

Flower Forensics

Teacher Information

Summary

Students collect and analyze data to compare a rare black orchid with three suspicious black orchids that may have been illegally cloned. They perform simulations of chromatography of plant pigments, enzyme assays, restriction enzyme digestion and gel electrophoresis.

Core Concepts

- Sexually produced offspring resemble, but are not identical to, either of their parents. Asexually reproduced offspring are normally genetically identical to the parent. Cloning is the production of identical genetic copies.
- Offspring resemble their parents because they inherit similar genes that code for the production of proteins that form similar structures and perform similar functions.
- Genes are segments of DNA molecules.
- The coded instructions for specifying characteristics of the organism are carried in DNA, a large molecule formed from subunits arranged in a sequence of bases of four kinds (represented by A, G, C, and T).
- The genetic information stored in DNA is used to direct the synthesis of proteins.
- New varieties of cultivated plants and domestic animals have resulted from selective breeding for particular traits.

Time Required

Two 40-minute class periods

Kit contains

- Diagrams of orchids
- Simulated electrophoresis gel
- DNA Strips
- Genetic code chart
- Microtubes containing simulated “Orchid flower extracts”
- Labeled droppers for “Orchid flower extracts”
- Simulated “Chemical X Test Strip”
- Simulated “Chemical X Indicator Powder”
- Mini-scoop
- Cup
- Chromatography paper
- Pencil

Teacher Provides

- Safety goggles
- Scissors
- Transparent tape
- Paper towels for cleanup
- Access to water

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 *Flower Forensics* 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:

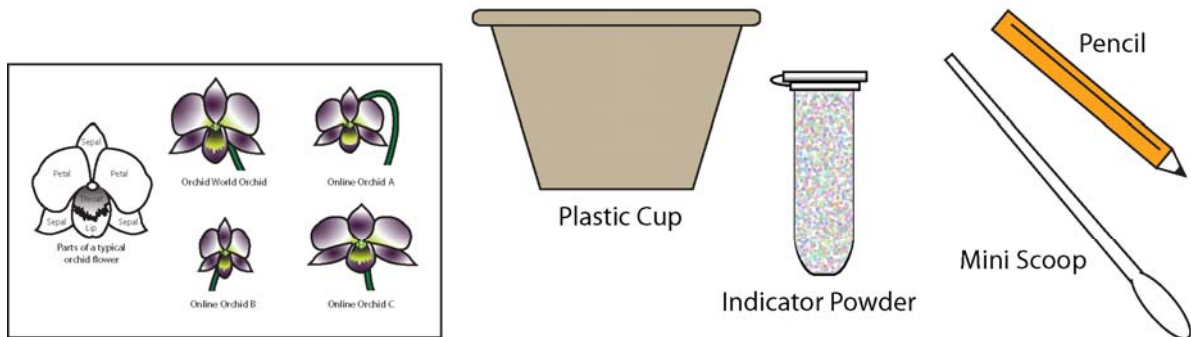
Discard	Rinse with water and dry with paper towel	Return to kit
<ul style="list-style-type: none"> • Used chromatography paper 	<ul style="list-style-type: none"> • Droppers • Cup • Plastic Test Strip 	<ul style="list-style-type: none"> • Microtubes of “Orchid Extracts” and “Chemical X Indicator Powder” • Droppers and cup (rinsed) • Pencil • Mini-scoop • Plastic Test Strip • Universal Genetic Code Chart * • Orchid diagrams*

*Note: Consider laminating printed parts of the kits that will be reused.

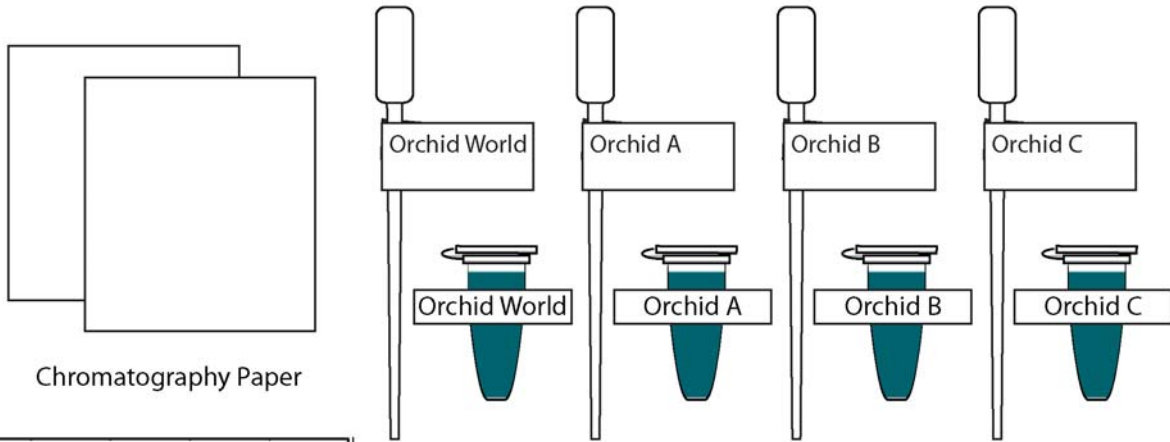
Refills for *Flower Forensics* kits are available at www.sciencetakeout.com. The **10 Kit Refill Pack** includes the following materials:

