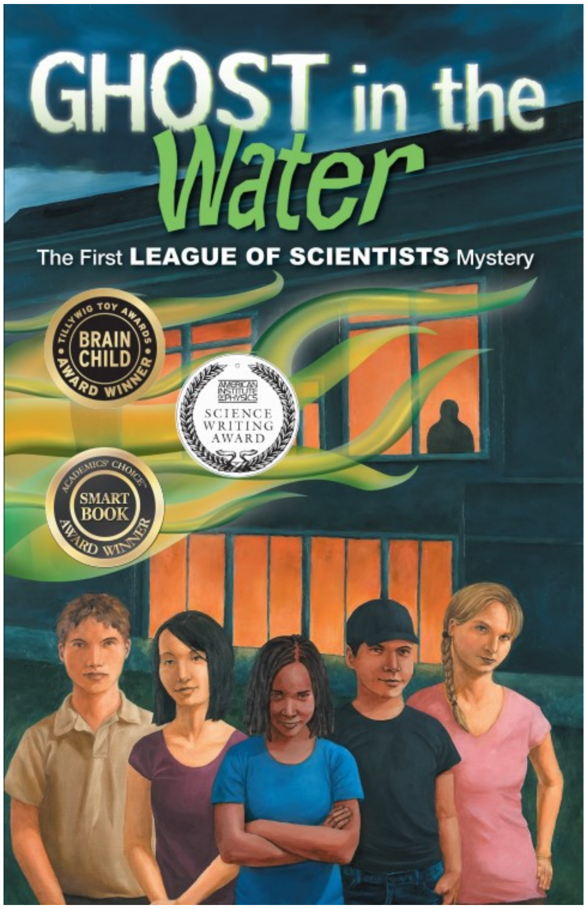


Teacher's Guide

for

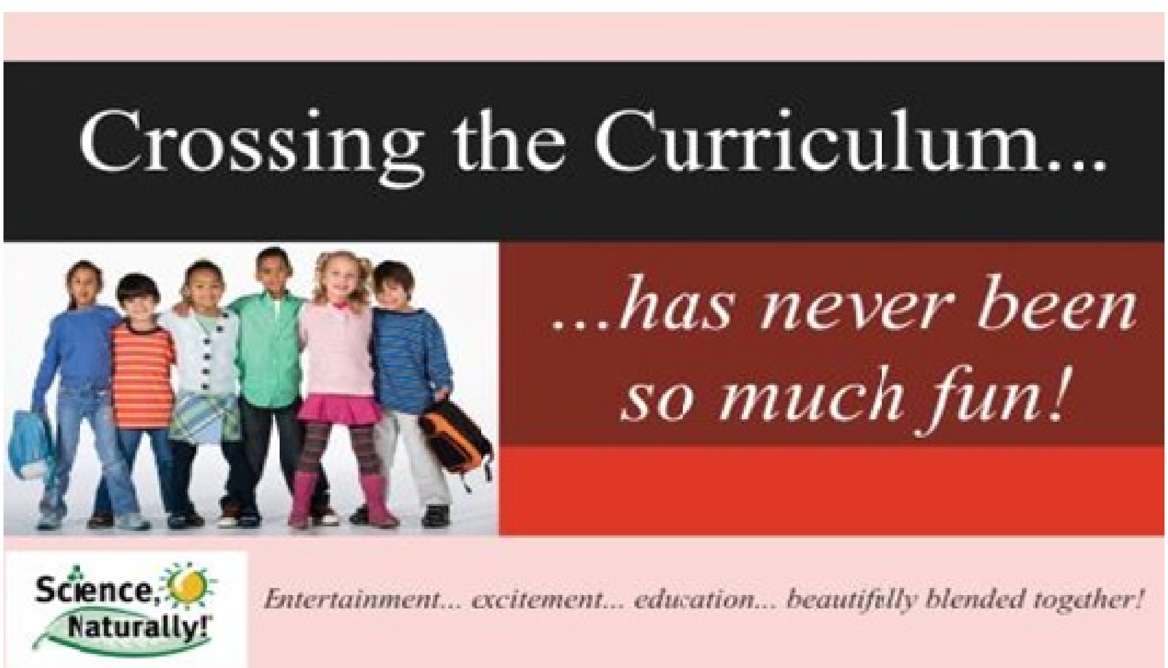
Ghost in the Water

Written by Sue Garcia

Associate Writers: Joan Wagner and Melissa McClellan

Edited by Megan E. Murray

Available for Free Download at ScienceNaturally.com



Background

This Guide provides ideas and strategies to use the book as a teaching tool.
Cross-curricular opportunities are highlighted.
Hands-on activities across the curriculum can be found in the appendices.
You will also find articulations to the Next Generation Science Standards and Common Core State Standards Connections.

Book Summary

Is a ghost haunting the school pool? Sixth-grader John Hawkins feels all alone at school until his interest in robotics lands him an invitation to join four of his classmates in a secret group called The League of Scientists. John and his new friends Malena, Hector, Natsumi, and Kimmey, pool their knowledge of biology, technology, logic, and chemistry to unravel mysteries that haunt the quiet town of East Rapids. The League is in a race against time to uncover the secret of the ghost terrorizing the middle school swimming pool. Can they expel the ghost in time for their star swimmer to compete against their cross-town rivals? A mystery novel with a side order of the supernatural….or is it science?

Awards and Acclaim

First Place (tie), AIP Science Communication Award, Science Writing for Children
Brain Child, Tillywig Award Winner
Smart Book Award Winner, Academic's Choice
Editor's Choice, Library Media Connection
Recommended Title, Learning Magazine

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About the Publisher

Science, Naturally is an independent press located in Washington, DC.Our goal is to engage readers using both fiction and nonfiction strategies to make potentially intimidating subjects intriguing and accessible to scientists and mathematicians of all ages. *Ghost in the Water* is one of our first STEM (science, technology, engineering, and math) novels and we are excited to share it with our readers! We'd love to hear from you—feel free to email us at Info@ScienceNaturally.com.

About the Illustrator

Bob Al-Greene graduated from the University of Nebraska-Lincoln with a bachelor's degree in News-Editorial Journalism. He works as an illustrator and graphic designer in New York City. In addition to illustrating fiction, he also enjoys drawing cartoons. This is his first book. He can be reached at Bob@ScienceNaturally.com.

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Table of Contents

Background	1
Book Summary	1
Awards and Acclaim	1
About the Publisher	1
About the Illustrator	2
Meet the Teacher's Guide Writers	2
Why Teach With an Interdisciplinary Curriculum	5
Possible Ways to Foster Collaborative Learning	5
Introduction to this Teacher's Guide	6
Examples of how to use the Guide	7
Layout of Chapter by Chapter Contents*	8
Working with the Book, Chapter by Chapter	9
Chapter 1	10
Chapter 2	11
Chapter 3	11
Chapter 4	11
Chapter 6	11
Chapter 7	12
Chapter 8	12
Chapter 9	13
Chapter 10	13
Chapter 11	13
Chapter 12	13
Chapter 15	14
Chapter 16	14
Chapter 20	14
Chapter 21	15
Chapter 23	15
Discussion Questions	**16**

*No extensions found for Chapters 5, 13, 14, 17, 18, 19, 22, 24, 25

Hands-On Activities **18**

Chained Notes 19

Acrostics 19

Give Me Five 19

I Think, You Think 19

Let's Look Back 19

Muddiest Point 19

The Ah-ha Point 19

Decoding the Code 20

Make a Model 20

Name that Common Chemical 20

How to Make a Spectroscope 21

Dihydrogen Monoxide 23

Cell Block 24

It Indicates What? 25

Fluorescein – "I'm Too Young To Dye!" 26

Hi-lighter 27

Sparkling Candy 28

Claim, Evidence, Reasoning (CER) 29

Symbiosis 33

Periodic Tables 36

Dry Ice Investigation 38

Come Sublimate with Me 41

I Want to Hold Your Hand Robotic Activity 43

My Tower is Trembling 44

Binary Code Breaker 45

Learn More About Harry Houdini 48

Concept Map Definition Graphic Organizer 49

Ghost in the Water Word Search 50

Articulations **52**

Articulations to the Next Generation Science Standards 53

Articulations to the Common Core State Standards 54

Why Teach with an Interdisciplinary Curriculum?

- Interdisciplinary instruction helps students connect big ideas and skills from different disciplines and maximize classroom time to allow reinforcement of concepts and skills across subjects.
- Students do not always recognize that what they learn in one lesson or subject area can often be applied in other instances or scenarios.
- Knowledge gained from different approaches to the topic will allow optimal opportunities for student learning based upon their interests, involvement, and background knowledge.
- When students have multiple ways to encounter and represent knowledge, there is the potential for more effective learning.
- When students' learning is based upon multiple sources, disciplines, and approaches, they will actively build their knowledge rather than just acquire it in incremental unrelated pieces.
- Curriculum is requiring new paradigms for educating all of our students, emphasizing the interconnectedness of all subjects, allowing students to be better prepared for the 21st Century.

Possible ways to foster collaborative learning

Students can:

- Work in teams/small groups.
- Research a topic, and then write up their results in the format required for publication.
- Make an oral presentation about a topic.
- Present their work through use of a multimedia format.

Introduction to this Teacher's Guide

Ghost in the Water provides the reader with an engaging story about students working together to solve mysteries. The book can be used as an introduction to how scientists learn about the natural world. A number of science topics are introduced such as cell structure, light induced chemical reactions, and light energy. Crosscutting Next Generation Science Standards (NGSS) topics are represented in the engineering of the Robot called Houdini. Once the students have read the book, have them identify all the science, engineering, and math they can find in the book. Reading this story is an excellent way for students to see how greatly their lives are affected by science, concepts and methods, math, and engineering.

