breast cancer in humans.

1. What was DDT used for when Shelly and Alice were children?

***It was used to kill mosquitos that carry diseases.***

2. Why was the use of DDT banned in the United States?

***It persisted in the environment and had devastating effects on some wildlife.***

3. Why is DDT still used in some countries?

***DDT is used in countries where diseases carried by mosquitos are a serious health problem.***

4. What is an endocrine disruptor?

***Endocrine disruptors are chemicals that interfere with the normal action of hormones produced by the body's endocrine system.***

5. Why does DDT interfere with the normal action of female sex hormones?

***The chemical structure of DDT is similar to the chemical structure of estrogens.***

6. Does DDT increase the risk of breast cancer for women?

***Most research studies found no evidence that DDT exposure increases the risk of breast cancer for women***

Alice saw a TV news interview with a scientist who had done research on the link between DDT exposure and breast cancer. The scientist had a theory that there are certain times during human development, called “windows of susceptibility”, when people are more susceptible to (affected by) exposure to environmental risk factors. The scientist hypothesized that females who were exposed to DDT before puberty (before their breasts are fully developed) or before birth have an increased risk of breast cancer later in life.

7. How would you define “windows of susceptibility”?

***Ages during which exposures to environmental risk factors have a greater effect.***

8. What is the “window of susceptibility” that the scientist is investigating?

***Exposure before puberty (before breasts are fully developed)***

9. Observe the bead model in the bag labeled “Not Exposed to DDT in Insecticides.” This bag contains 40 beads. **Do NOT open this bag.**
- White beads represent women who did not develop breast cancer before age 60.
  - Red beads represent women who developed breast cancer before age 60.
10. How many of the 40 beads in the “Not Exposed to DDT in Insecticides” model are red beads representing women who developed breast cancer before age 60.   2
11. What is the approximate chance of a woman developing breast cancer before age 60 if she was not exposed to DDT in insecticides? Express your answer as % chance. Explain how you arrived at your answer.

  5   % chance                       $(2/40) \times 100 = 5\%$

The scientist found that women who were exposed to DDT before puberty (either during childhood or before birth) were 4 times more likely to develop breast cancer before they reached age 60. Exposure to DDT after puberty did not increase a woman’s risk of developing breast cancer.

12. What is the approximate chance of a woman developing breast cancer before age 60 if she was exposed to DDT before puberty? Express your answer as % chance. Explain how you arrived at your answer.

  20   % chance                      ***With no exposure to DDT, the chance was 5%. Exposure to DDT before puberty makes women 4 times more likely to develop cancer.  $5\% \times 4 = 20\%$***

13. Make a model using 40 beads to represent the results for 40 women who were exposed to DDT before puberty. Put the appropriate number of white and red beads into the bag labeled “**Exposed to DDT in Insecticides Before Puberty.**” Show your work or explain how you arrived at your answers.
- How many white beads did you put in the bag?   32
  - How many red beads did you put in the bag?   8

Show your work or explain how you arrived at your answers.

14. What is the approximate chance of a woman developing breast cancer before age 60 if she was exposed to DDT after puberty? Express your answer as % chance. Explain how you arrived at your answer.

5 % chance

**Exposure to DDT after puberty did not increase a woman's risk of developing breast cancer. So this should be the same as women who were not exposed to DDT.**

15. Make a model using 40 beads to represent the results for 40 women who were exposed to DDT after puberty. Put the appropriate number of white and red beads into the bag labeled "Exposed to DDT in Insecticides After Puberty."

- How many white beads did you put in the bag? 38
- How many red beads did you put in the bag? 2

Show your work or explain how you arrived at your answers.

16. Some communities today are considering using DDT spraying programs to control rising mosquito populations.

- What is one benefit of DDT spraying?

**Reduce mosquitos or mosquito borne disease**

- What are two risks of DDT spraying?

**Increased risk of breast cancer  
Harmful to the environment**

- Why are people most concerned about exposure of pregnant women and children to DDT?

**Exposure to DDT before birth or before puberty may increase a women's risk for developing breast cancer.**

- Would you support the use of DDT spraying in your community? Explain why or why not by weighing the risks and benefits?