- 1 Quick Guide for assembling kit
- 5 ml of each simulated orchid flower extract: “Orchid World”, “Orchid A”, “Orchid B”, “Orchid C”
- 20 ml tube of simulated “Chemical X Indicator Powder”
- 1 funnel
- 4 graduated transfer pipets (for teacher use)
- 15 sheets of Chromatography paper
- 10 *Simulated Electrophoresis Gels*
- 10 sheets of *DNA Strips*

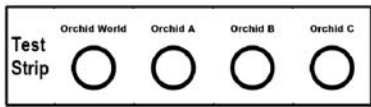
Kit Contents Quick Guide



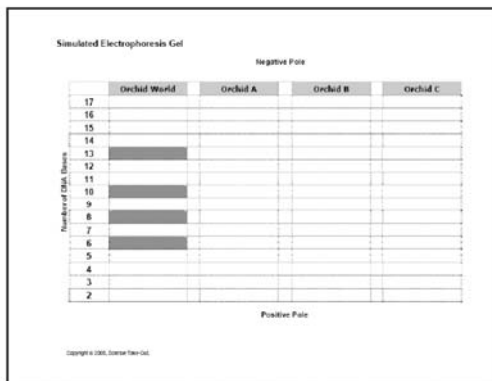
Plant Diagram



Chromatography Paper



Test Strip



Simulated Electrophoresis Gel

Use for Part 4:

DNA Strips - Cut out on dotted lines

mRNA from Orchid A: CCGAATTCAGGACATTCGTACGCGC ATTACAGCT
 mRNA from Orchid B: CCGGATTCAGGACATTCGTACGCGC ATTACAGCT
 mRNA from Orchid C: CCGAATTCAGGACATTCGTACGCGC ATTACAGCT
 mRNA from Orchid D: CCGAATTCAGGACATTCGTACGCGC ATTACAGCT
 mRNA from Orchid E: CCGAATTCAGGACATTCGTACGCGC ATTACAGCT

Use for Part 5:

Universal Genetic Code Chart
 Messenger RNA bases and the amino acids they code for
 Note: Amino acid abbreviations are in bold type (e.g., Phe, Leu, Ser, etc.)

		Second Letter			
		U	C	A	G
U	UUU	Phe	Phe	Tyr	Tyr
	UUC	Phe	Leu	Tyr	Tyr
	UUA	Leu	Leu	Stop	Stop
	UUG	Leu	Leu	Stop	Trp
C	CUU	Leu	Pro	His	Arg
	CUC	Leu	Pro	His	Arg
	CUA	Leu	Pro	Gln	Arg
	CUG	Leu	Pro	Gln	Arg
A	AUU	Ile	Thr	Asn	Ser
	AUC	Ile	Thr	Asn	Ser
	AUA	Ile	Lys	Asn	Ser
	AUG	Met	Thr	Lys	Arg
G	GUU	Val	Ala	Arg	Gly
	GUC	Val	Ala	Arg	Gly
	GUA	Val	Ala	Lys	Gly
	GUG	Val	Ala	Lys	Gly

DNA Strips and Genetic Code Chart

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.

Flower Forensics

The owner of a local flower store (Orchid World) has asked you to investigate a possible crime – the theft and illegal cloning of some of his prized black orchids. He has spent many years creating a new strain of rare black orchid that is resistant to insect predators. He recently noticed that three online flower companies are selling black orchids that seem similar to his. He is suspicious that these companies have stolen and are cloning some of his orchids.