- This book is designed to emphasize, using an interdisciplinary approach, exploration and extension of ideas that are encountered within the chapters.
- Its purpose is to provide teachers guidance, suggestions, and techniques to assist in their pursuit of an interdisciplinary curriculum.
- Each chapter provides a focus for the topic ideas (for each content area) being discussed.
- To help teachers expand their classroom practices, based upon the focus of the text, several suggestions for each content area topic idea are identified.
- Interdisciplinary instruction is a way of organizing content and processes from more than one discipline around a central theme, purpose, issue, topic, or experience.
- Starting with the central theme, purpose, issue, topic, or experience; teachers can start the interdisciplinary unit of study by examining the standards of their particular subject, finding the commonalities.
    - Teachers present the topic through multiple formats/models that address different dimensions of the same concept.
- Next, teachers design the contents of their lessons to build learning experiences that allow students a bridge between their thinking and the specific ideas targeted by state and national standards.
    - This starts with the teacher identifying which part of the topic needs to be understood, and how to convey that understanding to the student.
- Then, using the learning cycles to teach the other subjects, teachers will find that they can maximize the connections that students make in their learning.

Example of how to use the Guide

- This guide works best with a team approach. Find out which teachers would be willing to collaborate:
  - Science, Math, Language Arts, World History, World Geography, Social Studies, Music, Engineering, and Art are all possible choices.
  - You do not need to have every area represented, but this makes for a more multifaceted approach.

- Choose the Theme that you wish to focus on.

- Then, each content area teacher finds something that they have in common with the central theme.

- After determining what their sub-theme will be about, examine the local, district, state, and national standards to see which ones your lesson(s) will need to support.

- These sub-themes in the content areas might only occur in only 2 or 3 chapters, not in every chapter.

- Whenever communicating, use the Language Arts Common Core standards. (See the "Common Core State Standard Connections" at the end of this Guide.)

Layout of Chapter by Chapter Contents

In each chapter, we have pulled out material for you to work with, broken down by subject area.

The subject areas you will find in this guide include:

- History of Scientists
- Language Arts
- World History
- Math
- Science
- Engineering Practices
- Computer Programming
- Social Studies
- Possible Activities

In addition to the subject matter/content/ideas, we have also identified the NGSS and Common Core Connections referenced in this book.

Working with the Book,
Chapter by Chapter

Chapter 1(9-22)

p. 12: John encounters a situation dealing with a bully.
Social Studies&Language Arts can use this incident to discuss bullying in and out of school.

- Begin by discussing *what* bullying is.
  - Three types of bullying; Verbal, Social, and Physical
    - What about Cyber bullying?
  - Who is at risk to bullying?
  - How do you think you can prevent bullying?
  - How do you respond to bullying?
    - Possible additional resource: www.stopbullying.gov

p. 14: John is asked to explain the first step of an algebra equation: $6x + 7y = -9$
Math could provide extra support by providing several similar problems.

- "Warm-up" or "exit question"

p. 17: Ms. Heida talks about the Egyptian pharaoh Khufu who built the Great Pyramid.
World History has many opportunities to show cross-curricular support.

- Virtual tour of the Pyramids.
  - Photos and images
- Short research project about the Egyptian Pharaohs.
  - Use multi-media formats.
- Create a time line.
- Collaborative discussion about pharaohs' beliefs in the after-life.

p. 18-19: John reads a piece of paper with a puzzle, a secret message written in *Binary*.
Computer/Programming can discuss what *binary*, the first language of computers and robotsis.

- See included activity, "Binary Code breaker".

p. 20: John remembers when Mr. Steinhacker, the science teacher, compared living cells and robots, stating they have a lot in common.
Life Sciencescan talk about what cells are.

- Research what the human cell consists of and the role of each organelle found within the cell.
- See included activity, "Cell Block".
- Draw a Venn diagram comparing a human cell and a robot.

p. 21: John, while looking at a clock, begins to convert time intervals.
Math can practice many different types of conversions; length, volume, time, etc…

- At the beginning of class, establish and post a starting time. Then, as an "exit ticket", ask each student to list how many seconds, minutes, and hours there are from the starting time to the end of class.

Chapter 2 (23-28)

p. 27-28: The Greek alphabet is mentioned.
Language Arts or World History could elaborate what the Greek alphabet looks like.

- Why do college fraternities and sororities use the Geek alphabet?

Chapter 3 (29-37)

p. 36: John talks about building a vibration monitor.
Science: Energy comes in many forms, one form is vibrational energy.

- See included investigation, "My Tower is Trembling".
    - Possible "Claim, Evidence, Reason": How did the streetlight get broken?

Chapter 4 (39-45)

p. 44: Carlos's laptop computer time said "Monday, 19:11".
Math:This is an example of *military time*.

- Show a few examples of military time.
- Have student write (using military time); the beginning of school, their lunch period, and the ending of school.

Chapter 6 (55-59)

pp.56-59: List someevidence that Casey gave to support his claim that he saw a ghost in the water.

Chapter 7 (61-68)

pp. 62-63: Mr. Steinhacker talks about the anglerfish being a perfect example of mutualism.

Science: Ecosystems are being discussed.

- Explain&talk about symbiotic relationships; mutualism, parasitism, and commensalism.
- Make a foldable for the different relationships.
- Make a T-Table comparing and contrasting benefits and/or disadvantages of the symbiotic relationship.
- Provide or have students supply examples of different organisms and their relationships.
- See included activity, "Symbiotic Relationships".

p. 64: John thought he was not good at *cryptology*.

- An activity using cryptology;
  - Discuss what it is.
  - Why it is used.
  - Provide opportunities for students to practice making and solving codes.
  - See included activity, "Binary Code Breaker". (Also found in Math)

World History: Have students write their name or a simple phrase, using Cuneiform symbols.

Math:

- Provide students with a math puzzle that uses symbol (word or letter) substitution to demonstrate how cryptology works.
- See included activity, "Binary Code Breaker". (Also found in Science)
- Have them make up their own puzzle that uses cryptology substitution to find the solution. Then, have the students switch puzzles and see if they can figure out the word or statement that was encrypted.

Chapter 8 (69-76)

p. 73: John displays *goose bumps*while trying to collect data by recreating the "ghost encounter".

Science:

- What are *goose bumps*?
  - Objects (bodies) in motion transfer energy, usually in the form of heat.
- How do you get *goose bumps*?
- Why are they called *goose bumps*?

Chapter 9 (77-83)

This chapter could be used to find some of the "Evidence" needed for the"Claim, Evidence, Reason" investigation about "Do you believe in ghosts?

Chapter 10 (85-90)

p.85: Kimmey and Natsumi could hardly talk about anything other than chemicals and solutions. Kimmey's parents felt that they needed a break from their discussions of the periodic table.

This chapter could be used to find some of the "Evidence" needed for the CER investigation about "Do you believe in ghosts?

<u>Science:</u>

- Discuss the history of the Periodic Table
- See included, "Periodic Table"
  - Blank Periodic Table
  - Periodic Table with Names.

p. 89: Mr. Pryce talks about a cheap easy way to produce the special effect of creating fog.

- See included activity, "Come Sublimate with Me."
- See included activity, "Dry Ice Investigations."

Chapter 11 (91-98)

pp. 92-93: An adult tried to get Carlos to leave the West Shore swimming pool, assuming that Carlos was a "punkimmigrant kid."

<u>Social Studies</u> (discussion):

- What does prejudice mean?
  - What are the meanings of the root prefixes?
- What are some of the causes of prejudice?
- How does prejudice relate to profiling, stereotyping, and racism?
- How did Carlos support the adult's assumptions?

Chapter 12 (99-102)

pp. 99-100: John starts thinking of an algebra problem while he was being chased.
<u>Math:</u>As a warm-up in an Algebra class, the problem stated on p. 100 could be used.

Chapter 15 (109-114)

p. 109: A sign on the outside of the Leagues Lab states, "Danger: Do Not Enter. Dihydrogen monoxide exposure and contamination".
Science: Display on the Smart board, "Dihydrogen Monoxide" and ask the students to individually write in their Journal what they think the answer is. (Dihydrogen Monoxide = water)

- See included "Dihydrogen Monoxide" sheet.

Chapter 16 (115-124)

p. 117: Kimmey talks about different kinds of light with different wavelengths.
Science**:**

- See the included activity, "Build Your Own Spectroscope"

p. 118: Kimmey talks about a special dye called "fluorescein".

- "How to Make Fluorescein", a YouTube video, is great to watch to see how fluorescein reacts when added to water and shown using a UV light.
  - http://youtu.be/ihssISvNL3o
- YouTube video to accompany included "Hi-lighter" activity.
  - http://youtu.be/zIpoLiesBgg
- See included activity, "Sparkling Candy".

Chapter 20 (139-144)

p. 144: John was thinking about a Houdini device he planned to build to recreate Casey's ghost.

- Why is John calling it a Houdini Devise?
- Research and give a short presentation to the class about Harry Houdini.
- See included activity, "Learn More About Harry Houdini".

Chapter 21 (145-153)

p. 145: John talks about how Mr. Watson, Carlos, and he built "Houdini", a remote-controlled robot.

- See included activity, "I Want to Hold Your Hand".
- Challenge the engineering, STEM, or robotics classes to build Houdini using the information provided by John and Carlos on pp. 145-147.