**Student answers will vary but they should support their answer by weighing the risks and benefits.**

**Section 1 Chemical Product and Company Information**

Science Take-Out  
80 Office Park Way  
Pittsford, NY 14534  
(585)764-5400

**CHEMTREC 24 Hour Emergency  
Phone Number (800) 424-9300**  
For laboratory use only. Not for drug, food or household use

<b>Product</b>	Sodium Carbonate, Anhydrous
<b>Synonyms</b>	"DNA Stain"

**Section 2 Hazards Identification**

**Signal word:** WARNING  
**Pictograms:** GHS07  
**Target organs:** None known.



**GHS Classification:**  
Eye irrit. (Category 2A)

**GHS Label information: Hazard statement(s):**  
H319: Causes serious eye irritation.

**Precautionary statement(s):**

P264: Wash hands thoroughly after handling.  
P280: Wear protective gloves/protective clothing/eye protection/face protection.  
P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.  
P337+P313: If eye irritation persists: Get medical advice/attention.

Ca Prop 65 - This product does not contain any chemicals known to the State of California to cause cancer, birth defects, or any other reproductive harm.

**Section 3 Composition / Information on Ingredients**

Chemical Name	CAS #	%	EINECS
Sodium carbonate	497-19-8	100%	207-838-8

**Section 4 First Aid Measures**

**INGESTION:** Call physician or Poison Control Center immediately. Induce vomiting only if advised by appropriate medical personnel. Never give anything by mouth to an unconscious person.

**INHALATION:** Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

**EYE CONTACT:** Check for and remove contact lenses. Flush thoroughly with water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get immediate medical attention.

**SKIN ABSORPTION:** Remove contaminated clothing. Flush thoroughly with mild soap and water. If irritation occurs, get medical attention.

**Section 5 Fire Fighting Measures**

**Suitable Extinguishing Media:** Use any media suitable for extinguishing supporting fire.

**Protective Actions for Fire-fighters:** In fire conditions, wear a NIOSH/MSHA-approved self-contained breathing apparatus and full protective gear. Use water spray to keep fire-exposed containers cool.

**Specific Hazards:** Sodium carbonate reacts with hydrated lime to form caustic soda. Special care should be taken where lime and sodium carbonate are handled in the same area.

**Section 6 Accidental Release Measures**

**Personal Precautions:** Evacuate personnel to safe area. Use proper personal protective equipment as indicated in Section 8. Provide adequate ventilation.

**Environmental Precautions:** Avoid runoff into storm sewers and ditches which lead to waterways.

**Containment and Cleanup:** Sweep or vacuum up and place in a suitable container for proper disposal. Wash spill area with soap and water.

**Section 7 Handling and Storage**

**Precautions for Safe Handling:** Read label on container before using. Do not wear contact lenses when working with chemicals. Keep out of reach of children. Avoid contact with eyes, skin and clothing. Do not inhale dusts. Use with adequate ventilation. Avoid ingestion. Wash thoroughly after handling. Remove and wash clothing before reuse.

**Conditions for Safe Storage:** Store in a cool, well-ventilated area away from incompatible substances.

**Section 8 Exposure controls / Personal Protection**

Exposure Limits:	Chemical Name	ACGIH (TLV)	OSHA (PEL)	NIOSH (REL)
	Sodium carbonate	None established.	None established.	None established.

**Engineering controls:** Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower and fire extinguishing material. Personnel should wear safety glasses, goggles, or faceshield, lab coat or apron, appropriate protective gloves. Use adequate ventilation to keep airborne concentrations low.

**Respiratory protection:** None should be needed in normal laboratory handling at room temperatures. If misty conditions prevail, work in fume hood or wear a NIOSH/MSHA approved respirator.

## Section 9 Physical and Chemical Properties

**Appearance:** Solid, white powder.  
**Odor:** No odor.  
**Odor threshold:** Data not available.  
**pH:** Data not available.  
**Melting/Freezing point:** 864°C (1587°F)  
**Boiling point:** Decomposes  
**Flash point:** Not flammable.