Your Task: Analyze biological evidence to determine if the orchids sold by the online flower companies (orchid A, orchid B, and orchid C) are clones of (identical to) the Orchid World company's black orchid.

Part I: Analysis of Flower Structure


You will compare the structure of the Orchid World orchid with the orchids sold by the online flower company.

1. Observe the color orchid flower diagrams in your kit. The diagram on the left shows the names for the parts of a typical orchid flower. The four diagrams on the right show the Orchid World company's black orchid and the orchids sold by the three online flower companies.
2. Compare the structure (shape, size, and organization of parts) of the four orchid flowers. Record your observations of the flower structure on the data table included with your kit. *(See data table on the last page. You may tear this data table off so that is easier to record your data as you work on this lab activity.)*
3. Based on your observation of orchid flower structure, hypothesize which orchids (A, B, and C) are clones of the Orchid World black orchid.

Part 2: Analysis of Flower Pigments

You will use paper chromatography to compare the pigments present in the four orchid flowers. Chromatography is a method used to separate the plant pigments into a distinct banding pattern of different colors.

Your kit contains droppers of the orchid flower extracts that were created by grinding up the orchid flowers. Follow the paper chromatography procedure below compare the pigments of your four orchid samples.

1. Draw a pencil (not pen) line 1 cm (approximately this distance ) from the bottom of a piece of chromatography paper as shown in Figure 1. Use a pencil to label the top edge of the chromatography paper OW, A, B, and C as shown in Figure 1.
2. Use the dropper labeled Orchid World to spot one small drop of the Orchid World flower extract just above the pencil line (see Figure 1).

Warning!
The pigments in the flower extracts will stain skin, clothing, and furniture.

- Cover your work area with waterproof material.
- Avoid contact with skin and clothing.

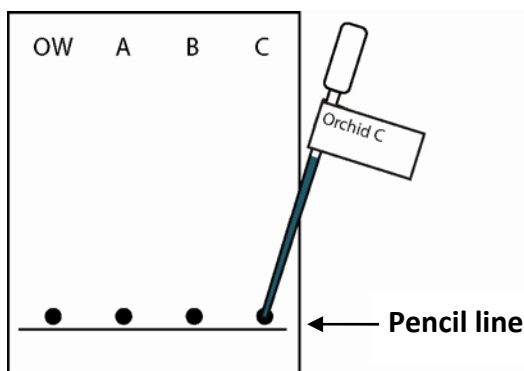


Figure 1

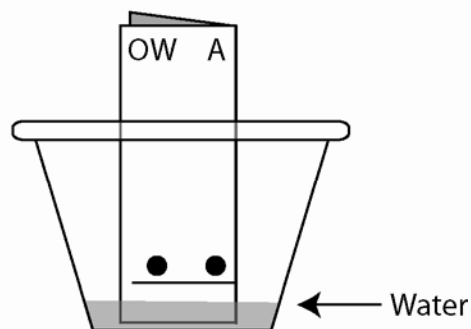


Figure 2

3. Repeat step 2 to spot the A, B and C orchid extracts in the appropriate locations. Make sure you use the correct dropper for each sample.
4. Add just enough water to cover the bottom of the cup approximately 0.5 cm deep. The water line should NOT be high enough to touch the spots of flower extract on the chromatography paper.
5. Fold and stand the chromatography paper in the cup as shown in Figure 2. Do not move the chromatography paper once you have set it in the cup.

6. Wait at least 5 minutes for the water to move up the chromatography paper and drag the flower extracts through the chromatography paper. Because the pigments in the extracts move at different rates, they will separate into colored bands of pigments.
7. The chromatography paper must be removed from the cup before the wetness reaches the pencil labels at the top of the chromatography paper.
8. While you are waiting for the water to move up the chromatography paper, go on to Part 3.
9. Record your observations of the types of colors and relative darkness of the colors on the data table. Save the droppers for use in Part 3.
10. Based ONLY on the information from Parts 1 and 2, which of the online orchids (A, B, and C) is NOT a clone of the Orchid World black orchid? Support your answer with specific information from your data table.

Part 3: Test for Chemical X

Orchid World's black orchids produce a special chemical (Chemical X) that protects the flowers from being eaten by insect predators. You will test the orchid flower extracts for the presence of Chemical X by mixing a small amount of the extracts with Chemical X Indicator Powder. A fizzing reaction will occur if Chemical X is present in the orchid extracts.