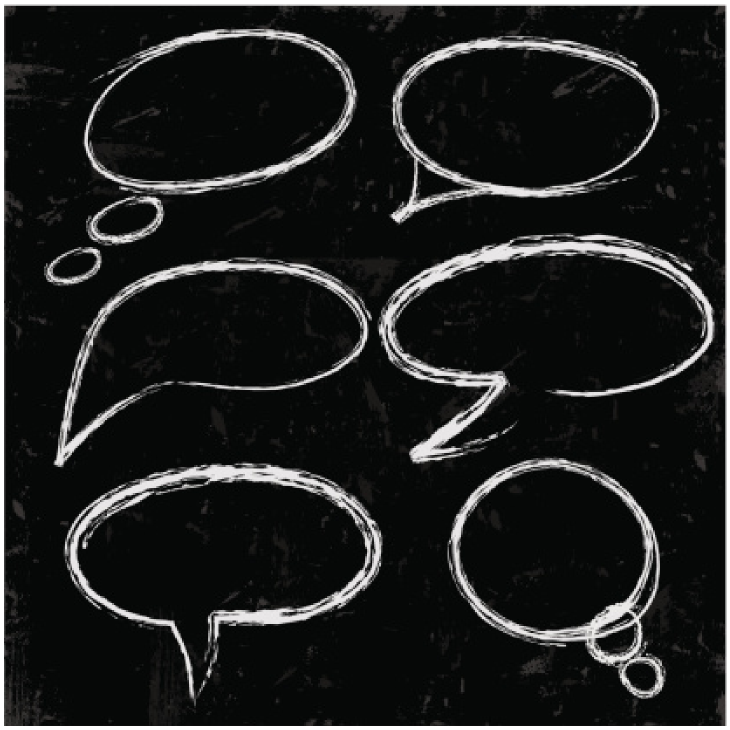
Chapter 23 (163-166)

p.163: "They had made a huge mistake: *a small experiment doesn't work the same as a big one*."

- What was Kimmey talking about?
    - Why more complicated and dangerous?

p. 164: What evidence does the dye fluorescein leave when handled?

Discussion Questions



Discussion Questions

Why was John a loner in the opening of this story? ______

______

What allowed him to be more social? ______

______

Do bullies generally pick on kids who are loners? ______

______

How did the League help stop the bullying? ______

______

______

What are some of the things the League members learned from each other? ______

______

______

______

______

______

______

How did the adults in the story encourage and help or discourage and hinder the League? ______

______

______

______

______

______

______

______

Hands-On Activities

Hands-On Activities

The activities that are listed here are just suggestions. You may have activities that you feel are more appropriate. They are intended to assist teachers that wantto try something that they may not have tried before. All of these activities can be changed to match the needs of your students.

Chained Notes

- Begin with a question printed at the top of a paper. This paper is circulated between students/groups. Each student/group responds by adding to the question with one or two original sentences that relate to the original question; then it is passed to the next student or group.
    - Providethe students the opportunity to examine other students' ideas and compare them to their own. This activity then encourages the student(s)/groups to move beyond fact recall because they must first synthesize and evaluate what others have recorded before adding their own comments.

Acrostics

- Begin by choosing one word to represent a major concept or focus in the topic that is being taught. Write this word vertically on a sheet of paper then write related words that start with each letter of the vertical word.

Give Me Five

- Provide a reflection prompt such as…"What was the most significant thing you learned about…?"
    - Invite five open responses from the students to share in the classroom.

I Think, You Think

- In teams of two; the first student tells the second student something they knew/learned about the topic they were just reading about, then the second student tells the first student something different. This can continue as long as you want.

Let's Look Back

- In either teams of two or small groups; each student tells the other student(s) something that they did not understand. The other student (or group) clarifies what that student did not understand. The next student then does the same thing.

Muddiest Point

- Similar to "Let's Look Back," except each student (or group) writes down on a piece of paper a difficult part of the lesson that they found was unclear. These slips of paper (anonymous) are collected and discussed by the class to help clarify the concept.

The *Ah-ha* Point

- Similar to both "Let's Look Back" and the "Muddiest Point," but it is the opposite. As an "exit ticket" ask students to write down the most significant point they learned in the lesson on a slip of paper, then give that paper to the teacher as they leave the class.

Decoding the Code

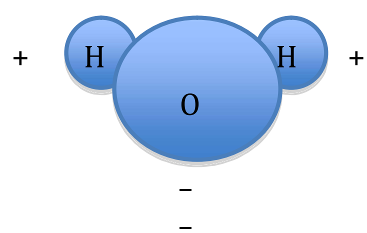
- Have students use the binary code translator on the website: http://www.binarytranslator.com/ to write a secret message that one of the characters in the book may have written. Share the code with the class and explain how it works. [Also see "Binary Code Breaker" in this Guide.]

Make a Model

- As referenced by the Next Generation Science Standards, scientists use models to help them understand the natural world. They represent objects in the real world with other objects, diagrams, mathematics, or computer programs. A very simple model is a map to represent an area or a replica of something such as a globe to represent Earth. Models are particularly useful when a scientist cannot observe it directly. For example, climatologists use climate models to make predictions about Earth's climate through computer models. Ask a team of students to make a model of something to help understand how it works. Here are some examples:
    1. Model of how lungs take in air
    2. Model of a watershed
    3. Model of an Atom
    4. Model of a magnetic field
    5. Model of an solar eclipse
    6. Model of solar system
    7. Model of DNA
    8. Model of a plant or animal cell

Name that Common Chemical

- Each day place the name of a common chemical written in an unfamiliar format such as dihydrogen oxide (water). After a few days of providing the names, have the students volunteer to write names of chemicals for the class to decipher. An additional challenge is for the students to make models of the chemical. For example here is a model of a water molecule showing its bipolarity.



1. Monosodium chloride (table salt)
2. Dihydrogen dioxide (hydrogen peroxide)
3. Nitrogen trihydride (ammonia)
4. Carbon tetrahydride (methane)
5. Dioxygen (oxygen gas)

Name:
Teacher/Period;

How to Make a Spectroscope

Introduction

A spectroscope is a device for forming and observing the spectrum of colors of visible light. A spectrum is produced when light from any source is bent or dispersed. In this activity, students use common household materials and a holographic diffraction grating to build a simple, working spectroscope.

Materials

Flinn C-Spectra® (holographic diffraction grating) www.flinnsci.com
1.5-cm square Hole punch
Cardboard tube (paper towel size)
Pencil
Cellophane tape
Metric ruler
Construction paper, black
Scissors
Electrical tape, black

Procedure

1. Trace the ends of the cardboard tube onto black construction paper to give two circles.
2. Carefully cut out each circle, making sure the diameter is no smaller than the tube. Each circle must completely cover the open end of the tube.
3. Using the Hole punch, make a hole in the center of one of the circles.
4. Cut a 1.5-cm square piece from the sheet of C-Spectra.
5. Take the circle with the punched round hole and, holding the square of C-Spectra by the edges, cover the hole with the C-Spectra. Secure with small pieces of cellophane tape. *Do not place any tape over the part of the C-Spectra that will be visible through the hole.* **Figure 1**

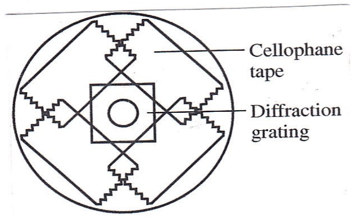


Figure 1.

6. Use the electrical tape to secure the circle with the C-Spectra facing inward to one end of the cardboard tube. Use enough tape so that light will only enter the tube through the hole, not around the edges.
7. Fold the other black circle in half and cut a 1-cm slit in the middle of the half-circle, starting at the fold.
8. Make an identical slit 1 mm from the first one, then cut the resulting small strip from the circle. **Figure 2**

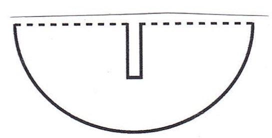


Figure 2.

9. Unfold the circle. There should be a slit approximately 2 cm × 1 mm in the middle of the circle. The edges should be clean, not frayed.
10. Press pieces of electrical tape firmly around the edges

of the circle with the slit, *but do not fasten to the tube yet*. Use enough tape to completely cover the edge of the circle. **Figure 3**

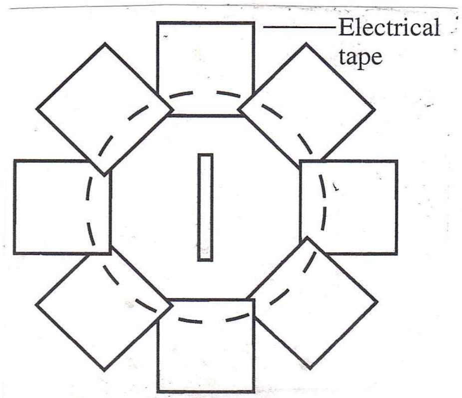


Figure 3.

11. Hold the circle with the slit over the open end of the tube and look at any light source through the hole in the other end containing the C-Spectra.

Rotate just the tube until a clear spectrum of the light is visible on both sides of the slit and the spectrum is as wide as possible. Now, tape the circle with the slit to the end of the tube in this position. **Figure 4**

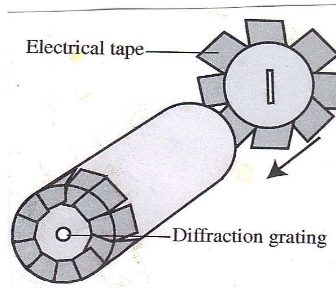


Figure 4.

12. View various light sources by looking through the end of the tube containing the C-Spectra and aiming the slit at the light. Note differences in bands of colors, the width and intensity of the bands, and any dark lines in between.