**Evaporation rate (Water = 1):** Data not available  
**Flammability (solid/gas):** Data not available.  
**Explosion limits: Lower/Upper:** Not flammable.  
**Vapor pressure (mm Hg):** Data not available  
**Vapor density (Air = 1):** 0.7 (water)  
**Relative density (Specific gravity):** 2.533  
**Solubility(ies):** 17% @ 20°C in water.

**Partition coefficient:** Data not available.  
**Auto-ignition temp.:** Data not available.  
**Decomposition temp.:** Data not available  
**Viscosity:** Data not available.  
**Molecular formula:** Na<sub>2</sub>CO<sub>3</sub>  
**Molecular weight:** 105.99

## Section 10 Stability and Reactivity

**Chemical stability:** Stable

**Hazardous polymerization:** Will not occur.

**Conditions to avoid:** Excessive temperatures. Hygroscopic material, avoid moisture.

**Incompatibilities with other materials:** Acids cause decomposition liberating gaseous carbon dioxide. When mixed with lime dust and water, corrosive and caustic soda may be produced.

**Hazardous decomposition products:** Carbon dioxide.

## Section 11 Toxicological Information

**Acute toxicity:** Oral-rat LD50: 4090 mg/kg ; Inhalation-rat LC50: 2.3 mg/l/2 hours ; Dermal-rat LD50: 2210 mg/kg

**Skin corrosion/irritation:** Data not available

**Serious eye damage/irritation:** Data not available

**Respiratory or skin sensitization:** Data not available.

**Germ cell mutagenicity:** Data not available

**Carcinogenicity:** Data not available

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity:** Data not available

**STOT-single exposure:** Data not available

**Aspiration hazard:** Data not available

**STOT-repeated exposure:** Data not available

**Potential health effects:**

Inhalation: May be harmful if inhaled. Causes respiratory tract irritation.

Ingestion: May cause irritation of the digestive tract. May be harmful if swallowed.

Skin: May be harmful if absorbed through skin. Causes skin irritation.

Eyes: Causes eye irritation.

**Signs and symptoms of exposure:** Burning sensation, cough, wheezing, laryngitis, shortness of breath, headache, nausea, vomiting.

**Additional information:** RTECS #: VZ4050000

## Section 12 Ecological Information

**Toxicity to fish:** LC50 - Lepomis macrochirus (Bluegill) - 300 mg/l - 96 h.

**Toxicity to daphnia and other aquatic invertebrates:** EC50 - Daphnia magna (Water flea) - 265 mg/l - 48 h

**Toxicity to algae:** No data available

**Persistence and degradability:** No data available

**Bioaccumulative potential:** No data available

**Mobility in soil:** No data available

**PBT and vPvB assessment:** No data available

**Other adverse effects:** An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

## Section 13 Disposal Considerations

These disposal guidelines are intended for the disposal of catalog-size quantities only. Federal regulations may apply to empty container. State and/or local regulations may be different. Dispose of in accordance with all local, state and federal regulations or contract with a licensed chemical disposal agency.

## Section 14 Transport Information

**UN/NA number:** None assigned

**Shipping name:** Not Regulated

**Hazard class:** Not applicable

**Packing group:** Not applicable

**Reportable Quantity:** No

**Marine pollutant:** No

**Exceptions:** No

**2012 ERG Guide #** Not applicable

## Section 15 Regulatory Information

A chemical is considered to be listed if the CAS number for the anhydrous form is on the Inventory list.

Component	TSCA	CERLCA (RQ)	RCRA code	DSL	NDSL	WHMIS Classification
Sodium carbonate	Listed	Not Listed	Not Listed	Not Listed	Not Listed	E;D2B

## Section 16 Additional Information

The information contained herein is furnished without warranty of any kind. Employers should use this information only as a supplement to other information gathered by them and must make independent determinations of suitability and completeness of information from all sources to assure proper use of these materials and the safety and health of employees.

NTP: National Toxicology Program, IARC: International Agency for Research on Cancer, OSHA: Occupational Safety and Health Administration, STOT: Specific Target Organ Toxicity, SE: Single Exposure, RE: Repeated Exposure, ERG: Emergency Response Guidebook.

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