Follow this procedure to test for Chemical X:

1. Add one small scoop of Chemical X Indicator Powder to the circle on the plastic test strip labeled Orchid World. Add 3 drops of Orchid World (OW) extract on top of the Chemical X Indicator Powder on the **plastic test strip**. Immediately observe and record the results on the data table.
2. Repeat the indicator test for Chemical X using the other orchid extracts (Orchid A, Orchid B, and Orchid C) and the appropriate circles on the test strip. Make sure you use the correct dropper for each sample.
3. Record the results (fizzes or no reaction) of your tests for Chemical X on the data table.
4. Discard the droppers of orchid extracts, the test strip and the tube of Chemical X Indicator Powder by placing them in the small bag labeled "Part 3."
5. Based **ONLY** on the information from Part 3, which of the online orchids (A, B, and C) is **NOT** a clone of the Orchid World black orchid? Support your answer with specific information from your data table.

Make sure you go back to complete steps 9-10 in Part 2

Part 4: Compare the DNA from the Orchid Plants

Cloned plants are produced by asexual reproduction. If the online orchids were cloned from the Orchid World black orchid, they should be genetically identical to the original plant. This means that the coded information in DNA molecules of cloned plants should be identical to the Orchid World orchid.

You can use DNA samples from the four plants (OW, A, B, and C) to make “DNA fingerprints” for the plants. Your kit contains colored DNA strips that represent one section of bases in the gene for flower color isolated from the Orchid World orchid and from Online Orchids A, B and C. You use these DNA strips to simulate the process of “DNA fingerprinting.”

To make “DNA fingerprints” for the four plants, you will simulate the use of special enzymes called restriction enzymes to cut the plant DNA into small pieces. Restriction enzymes bind to and cut specific base sequences on the DNA. Then you will simulate the use of gel electrophoresis to separate the small pieces of DNA into a specific pattern of bands which can be compared.

1. Obtain the page with the colored DNA strips from your lab kit. Cut along the dotted lines to cut out the green colored DNA strip labeled Orchid World.

CCGGAATTCAGGACAATTCGTACGCGCTATAATTACAGCT

2. The restriction enzyme you will use in this simulation binds to the base sequence, AATT, and cuts between the A and the T. Use a pencil to circle all the AATT nucleotide sequences on the Orchid World orchid’s DNA.

CCGGAATTCAGGACAATTCGTACGCGCTATAATTACAGCA

3. Use scissors to cut the strip between the A and T in each of these AATT sequences. This will create smaller fragments of the Orchid World orchid’s DNA.

CCGGAA TTCAGGACAA TTCGTACGCGCTATAA TTACAGCA

4. The fragments from the Orchid World’s DNA are then placed at one end of a gel (which is made of a substance that looks like Jell-O). Instead of a real gel, you will use the paper Simulated Electrophoresis Gel in your kit.

5. You will use the Simulated Electrophoresis Gel to separate the DNA fragments based on their size. When an electrical current is applied to the gel, the smaller DNA fragments will move more quickly through the electrical field than the larger DNA fragments.
6. Simulate the movement of the DNA fragments in the gel.
 - Count the number of DNA base letters (A, T, C, G's) in each of the DNA fragments.
 - Refer to the number of bases indicated along the left side of the gel to determine the position for each DNA fragment on the gel. Place each DNA fragment in its appropriate location on the electrophoresis gel. *Dotted line boxes are shown to indicate the position of the Orchid World DNA fragments so that you can check your work.*
 - Tape each Orchid World DNA fragment in the proper location on the electrophoresis gel.
7. Repeat steps 1–6 to make a “DNA fingerprint” for the DNA molecules from orchids A, B and C.
 - Simulate using a restriction enzyme to cut between the A and T in each of the AATT sequences on the DNA strips.
 - Simulate using gel electrophoresis to separate the DNA fragments.
8. The banding pattern of DNA from the plant samples can be compared. On the data table, record the positions of the DNA bands (use the corresponding numbers on the left side of the electrophoresis gel) for each orchid).
9. Based **ONLY** on the information from Part 4, which of the online orchids (A, B, and C) is **NOT** a clone of the Orchid World black orchid? Support your answer with specific information from your data table.

Part 5: Comparing the Protein Amino Acid Sequences from the Orchids

The genetic information stored in DNA is used to assemble amino acids into protein chains. Cloned plants should produce identical proteins. The final test that you will do is to compare the sequence of amino acids in the proteins produced by the flower color gene in the four orchids.