Tips

- Students can look at various light sources around the school fluorescent, sunlight (be sure they do not look directly at the Sun), or other sources that might be in the lab, such as black lights or ultraviolet lights (students should wear goggles and not look directly at the ultraviolet light).
- Have students use the spectroscope to look at different light sources in their homes and neighborhoods. (Evening works best.) Ask students to record the type and color of each light source viewed with the unaided eye in their Journal, then draw and label each spectrum they see using colored pencils or crayons.
- Students can also look at various solid colored objects to see which colors cscpthe object absorbs and which are reflected. Another option is to look at the transmitted light after light has passed through different colored filters. [Special thanks to David Katz, Tucson, AZ, for providing the idea and instructions for this activity to Flinn Scientific.]

Discussion

- The spectroscope uses a diffraction grating to separate light into its component colors. When light strikes the grooves on the diffraction grating film, it is separated, or diffracted, into its component wavelengths. Longer wavelengths (red) will diffract, or bend, more than shorter wavelengths (blue/violet).
- The sun spectrum is quite uniform from red to blue. Only the blue parts are weaker. The reason for this is that these parts are partially filtered out by the atmosphere (and that's why the sky looks blue!)
- The spectrum of the light bulb is very similar to the sun. This makes us consider it as pleasant.
- The energy saving bulb and the fluorescent lamp have a different spectrum: the blue parts are more intense, they have gaps and peaks. They differ from the sun noticeably and that's why some people don't like this light.
- Not very surprisingly the green, red and blue LEDs mainly have their main color in their spectrum.
- The white LED has a uniform spectrum too going up to the violets.

http://sci-toys.com/scitoys/scitoys/light/cd_spectroscope/spectroscope.html
http://solarcenter.stanford.edu/activities/cots.html
http://www.exploratorium.edu/spectra_from_space/visible_activity.html

DIHYDROGEN MONOXIDE

Dihydrogen monoxide is colorless, odorless, tasteless, and kills uncounted thousands of people every year. Most of these deaths are caused by accidental inhalation of DHMO, but the dangers of dihydrogen monoxide do not end there.Prolonged exposure to its solid form causes severe tissue damage.

Symptoms of DHMO ingestion can include excessive sweating and urination, and possibly a bloated feeling, nausea, vomiting and body electrolyte imbalance. For those who have become dependent, DHMO withdrawal means certain death.

Dihydrogen monoxide:

- Is also known as hydroxyl acid, and is the major component of acid rain.
- Contributes to the "greenhouse effect."
- May cause severe burns.
- Contributes to the erosion of our natural landscape.
- Accelerates corrosion and rusting of many metals.
- May cause electrical failures and decreased effectiveness of automobile brakes.
- Has been found in excised tumors of terminal cancer patients.

Quantities of dihydrogen monoxide have been found in almost every stream, lake, and reservoir in America today. But, the pollution is global, and the contaminant has even been found in Antarctic ice. DHMO has caused millions of dollars of property damage in the Midwest, and recently California.

Despite the danger, dihydrogen monoxide is often used:

- As an industrial solvent and coolant.
- In nuclear power plants.
- In the production of Styrofoam.
- As a fire retardant.
- In many forms of cruel animal research.
- In the distribution of pesticides.
- As an additive in certain "junk-foods" and other food products.
- Even after washing, produce remains contaminated by this chemical.

Companies dump waste DHMO into rivers and the ocean, and nothing can be done to stop them because this practice is still legal. The impact on wildlife is extreme, and we cannot afford to ignore it any longer!

The American government has refused to ban the production, distribution, or use of this damaging chemical due to its "importance to the economic health of this nation." In fact, the navy and other military organizations are conducting experiments with DHMO, and designing multi-billion dollar devices to control and utilize it during warfare situations. Hundreds of military research facilities receive tons of it through a highly sophisticated underground distribution network. Many store large quantities for later use.

Cell Block

Background:

Water is vital to all life. When cellsdo not get enough water, they shrivel up or lack ***turgor***. This is particularly noticeable in plant cells because they have water vacuoles. When there is enough water in the vacuole, the water applies pressure against the cell wall providing stiffness to the plant so it does not droop. The League of Scientists learned in Mr. Steinbacker's science class that when water is blocked from entering a plant, the plantdroops or wilts.

Purpose:

You will simulate turgor loss and observe cells under a microscope with and without turgor.

Materials:

Balloon
Elodea leaves
Salt water
Distilled water
Tap water
Microscope
Pipettes
Slides and coverslips

Procedure:

1. Using a balloon as a model of a cell, design and carry out your own experiment to show a cell with and without turgor. Include diagrams and measurements. Explain how the balloon models a cell.
2. Using *Elodea* leaves design and carry out an experiment to observe how different types of water affect the turgor of *Elodea*. Include diagrams in your write-up of your experiment. Make sure to explain the affects of different water types on Elodea cells.
3. Draw and label the main parts of an *Elodea* cell (cell membrane, cell wall, cytoplasm, chloroplasts, nucleus, food vacuole.)

It Indicates What?

Background:

Fluorescein was used in the swimming pool along with dry ice to create the illusion of a green ghost. In science, fluorescein is an indicator chemical often used to trace chemical reactions or even the motion of tides.

Purposes:

Explore some of the common chemical indictors used in science.

Materials:

pH paper
Methylene blue
Red cabbage juice
Iodine

Procedure:

1. Research how each of these chemicals are used.
2. Design and carry out an experiment to show how these chemicals identify the properties of other chemicals.
3. Do a write up of your experiment. Include your hypotheses, results, and conclusions.
4. Name other chemicals that are useful to scientists as indicators.
5. Extra credit: Design a device that measures a property of matter such as its transparency, weight, density, reactivity, etc.

Fluorescein – "I'm Too Young To Dye!"

Fluorescein is a man-made chemical that gives off an intense green light when exposed to UV light (like black lights or the Sun).

First created in 1871, we now use it often for research applications because it's easy to detect. We've used it to study the blood-brain barrier and how well certain chemicals get into bones (Source). We also use it in eye drops to find problems with the eye surface (Source).

Long ago, we used to put it into rivers to find out where sewage was being illegally dumped. In 1962, plumbers put it into the Chicago River, and the river turned green. Since then, it's been a tradition to dye the Chicago River green the weekend of St. Patrick's Day. Nowadays, though, they use a vegetable dye instead of fluorescein.

Fluorescein is safe enough that we use it in medical applications. As further examples, we use it to determine how well blood is flowing through the blood vessels of your eyes (Source) and during surgery for brain tumors (Source). However, the MSDS (Material Safety Data Sheet) for the substance notes that it can be toxic under certain circumstances, and that the toxicological properties have not been fully investigated. In the case of medical use of fluorescein, we generally agree that the potential benefits outweigh the risks.

The final thing I want to note is that they stopped using fluorescein in the Chicago River because it's considered to be harmful to the plants and animals of the river (Source)
Fluorescein: Great chemical, as long as we use it responsibly.

Source: chemicalsareyourfriends.com

(http://chemicalsareyourfriends.com/sliders/fluorescein-im-too-young-to-dye/)

Hi-lighter

Background

Fluorescein was used in the swimming pool along with dry ice to create the illusion of a green ghost. The League learned that fluorescein is a dye that glows under a black light or sunlight. In this experiment, students will experience this firsthand when they make their own fluorescein solution.

Purpose

To explore the process of making fluorescein and the properties of the solution.

Materials

Goggles
Gloves
Eyedropper
Heat source
Black light
166 mg of phthalic anhydride
220 mg of resorcinol
3 drops of concentrated Sulfuric Acid
10 mL of distilled water
300 mg of sodium hydroxide
2 500mlbeakers of water
1 Erlenmeyer flask

Procedure

1. Combine 166 mg of phthalic anhydride, 220 mg of resorcinol and 3 drops of concentrated sulfuric acid in the Erlenmeyer flask. (NOTE: Use extreme caution when handling concentrated acid!)
2. Heat to 200 degrees Celsius for 5 minutes. The solution produced after 5 minutes is fluorescein.
3. Dissolve the fluorescein produced in diluted sodium hydroxide solution (300 mg of sodium hydroxide in 10 mL of water).
4. Add a few drops of the solution into a beaker of water under ultraviolet light.
5. In the second beaker of water, add a few drops of the solution in a completely dark room.

Teacher Info

Phthalic Anhydride, Resorcinol, Sulfuric Acid, and Sodium Hydroxide should be available to purchase through chemical suppliers. Use caution when dealing with chemicals. Please wear goggles and gloves when handling chemicals. Only teachers should handle the concentrated Sulfuric Acid, making sure to always wear protective safety gear.

To watch a video of this experiment, go to http://www.youtube.com/watch?v=ihssISvNL3o
To learn more about this experiment, go to http://youtu.be/zIpoLiesBgg

Sparkling Candy

In *Ghost in the Water*, you learned about a chemical called Fluorescein.

Background

Fluorescein fluoresces (glows, or gives off light) under UV light or light from a black lamp. The fluorescence is relatively short lived. Phosphorescent chemicals absorb the light energy more slowly, but release it for a longer time period. Thus the glow is not short lived as in fluorescence. All of this has to do with the structure of atoms, which are the building blocks of all chemicals. Electrons are particles that orbit the nucleus of an atom. They orbit certain distances from the nucleus. These distances are called energy levels. Light energy excites (adds energy to) electrons causing them to jump to higher energy levels (further from the nucleus). When the electrons fall back to a lower energy level, they release energy in the form of light. Sometimes the light is in the visible part of the spectrum. Then we say the chemical fluoresces or phosphoresces.

Wintergreen candy is a mixture of the chemical in wintergreen (methyl salicylate) and sugar. When you chew on the candy, a phenomenon called triboluminescense occurs. The crushed sugar releases light energy, which is then absorbed by the methyl saliclate. The excited electrons jump to higher energy levels, releasing bluish light when they fall back.