The sequences of DNA bases below represent part of the gene for one protein involved in flower color. Follow these instructions to transcribe the DNA into messenger RNA (mRNA) and then to translate the mRNA into a sequence of amino acids in a protein.

1. DNA is transcribed to make a complementary (opposite) mRNA molecule. Use the information in the chart on the right to write the letter sequence for the messenger RNA. Under each DNA sequence, write the complementary messenger RNA (mRNA) base sequences that each of these genes would produce.

Base Letter on DNA	Complementary Base Letter on RNA
A	U
T	A
G	C
C	G

The first six mRNA bases for the Orchid World flower color protein are provided as a sample.

Orchid World DNA	CCG	GAA	TTC	AGG	ACA
mRNA Produced	GGC	CUU			
Sequence of amino acids in the protein	Gly	Leu			

Orchid A DNA	CCG	GGA	TTC	AGG	ACA
mRNA Produced					
Sequence of amino acids in the protein					

Orchid B DNA	CCG	GAA	TTC	AGG	ACA
mRNA Produced					
Sequence of amino acids in the protein					

Orchid C DNA	CCG	TAA	TTC	AGG	ACA
mRNA Produced					
Sequence of amino acids in the protein					

2. Translate the mRNA code to make the amino acid sequence of a protein. Use the Universal Genetic Code Chart provided in your kit to translate the mRNA base sequences into sequences of amino acids in the protein produced by each species. Write the sequences of amino acids under the messenger RNA sequences. *The first two amino acids for the Orchid World flower color protein are provided as a sample.*
3. **Circle** the differences in the protein amino acid sequences that you can find when you compare Orchids A, B and C to the Orchid World orchid. On the data table, record your observations of the number of differences in the amino acid sequences.
6. Based ONLY on the information from Part 5, which of the online orchids (A, B, and C) is NOT a clone of the Orchid World black orchid? Support your answer with specific information from your data table.

Part 6: Data Analysis

You will now analyze ALL of the data that you have recorded on the data table. You may find it helpful to highlight or circle the characteristics that that orchids A, B and C have in common with the Orchid World orchid.

1. Which of the orchids (Orchid A, B or C) are likely to be clones of the Orchid World orchid? Why or who not? Support your answer by citing specific evidence from your data analysis.
2. Which data was the most helpful in making your decision? Explain why.
3. Describe two additional kinds of data that you might collect to provide additional evidence that the orchid you selected is a clone of the Orchid World black orchid.

Data Table:

Orchid	Part 1 Flower Structure	Part 2 Paper Chromatography	Part 3 Test for Chemical X (fizzes <u>or</u> no reaction)	Part 4 Gel Electrophoresis DNA Banding Pattern	Part 5 Protein Amino Acid Sequences
Orchid World					
Online Orchid A					
Online Orchid B					
Online Orchid C					

Simulated Electrophoresis Gel

	Orchid World	Orchid A	Orchid B	Orchid C
17				
16				
15				
14				
13				
12				
11				
10				
9				
8				
7				
6				
5				
4				
3				
2				

MATERIAL SAFETY DATA SHEET

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name (as printed on the label):

Orchid Extracts: Orchid World, Orchid A, Orchid B

Product identity:

Vinegar (dilute acetic acid) – 99.7%

Food coloring – 0.1%

Higgins Waterproof Black Drawing India Ink – 0.2%

Manufacturer:

Science Take-Out, LLC

P.O. Box 205

Pittsford, NY 14534

Telephone number for information: (585)764-5400

Preparation date of this MSDS: 10/5/08

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

2. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Ingredient: Vinegar

Chemical Name: Acetic Acid

CAS Number: 64-19-7

Formula: CH₃COOH

Synonyms: Ethanoic Acid

Principle Hazardous Components: Acetic Acid (CAS#64-19-7) 4-6%

TLV and PEL units: ACGIH-TLV 10ppm(TWA), STEL 15ppm

OSHA-PEL 10ppm(TWA)

3. HAZARDS IDENTIFICATION

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.

INGESTION: May cause gastrointestinal discomfort.

INHALATION: May cause irritation to respiratory tract.

4. FIRST AID MEASURES

Emergency and First Aid Procedures:

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.

INHALATION - Remove to fresh air. Give oxygen if breathing is difficult; give artificial respiration if breathing has stopped. Keep person warm, quiet, and get medical attention.

5. FIRE FIGHTING MEASURES

Flash Point(Method Used):109F (cc)

NFPA Rating: Health: 2 Fire: 2 Reactivity: 1

Extinguisher Media: Use dry chemical, CO₂ or appropriate foam.

Flammable Limits in Air % by Volume: 5.4%LEL 16.0%UEL

Autoignition Temperature: No data available

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

Unusual Fire and Explosion Hazards: No data available

6. SPILL OR LEAK PROCEDURES

Steps to be Taken in Case Material is Released or Spilled:

Ventilate area of spill. Eliminate all sources of ignition. Remove all non-essential personnel from area. Clean-up personnel should wear proper protective equipment and clothing.

Absorb material with suitable absorbent and containerize for disposal.

7. HANDLING AND STORAGE

Store above 62 degrees F, away from direct heat, ignition sources and oxidizers.

Other Precautions: Do not reuse container. Residue may make empty containers dangerous.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Respiratory Protection: A NIOSH/MSHA chemical cartridge respirator should be worn if PEL or TLV is exceeded.

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.

Requirements with respect to specific equipment and applications are the responsibility of the user.

9. PHYSICAL AND CHEMICAL PROPERTIES

Molecular Weight: 60.05	Melting Point: 16.7C
Boiling Point: 118.1C	Vapor Pressure: 11.4 at 20C
Vapor Density (Air=1): 2.07	Specific Gravity (H ₂ O=1): 1.049
Percent Volatile by Volume: 100	Evaporation Rate (BuAc=1): 0.97
Solubility in Water: Miscible	Appearance and Odor: Dark liquid with pungent odor.

10. STABILITY AND REACTIVITY

Stability: Stable Conditions to Avoid: Heat, ignition sources, metals
Incompatibility (Materials to Avoid): Oxidizers, strong alkalis, metals, amines, cyanides, sulfides, chromic acid, nitric acid, hydrogen peroxide, carbonates.

Hazardous Decomposition Products: Cox Hazardous Polymerization: Will not occur

11. TOXICOLOGICAL INFORMATION

Toxicity Data: aihl-mus LC50: 5620 ppm/1H orl-rat LD50: 3530 mg/kg
skin-rbt LD50: 1060 mg/kg

Effects of Overexposure: Acute: See section 3
Chronic: Mutation and reproductive effects data cited. Not listed as causing cancer by IARC, NTP, or OSHA.

Conditions Aggravated by Overexposure: Respiratory conditions

Target Organs: Eyes, skin, and respiratory tract.

Primary Route(s) of Entry: Inhalation, ingestion or skin contact.

12. ECOLOGICAL INFORMATION

EPA Waste Numbers: D002 D001

13. DISPOSAL CONSIDERATIONS

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

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

14. TRANSPORTATION INFORMATION

D.O.T. SHIPPING NAME: Not regulated

15. REGULATORY INFORMATION

EPA TSCA Status: On the TSCA Inventory List.

Hazard Category for SARA Section 311/312 Reporting: Acute

SARA EHS Section 302 TPQ(lbs.): No

SARA Section 313 Chemicals Name List: No Chemical Category: No

CERCLA Section 103 RQ(lbs.): 5,000

RCRA Section 261.33: No

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): Orchid C Extract

Product identity: Food coloring – 0.1%
Higgins Waterproof Black Drawing India Ink – 0.2%

Manufacturer: Science Take-Out, LLC
P.O. Box 205
Pittsford, NY 14534

Telephone number for information: (585)764-5400
Preparation date of this MSDS: 10/5/08
Medical emergency phone number (Chemtrec): (800) 424-9300

2. COMPOSITION/INFORMATION ON INGREDIENTS

This product contains no hazardous materials as defined by the OSHA Hazards Communications Standard

Chemical Ingredient: Food coloring	Chemical Name: N/A
CAS Number: N/A	Formula: N/A
Synonyms: N/A	Principle Hazardous Components: No Data
TLV and PEL units: No Data	OSHA-PEL 10ppm(TWA): No Data

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW Avoid skin and eye contact.

Potential Health Effects EYES: May cause irritation. SKIN: May cause irritation.

4. FIRST AID MEASURES

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.

5. FIRE FIGHTING MEASURES No data available

6. SPILL OR LEAK PROCEDURES

Wear proper eye and skin protection. Mop/wipe spill area. Rinse with water.