Procedure

Chew 2-3 Life Savers at the same time in a dark room with a mirror (closets or under a desk with the lights out work well). In a classroom, you can look at each other's mouth and check for the phenomenon. It is all science!

Extension: Do other flavors of Life Lavers fluoresce?

Claim, Evidence, Reason

CER (CL-EV-R)

John Hawkin's specialty is electronics and robots. He believes that a good scientist should collect more than one kind of data and that measuring data iscritical for good science.
Malena Curtina's specialty is biology.
Kimmey Pryce's specialty is physics,math, and logic. She believes that it isalways good to break a problem down into pieces.
Natsumi Haru's specialty is chemistry. She believes that the answer should always be decided only after the data is collected as evidence, never before.
Carlos Alejandro Manuel's specialty is technology and computers. He knows that part of being a good scientist is not jumping to conclusions.

Casey Keller, star swimmer for the East Rapids Swim Team, thinks he has seen a ghost.

Question: Do you believe in ghosts?

Claim:

(This is a statement, or conclusion, that answers the original question or problem. It is complete, relevant, stands alone, and is a complete sentence.):

John:I never thought about ghosts before, but I don't "not" believe in them.
Malena: I believe in viruses and they are not alive, so maybe there are such things as ghosts.
Kimmey: I don't believe in ghosts.
Natsumi: I need to see a ghost first before I'll believe in one.
Carlos: My grandmother told me that there were ghosts, but I'm not sure.

Your Claim:

____

____

____

Evidence:

This where you list data that supports your claim. Data must be from a valid source, such as a primary source, date of publication, "numbers", etc… Data must be appropriate (relevant or important to answer the question). Data must also be sufficient, having enough data to justify and support the claim. (There may be more or less pieces of Evidence.)

Evidence #1: ____

Evidence #2:____

Evidence #3:____

Evidence #4:____

Evidence #5:____

Reasoning:

This is the justification that connects the evidence to the claim. Reasoning shows why the data counts as evidence. Reasoning should include the "Big Idea" that is the focus of the lesson.(There should be at least one Reasoning statement for each piece of Evidence.)

Reasoning #1: ____

Reasoning #2: ____

Reasoning #3: ____

Reasoning #4: ____

Reasoning #5:____

Rebuttal:

After youhave #1) made your Claim, #2) listed all of the Evidence you can find, and #3) found a scientific justification or Reason, you can then write a Rebuttal. This is where you can state why another claim would be more appropriate.

____

____

____

Claim, Evidence, Reason

CER (CL-EV-R)

John Hawkins specialty is electronics and robots. He believes that a good scientist should collect more than one kind of data and that measuring data was critical for good science.
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Casey Keller, star swimmer for the East Rapids Swim Team, thinks he has seen a ghost.

<u>Question:</u> Do you believe in ghosts?

<u>Claim:</u>

(This is a statement, or conclusion, that answers the original question or problem. It is complete, relevant, stands alone, and is a complete sentence.):

These are the "claims" that the League of Scientist made.

John:I never thought about ghosts before, but I don't "not" believe in them.
Malena: I believe in viruses and they are not alive, so maybe there are such things as ghosts.
Kimmey: I don't believe in ghosts.
Natsumi: I need to see a ghost first before I'll believe in one.
Carlos: My grandmother told me that there were ghosts, but I'm not sure.

Students Claim: This is where the student would write their answer (their claim).

<u>Evidence:</u>

This is where the students list data that supports their claims. Data must be from a valid source, such as a primary source, published date, "numbers", etc… Data must be appropriate (relevant or important to answer the question). Data must also be sufficient, having enough data to justify and support the claim.

Students look for "evidence" that would suggest there was a ghost.

This is where the student would read the book and look for text that would suggest there was a ghost.

Evidence #1: When swimming, Casey passed throughspots of water that weren't just chilly, rather they were freezing. (p. 56)
Evidence #2: He saw a curling, twisting fog form over the surface of the water. (p. 56)
Evidence #3: The fog that Casey saw became more of a cloud that began to move toward him in the form of a gelatinous tentacle, a stretching claw. (p. 56)
Evidence #4: Near the pool's edge, Casey saw a gelatinous tentacle had turned into a glowing dark orange claw that reached out towards him. (p. 58)
Evidence #5: With Casey's last look at the pool, it no longer glowed orange; rather it shone an eerie ghostly green. (p. 59)

Reasoning:

This is the justification that connects the evidence to the claim. Reasoning shows why the data counts as evidence. Reasoning should include the "Big Idea" that is the focus of the lesson.

For every piece of "Evidence", there needs to be a scientific reason to explain it. This allows the data to count as evidence.

Reasoning #1: The fog can be caused bydry ice, frozen carbon dioxide (more than 100 degrees below zero Fahrenheit). As dry ice sublimates, it makes the water it was put into incredibly cold. (pp. 118-119)
Reasoning #2: Dry ice is one of the few things on Earth that does not "melt." It goes from a solid to a gas automatically, called sublimation. When dry ice is put into water it turns into a gas, or fog. (pp. 116-119)
Reasoning #3: By manipulating the stream of water coming from the water pump, the glowing water can be directed in any direction. (p. 118-120)
Reasoning #4: A chemical called "fluorescein", which is a special dye that produces a glowing liquid and was found to be safe when added to water, could be used to create the glowing claw. (pp. 120)
Reasoning #5: Fluorescein is a special chemical that glows green when exposed to a black light. However, when exposed to daylight, it glows orange. (pp. 120-121)

Rebuttal:

After the student has #1) made their Claim, #2) listed all of the Evidence they can find, and #3) found a scientific justification or Reason, they can then write a Rebuttal. This is where they can state why another claim would be more appropriate.

Symbiosis

Symbiosis

Symbiosis comes from two Greek words meaning “with” and “living”.

Symbiosis is a close relationship between two or more organisms of different species to that live together in a close, long-term relationship.

Types of Symbiosis

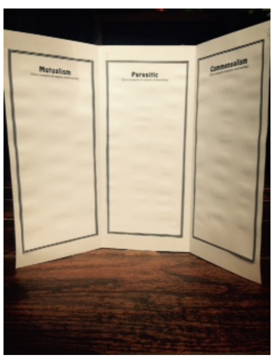
M**utualism** is a relationship where both participating organisms benefit from this association. Many of these relationships are long lasting.

Commensalism is a type of relationship where only one organism benefits from this relationship. However, but the other organism is neither helped nor harmed. This is a one-sided relationship.

In a **parasitic** relationship, one organism generally lives on or in another organism, called the host. This host provides food and/or a place to live for the parasite and often serves as a means to transmit the parasite’s offspring to new hosts. In a parasitic relationship, only the parasite benefits and the host usually suffers negatively. It is important that the host survives.

Directions:

1. Use a standard sheet 8 ½” X 11” of paper.
2. Make a tri-fold (landscape), about 9 cm per fold.
3. Open up and on the inside: glue the three types of symbiosis, aligning each type into one of the spaces provided by the fold.
4. Next, fold the tri-fold together and glue the title page, “Symbiosis” to the top and the “Types of Symbiosis” to the next folded blank page.
5. Finally, glue the entire fold-able into your Journal.

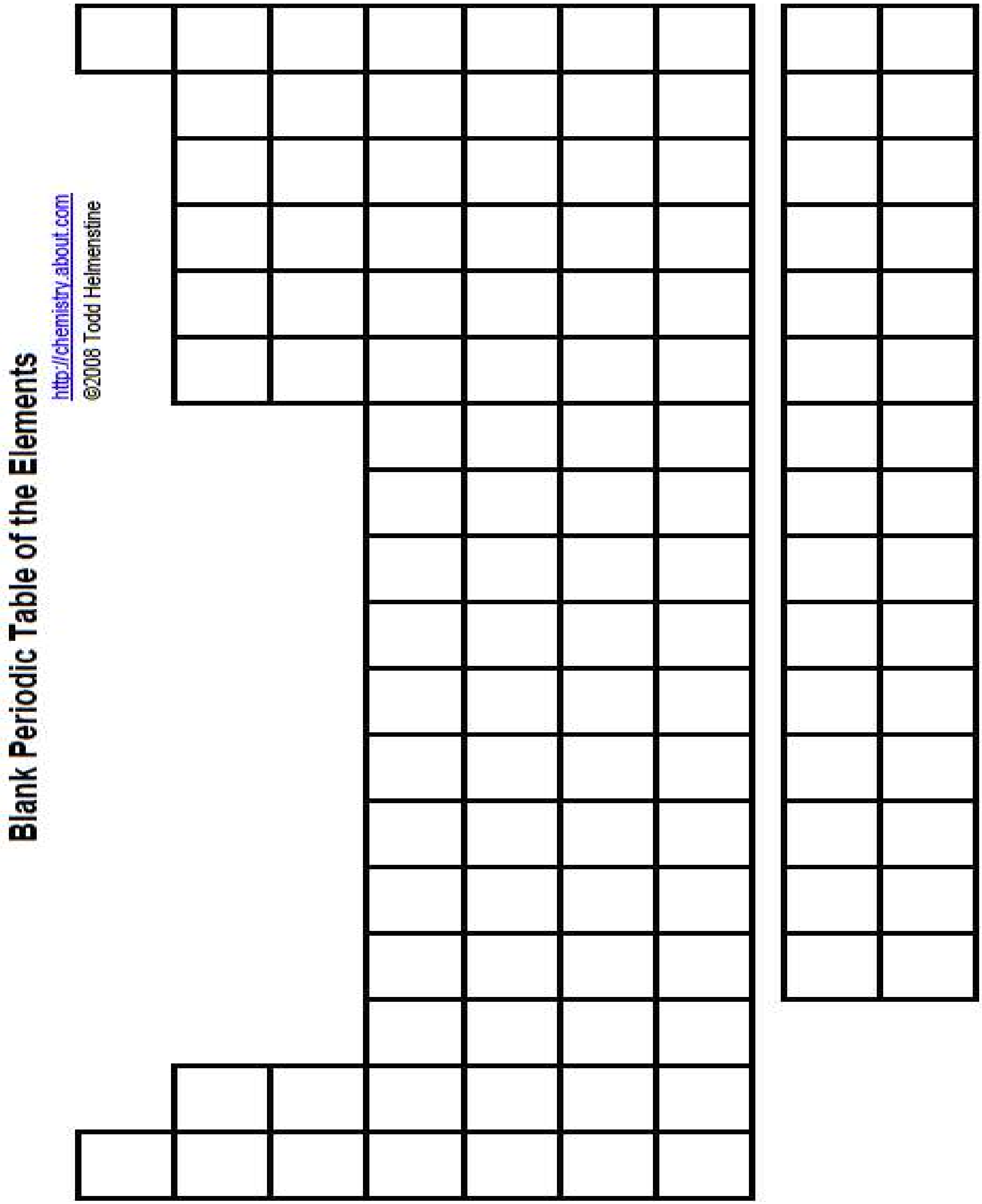


Mutualism

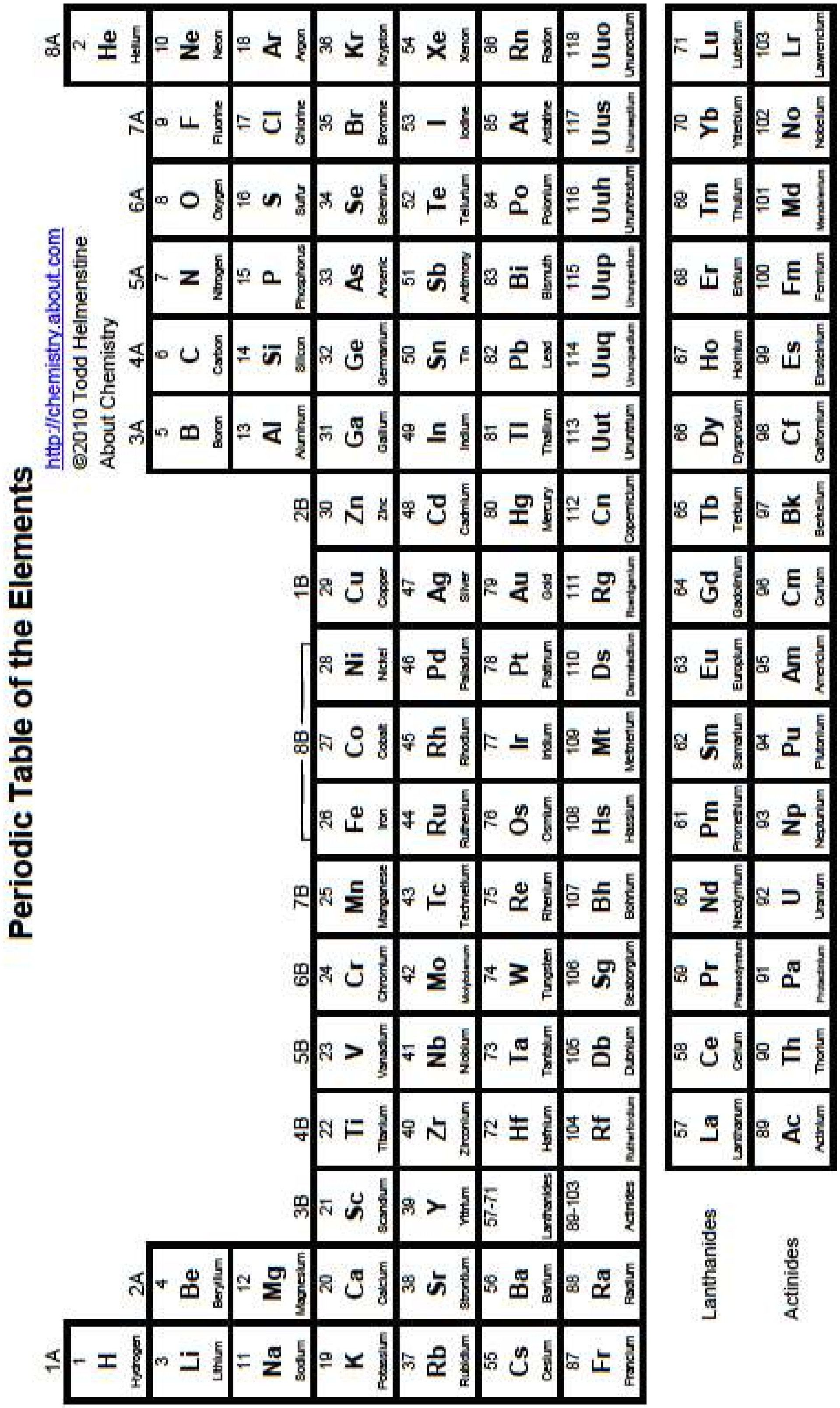
(Give examples & explain relationship)

Parasitic (Give examples & explain relationship)	Commensalism (Give examples & explain relationship)

Periodic Table



Periodic Table



Periodic Table of the Elements

http://chemistry.about.com

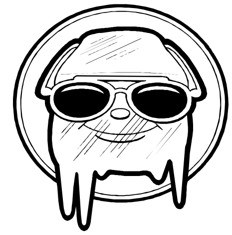
©2010 Todd Helmenstine

About Chemistry

1A	2A	3B	4B	5B	6B	7B	8B	8B	8B	1B	2B	3A	4A	5A	6A	7A	8A
1 H Hydrogen																	2 He Helium
3 Li Lithium	4 Be Beryllium											5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
11 Na Sodium	12 Mg Magnesium											13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon
55 Cs Cesium	56 Ba Barium	57-71 Lanthanides	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium	89-103 Actinides	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Uut Ununtrium	114 Uuq Ununquadium	115 Uup Ununpentium	116 Uuh Ununhexium	117 Uus Ununseptium	118 Uuo Ununoctium

Lanthanides	57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium
Actinides	89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium

Dry Ice Investigations



Name:
Date:
Class/Period:

Objective: To study the phase change called sublimation, solid to gas, using dry ice and to study some of theproperties that dry ice exhibits.

Background: Water (H_2O), in its liquid state, will change into a solid at 0^0 C (32^0 F). Compressed carbon dioxide (CO_2) is a solid at -78.5^0 C (-109^0 F). Dry ice is frozen carbon dioxide, or CO_2, which is a gas under standard temperature and pressure conditions. About .035% of the atmosphere is made up of this gas. CO_2 is a greenhouse gas, which means it absorbs light at infrared wavelengths. An increase in the concentration of this gas would, some scientists believe, cause an increase in the atmosphere's average temperature. The high concentration of CO_2 in the atmosphere of the planet Venus is said to contribute to that planet's high average temperature.

At normal atmospheric pressure on *this* planet, frozen CO_2 doesn't melt into a liquid, but rather evaporates directly into its gaseous form. Hence the name *dry* ice. This process is called *sublimation.* All of the experiments below rely on this property of dry ice. 1 pound of dry ice, when it "sublimes" (turns to gas) will produce 250 liters of gas at atmospheric pressure, enough to fill 125 2-liter bottles. That's a lot of gas!

Materials needed:

- Dry ice (about 1-2" cube)
- Triple beam or electronic balance
- 9" balloon
- Metal spoon
- 2 glass beakers, same size
- Candle
- Match to light candle
- Tongs (or forceps)
- Oven glove (or something with which to hold a hot container)

Safety:

Goggles!!!!

DO NOT TOUCH THE DRY ICE. At these extreme temperatures, Dry ice can cause a severe "burn" if you touch it. Always handle it with insulated gloves or tongs.

Procedure:

1. Obtain a piece of dry ice and regular ice (same size).
2. Observe the piece of dry ice and regular ice.
3. Create a Venn diagram showing as manyattributes as possible.

Investigations	Observations/Explanations
Pour dry ice onto table. Push the dry ice with the end of your pencil so that it slides. Does it slide easily? _____ Describe why the dry ice slides so easily. →	
Place a piece of dry ice into Beaker A and let it sit for a few moments. Find the mass of Beaker B using a triple beam balance. Mass of Beaker B: _______ With Beaker B still on the triple beam balance, “pour” the vapor from Beaker A (with dry ice) into Beaker B (DO NOT let the dry ice fall into Beaker B) Does this make the balance seem unbalanced? ________ What caused this to happen?	
Carefully light the candle at your table. Place a piece of dry ice into a beaker and let it sit for a few moments. “Pour” the vapor from the beaker (with the dry ice) over the candle (DO NOT let the dry ice fall out of the beaker). Describe your observations. Why do you think this happened?	
Place a piece of dry ice on the table. With a metal spoon, push down on the dry ice. Describe your observations. Why do you think this happened?	
Carefully place a small piece of dry ice in a beaker half full of water. Describe your observations. Why do you think this happened?	
With tongs, pick up a few small pieces of dry ice and place them into a balloon. Tie the end of the balloon shut. Describe your observations. Why do you think this happened?	

Come Sublimate with Me

Background

Dry ice is frozen carbon dioxide (CO_2). It freezes at -78°C (-109°F). As a comparison, water freezes at 0° C (32° F). Water can exist naturally as a solid, liquid, or gas on our planet. When a liquid turns into a gas, it vaporizes. When a gas becomes a liquid, it condenses. When a liquid becomes a solid, it freezes, and when a solid becomes a gas, it sublimates.