7. HANDLING AND STORAGE Avoid eye and skin contact

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Respiratory Protection: N/A Ventilation: N/A
Protective Gloves: Natural rubber, Neoprene, PVC or equivalent.
Eye Protection: Splash proof chemical safety goggles should be worn.
Other Protective Clothing or Equipment: None

9. PHYSICAL AND CHEMICAL PROPERTIES

Molecular Weight: No data	Melting Point: N/A
Boiling Point: No data	Vapor Pressure: No data
Vapor Density (Air=1): No data	Specific Gravity (H ₂ O=1): No data
Percent Volatile by Volume: No data	Evaporation Rate (BuAc=1): No data
Solubility in Water: Soluble	Appearance and Odor: Dark liquid

10. STABILITY AND REACTIVITY

Stability: Stable Conditions to Avoid: No data
Incompatibility (Materials to Avoid): None Hazardous Decomposition
Products: No Data Hazardous Polymerization: Will not occur

11. TOXICOLOGICAL INFORMATION

Toxicity Data: No data Effects of Overexposure: See section 3
Conditions Aggravated by Overexposure: See section 3
Target Organs: Eyes and skin Primary Route(s) of Entry: Eye or skin contact.

12. ECOLOGICAL INFORMATION No data

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

14. TRANSPORTATION INFORMATION D.O.T. SHIPPING NAME: N/A

15. REGULATORY INFORMATION N/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): Chemical X Indicator Powder

Product identity: Sodium Bicarbonate (Baking Soda)

Manufacturer: Church & Dwight Co., Inc.
469 N. Harrison Street
Princeton, NJ 08543
Telephone number for information: (609)683-5900 (USA)

Manufacturer's Issue date of this MSDS: 9/17/02

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

2. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Ingredient: Sodium bicarbonate % by Weight: 100%

CAS Number: 144-55-8

Not hazardous under OSHA Standard 29 CFR 1910.1200.

Not a WHMIS controlled substance.

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

White crystalline powder; no odor. Not a fire hazard.
No significant health or environmental effects associated with this material.

HMIS Rating Health 0, Fire 0, Reactivity 0

Potential Health Effects

EYE: Not an eye irritant. **SKIN CONTACT:** Not a skin irritant.

INGESTION: Material is practically non-toxic. Small amounts (1-2 tablespoons) swallowed during normal handling operations are not likely to cause injury as long as the stomach is not overly full; swallowing larger amounts may cause injury (see Note in Section IV).

INHALATION: None known.

SUBCHRONIC EFFECTS/CARCINOGENICITY: Based on published studies on its effects in animals and humans, sodium bicarbonate is not teratogenic or genotoxic. Only known subchronic effect is that of a marked systemic alkalosis. The material is not listed as a carcinogen or potential carcinogen by IARC, NTP, OSHA, or ACGIH.

4. FIRST AID MEASURES

EYES: Check for and remove contacts. Flood eyes with clean flowing water, low pressure and luke warm (not hot) if possible, occasionally lifting eyelids.

INGESTION: If large amounts of this material are swallowed, do not induce vomiting. Administer water if person is conscious. Never give anything by mouth to an unconscious person.

NOTE TO PHYSICIAN: Large doses may produce systemic alkalosis and expansion in extracellular fluid volume with edema.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES: FLASHPOINT: Not combustible **METHOD USED:** N/A

FLAMMABLE LIMITS: LFL: Not applicable UFL: Not applicable

EXTINGUISHING MEDIA: Non-combustible material. Use extinguishing media appropriate for surrounding fire.

FIRE-FIGHTING INSTRUCTIONS: Carbon Dioxide may be generated making necessary the use of a self-contained breathing apparatus (SCBA) and full protective equipment (Bunker Gear). Carbon dioxide is an asphyxiant at levels over 5% w/w. Sodium oxide, another thermal decomposition product existing at temperatures above 1564°F is a respiratory, eye, and skin irritant. Avoid inhalation, eye and skin contact with sodium oxide dusts.

UNUSUAL FIRE AND EXPLOSION HAZARDS: None known.

6. ACCIDENTAL RELEASE MEASURES

Scoop up into dry, clean containers. Wash away uncontaminated residue with water.

7. HANDLING AND STORAGE

Store in cool, dry areas and away from incompatible substances (see Section 10). Sodium Bicarbonate reacts 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 and oxygen levels have been determined to be safe.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

RESPIRATORY PROTECTION: Dust mask required if total dust level exceeds 10 mg/m³.

PROTECTIVE GLOVES: General purpose for handling dry product. Impervious gloves when working with solutions.

EYE PROTECTION: Safety glasses when handling bulk material or when dusts are generated.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT: Full cover clothing. Apron where splashing may occur when working with solutions.