The League learns that dry ice sublimates instead of melts when they research different possibilities for what the ghost could really be. This experiment allows students to learn about the properties of dry ice as well as to use critical thinking skills. This experiment illustrates the differences between carbon dioxide and oxygen.

Purpose

To study the properties of dry ice.

Materials

- Safety goggles or other protective eyewear
- Heavy-duty rubber gloves
- Chopped up dry ice
- 8-12 inch diameter balloons
- Empty one-liter plastic bottles, tops removed (one for each group)

Safety Tips

Carbon dioxide is toxic in high concentrations. Do this experiment in a large ventilated room. Wear rubber gloves and protective eyewear. Contact with your skin can cause severe frostbite.

Teacher Info

It is important that this experiment is done in a well-ventilated room. Carbon dioxide in high concentrations can be deadly. Students with asthma should probably not do the experiment.

A balloon filled with carbon dioxide will fall to the floor faster than one filled with air because the balloon filled with carbon dioxide has more mass, therefore causing the gravitational attraction to be greater.

Students may notice a temperature difference between the balloons.

The property of sublimation allows the balloon to be filled.

Come Sublimate with Me Worksheet

Instructions

Using the materials provided, design and conduct an experiment to compare a balloon you blow up with one that is blown up using dry ice.

Observations

What is your hypothesis?

____

____

How will you inflate the balloon with dry ice?

____

____

What will you do to compare the two balloons?

____

____

Conclusions

Would the balloon inflate if you used frozen water?

____

____

Explain.

____

____

Based on your study, what are some of the properties of dry ice?

____

____

What do you think would happen to the balloon if you used liquid nitrogen?

____

____

____

At what temperature does liquid nitrogen freeze? ________________________________

What are some potential uses of dry ice?

____

____

____

____

How was dry ice used in *The League of Scientists* to create the illusion of a ghost?

____

____

____

What property of dry ice was needed for it to inflate a balloon?

____

____

____

____

____

I Want To Hold Your Hand
Robotic Activity

Purpose
To construct a robotic-like hand and to demonstrate how data are collected when using robotic technology.

Background
A robot is a machinethat uses given information to follow instructions and to complete a task. Today's robots have multiple sensors and are able to make their own decisions based on given information. Robots come in all shapes and sizes. The jobs they do are also varied. Some robots are used in factories. Others are experimental robots that use artificial intelligence. Artificial intelligence allows robots to behave more like human beings and to act independently in a changing environment. Today, robots are used in hospitals, space and ocean exploration, and other dangerous areas.

Materials
Narrow rubber bands
Drinking straws
Cardboard
Tape
Scissors
Nylon cord
Centimeter ruler
Pen

For procedures and complete details, visit:
http://www.nasa.gov/pdf/172353main_Hold_Your_Hand.pdf

My Tower is Trembling

Background

In *Ghost in the Water*, a broken light bulb was traced to the vibrations of a thrown basketball. Sound is an example of vibration energy. It must have a medium through which to travel. When an earthquake takes place, vibration energy is released.

You are each architects contracted to design a clock tower. When the final tower is built it will be in a local city near a tectonic plate. Your goal is to build a prototype model and test it to see if your tower can withstand vibrations.

Purpose

To study vibrations and how to take counteractive measures.

Materials

You can use whatever materials you chose, but the model should be 10 cm across and 1 meter high.

Procedure

1. Have students build a tower that is a minimum of 10 cm across and 1 meter high.
2. Place the tower on the floor for testing
3. Once each team is done building their tower, test the models to see if they withstand vibrations from the following:
   - Bouncing balls
   - Jumping students
   - Your choice

Discussion

Analyze why the winning and losing towers performed in the ways they did.

____

____

Do the towers perform differently on different floor surfaces?

____

____

Based on what you learned, how would you construct your tower differently?

____

____

Binary Code Breaker

Background

Binary is a code comprising of a combination of 2 digits, 1 and 0, strung together in different orders to represent text and computer processor instructions.

The foundation for the binary code we use today was discovered by Gottfried Leibniz in 1679 when he wrote an article on the "Explanation of the Binary Arithmetic." He remarked how using two numbers was versatile and similar to the Chinese figures of Fu Xi. In 1605, Francis Bacon expanded binary to have it represent alphabetical letters. His use of binary was practical in that it was meant to encode text. Two centuries later in 1847, George Boole used a system similar to binary to create a code that consisted of three commands: AND, OR, and NOT. However it wasn't until 1937 that Claude Shannon expanded on all previous work and it is from Shannon's version that we get the binary code used in computers, electric circuits, and more today.

Carlos and the rest of the League put a message into binary for John to break. See if you can solve these words and phrases from the book or make some of your own for your friends. Use the conversion chart to translate between letters and binary. In the activity each letter written in binary is separated by (/). Spaces between words are separated by (\\).

Words and phrases are on the next page. Answers are below.

Answer Key

1. Robots
2. Abyssopelagic
3. It is a race against time
4. Curious kids are smart kids
5. Is it supernatural
6. It is all binary to me

Binary Code Breaker

Lower Case Conversion Chart

a	01100001	n	01101110
b	01100010	o	01101111
c	01100011	p	01110000
d	01100100	q	01110001
e	01100101	r	01110010
f	01100110	s	01110011
g	01100111	t	01110100
h	01101000	u	01110101
i	01101001	v	01110110
j	01101010	w	01110111
k	01101011	x	01111000
l	01101100	y	01111001
m	01101101	z	01111010

Upper Case Conversion Chart

A	01000001	N	01001110
B	01000010	O	01001111
C	01000011	P	01010000
D	01000100	Q	01010001
E	01000101	R	01010010
F	01000110	S	01010011
G	01000111	T	01010100
H	01001000	U	01010101
I	01001001	V	01010110
J	01001010	W	01010111
K	01001011	X	01011000
L	01001100	Y	01011001
M	01001101	Z	01011010

01010010 / 01101111 / 01100010 / 01101111 / 01110100/ 01110100

____

____

01000001 / 01100010 / 01111001 / 01110011 / 01110011 / 01101111 / 01110000 / 01100101 / 01101100 / 01100001 / 01100111 / 01101001 / 1100011

____

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01001001 / 01110100 \\ 01101001 / 01110011 \\ 01100001 \\ 01110010 / 01100001 / 01100011 / 01100101 \\ 01100001 / 01100111 / 01100001 / 01101001 / 01101110 / 01110011 / 01110100 \\ 01110100 / 01101001 / 01101101 / 01100101

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01000011 / 01110101 / 01110010 / 01101001 / 01101111 / 01110101 / 01110011 \\ 01101011 / 01101001 / 01100100 / 01110011 \\ 01100001 / 01110010 / 01100101 \\ 01110011/ 01101101 / 01100001 / 01110010 / 01110100 \\ 01101011 / 01101001 / 01100100 / 01110011

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Translate your own messages using the conversion charts.

Learn More about Harry Houdini

Background

In the book, the students name a robot after the famous escape artist magician Harry Houdini because the robot can get in and out of places easily. A good magician uses his or her knowledge of science to do tricks. Houdini did a lot to disprove the existence of ghosts or spirits. Houdini's major science trick was as an escape artist. Houdini was a member of Scientific American. He died of appendicitis on Halloween after performing a show.

Your Challenge

You are a journalist for a science magazine that wants to demonstrate how magicians must know a lot of science in order to be effective. Research Harry Houdini.
Answer the following questions:

What did he have to know about the human body to do his escape acts? How did he escape?

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How did he debunk those who claimed to communicate with spirits?

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Did Houdini believe in spirits?

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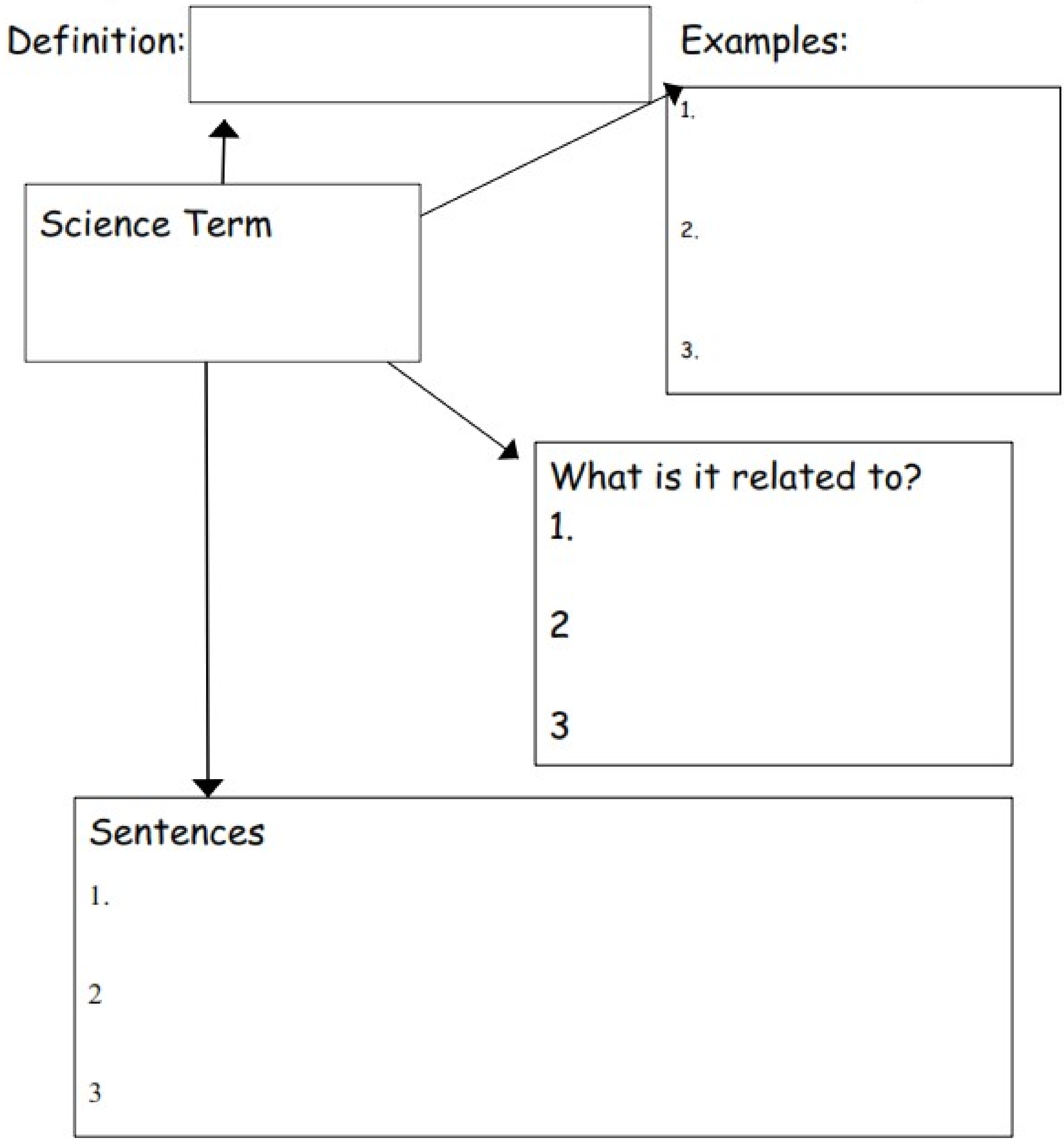
Concept Map Definition Graphic Organizer