PROTECTIVE WORK/HYGIENIC PRACTICES: No special requirements with respect to chemical exposure beyond those provided above.

Requirements with respect to specific equipment and applications are the responsibility of the user.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: White crystalline powder. ODOR: None.
PHYSICAL STATE: Solid pH AS IS: Not Applicable
pH (1% SOLN. w/v): 8.2 VAPOR PRESSURE: Not applicable.
VAPOR DENSITY: Not applicable. BOILING POINT: Not applicable.
FREEZING/MELTING POINT: Not applicable.
SOLUBILITY IN WATER: 8.6 g/100 ml @ 20°C.
BULK DENSITY (g/cc): 62 lb/Ft³ % VOLATILE: Not applicable.
VOLATILE ORGANIC COMPOUNDS: Not applicable. MOLECULAR WEIGHT: 84.02

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable.
CONDITIONS TO AVOID: Temperatures above 65°C (150°F).
INCOMPATIBILITY WITH OTHER MATERIALS: Reacts with acids to yield carbon dioxide. Also may yield free caustic in presence of lime dust (CaO) and moisture (i.e., water, perspiration).
HAZARDOUS DECOMPOSITION PRODUCTS: Heating above 100°C may cause dangerous levels of carbon dioxide gas to be present in confined spaces. Yields sodium oxide if exposed to temperatures above 850°C. Avoid inhalation, eye and skin contact with sodium oxide.
HAZARDOUS POLYMERIZATION: Not applicable.

11. TOXICOLOGICAL INFORMATION

EYE EFFECTS: The material was minimally irritating to unwashed eyes and practically non-irritating to washed eyes (rabbits).
SKIN EFFECTS: Not a skin irritant or dermally toxic. Not a contact sensitizer.
ACUTE ORAL EFFECTS: Acute Oral-rat LD50 = 7.3 g/kg
ACUTE INHALATION: LC50 (rat) > 4.74 mg/l

12. ECOTOXICOLOGICAL INFORMATION

AQUATIC TOXICITY: Daphnids: EC50 = 4100 mg/l; Bluegill: LC50 = 7100 mg/l
Rainbow Trout: LC50 = 7700 mg/l

13. DISPOSAL CONSIDERATIONS

Bury in a secured landfill in accordance with all local, state and federal environmental regulations. Empty containers may be incinerated or discarded as general trash.

14. TRANSPORTATION INFORMATION

D.O.T. SHIPPING NAME: Not regulated D.O.T. HAZARD CLASS: None
TECHNICAL SHIPPING NAME: Sodium Bicarbonate

U.N./N.A. NUMBER: None HAZARDOUS SUBSTANCE/RQ: None
D.O.T. LABEL: None

15. REGULATORY INFORMATION

CLEAN AIR ACT SECTION 611: Material neither contains nor is it manufactured with ozone depleting substances (ODS).

FEDERAL WATER POLLUTION CONTROL ACT (40 CFR 401.15): Material contains no intentionally added or detectable (contaminant) levels of EPA priority toxic pollutants.

FOOD AND DRUG ADMINISTRATION: Generally Recognized As Safe (GRAS) direct food additive (21 CFR 184.1736).

US DEPARTMENT OF AGRICULTURE: List of Proprietary Substances - Permitted Use Codes 3A, J1, A1, G1, and L1.

CERCLA REPORTABLE QUANTITY: None

OSHA: Not hazardous under 29 CFR 1910.1200

RCRA: Not a hazardous material or a hazardous waste by listing or characteristic.

SARA TITLE III: Section 302, Extremely Hazardous Substances: None
Section 311/312, Hazardous Categories: Non-hazardous
Section 313, Toxic Chemicals: None

Sodium Bicarbonate is reported in the EPA TSCA Inventory List.

This material is listed on the Canadian DSL.

This material is not listed as carcinogen or potential carcinogen by NTP, IARC, OSHA, ACGIH or NIOSH.

This material is neither a volatile organic compound nor does it contain VOCs.

NATIONAL STOCKING NUMBER: 6810002646618, Contract No. DLA 40086C1831
NSF STANDARD 60: Corrosion and Scale Control in Potable Water. Max use 200 mg/l.

EUROPEAN INVENTORY (EINECS): 205-633-8

JAPANESE INVENTORY (MITI): 1-164

AUSTRALIAN INVENTORY (AICS): Carbonic acid, monosodium salt.

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.