By Joan Wagner

Ghost in the Water Glossary Word Search

E	C	T	N	M	E	T	M	I	A	H	N	I	H	I	U	S	I	Q	A	W	A	G	T	O
Y	D	R	H	O	H	T	S	P	O	I	A	E	H	O	N	T	E	L	R	P	V	N	O	I
G	M	I	H	G	P	S	N	I	D	D	R	D	N	C	O	A	T	N	B	I	E	I	R	T
O	S	P	X	U	I	A	O	U	G	M	E	I	O	C	A	I	R	Y	O	M	L	S	G	I
L	A	R	N	O	C	L	O	U	O	O	T	G	H	P	M	D	T	Y	N	R	E	W	A	T
O	L	E	O	W	N	H	K	S	R	A	L	O	R	E	E	I	O	O	D	V	N	O	N	E
T	P	D	I	P	O	O	T	C	L	S	N	O	T	A	D	L	R	M	I	Y	G	D	I	P
P	O	A	T	O	I	A	M	E	A	D	O	E	N	I	D	I	A	B	O	W	T	E	S	M
Y	T	T	A	Y	T	X	G	N	R	L	R	P	M	A	V	A	S	G	X	T	H	Q	M	O
R	Y	I	R	S	U	B	E	I	E	D	B	U	A	N	C	S	B	K	I	P	Q	U	I	C
C	C	O	B	B	T	O	A	L	A	G	H	M	E	R	S	L	H	L	D	C	L	V	L	Y
Y	O	N	I	E	I	U	T	T	A	D	O	F	E	E	A	I	O	J	E	L	X	C	I	O
G	T	I	V	T	T	M	A	A	W	T	M	R	C	M	Y	S	Y	V	E	P	O	R	T	S
W	D	F	O	A	S	E	Y	R	G	S	E	O	D	R	B	P	I	G	R	M	P	E	A	U
C	I	T	O	I	B	M	Y	S	I	I	R	D	A	Y	S	R	A	T	P	Q	D	H	R	B
N	U	C	L	E	U	S	I	L	G	P	R	D	Z	I	H	L	A	U	I	E	U	P	Y	L
L	H	T	S	L	S	C	A	T	C	R	I	A	W	E	F	I	T	N	N	S	N	I	T	I
D	O	U	I	T	A	S	H	I	M	A	S	H	I	T	E	E	D	P	E	B	M	C	I	M
R	U	E	U	U	N	S	F	W	T	K	F	L	U	O	R	E	S	C	E	I	N	R	M	A
P	E	B	L	E	C	I	E	I	T	E	B	A	H	P	L	A	K	E	E	R	G	A	E	T
O	H	T	M	O	T	R	O	R	W	C	Y	T	O	S	K	E	L	E	T	O	N	S	M	I
J	G	M	E	N	U	N	I	S	P	P	O	R	G	A	N	E	L	L	E	S	O	E	I	O
P	O	I	E	M	D	C	T	C	R	O	T	I	N	O	M	E	S	L	U	P	R	A	N	N
C	I	I	M	R	O	A	A	N	T	S	I	S	D	O	P	I	H	P	M	A	M	C	A	D
Z	C	V	Y	A	G	R	A	V	H	R	S	N	T	E	L	O	I	V	A	R	T	L	U	E
S	B	I	I	N	F	R	A	R	E	D	O	A	T	M	U	T	U	A	L	I	S	M	O	J
D	C	A	A	V	I	S	I	B	L	E	V	H	M	E	S	U	L	U	M	I	T	S	N	A
E	R	N	L	A	I	D	N	U	S	Q	P	T	S	V	R	G	A	M	M	A	W	C	Q	V
C	T	L	J	Z	P	J	L	Q	M	Q	J	P	L	E	K	D	N	B	P	X	E	P	Q	U

Word Search Word Bank

Alpha
Altimeter
Amigo
Amphipods
Anime
Anpan
Arigato
Barometer
Beta
Binary
Biodegradable
Black light
Caesar cipher
Carbon dioxide
Commensalism
Competition
Computer ports
Cryptology
Cytoplasm
Cytoskeleton
Data
Déjà vu
Dihydrogen monoxide
Dou itashimashite
Dowsing
Dry ice
Environment
Flagellum
Fluorescein
Gamma
Gelatinous
Greek alphabet
Hadopelagic
Houdini
Humidity
Infrared

Kelp
Humidity
Infrared
Kelp
Laser pointer
Mass
Membrane
Military time
Mitochondria
Mutualism
Nucleus
Organelles
Organism
Parasitism
Pixelated
Predation
Psi
Pulse monitor
Radiation
Scientific process
Señor
Short circuit
Soursop
Stagnant
Stimulus
Sublimation
Substitution cipher
Sundial
Symbiotic
Thermostats
Tomodachi
Ultraviolet
Vacuole
Vibration
Visible
Volcanologist
Wavelength

Articulations to the
Next Generation Science Standards
and
Common Core State Standards Connections

Next Generation of Science Standards addressed in this book and elaborated upon in this Teacher's Guide

Connections to Engineering, Technology and Applications to Science
Defining and Delimiting an Engineering Problem
The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions.

Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses todeveloping, using and revising models to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop a model to predict and/or describephenomena.
- Develop a model to describe unobservable mechanisms

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 and progresses toextending quantitative analysis to investigations,distinguishing between correlation and causation, andbasic statistical techniques of data and error analysis.

- Analyze and interpret data to determine similaritiesand differences in findings.

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8builds on K–5 experiences and progresses to includeconstructing explanations and designing solutionssupported by multiple sources of evidence consistent withscientific knowledge, principles, and theories.

- Undertake a design project, engaging in the designcycle, to construct and/or implement a solution thatmeets specific design criteria and constraints.

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods.

- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.

Developing Possible Solutions
A solution needs to be tested and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem.

MS-PS1 Matter and Its Interactions: PS1.A: Structure and Properties of Matter (Forensic Chromatography and Triboluminescence activities.)

Common Core State Standard Connections

NGSS Crosscutting Concepts for Middle School in Science:

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.
RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
RTS.6-8.8 Distinguish among facts, reasoned judgment based on research findings, and speculations in a text.
RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading the text on the same topic.

NGSS Crosscutting Concepts for Middle School Social Studies:

WHST.6-8.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; quote or paraphrase the data and conclusions of others while avoiding plagiarism.
WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research.

NGSS Crosscutting Concepts for Middle School Math:

6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems.
7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about quantities.
7.RP.A.2 Recognize and represent proportional relationships between quantities.
8.EE.A.3 Use numbers expressed in the form of a single digit times a whole-number power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.

English Language Arts Standards>>History/Social Studies>>Grade 6-8:
http://www.corestandards.org/ELA-Literacy/RH/6-8/ - CCSS.ELA-Literacy.RH.6-8.10

Key Ideas and Details:
CCSS.ELA-Literacy.RH.6-8.1
Cite specific textual evidence to support analysis of primary and secondary sources.

Craft and Structure:
CCSS.ELA-Literacy.RH.6-8.4
Determine the meaning of words and phrases as they are used in a text, including vocabulary specific to domains related to history/social studies.
CCSS.ELA-Literacy.RH.6-8.5
Describe how a text presents information (e.g., sequentially, comparatively, causally).
CCSS.ELA-Literacy.RH.6-8.6
Identify aspects of a text that reveal an author's point of view or purpose (e.g., loaded language, inclusion or avoidance of particular facts).

Integration of Knowledge and Ideas:
CCSS.ELA-Literacy.RH.6-8.8
Distinguish among fact, opinion, and reasoned judgment in a text.
CCSS.ELA-Literacy.RH.6-8.9
Analyze the relationship between a primary and secondary source on the same topic.

NGSS Crosscutting Concepts for Middle School Language Arts
www.nextgenerationscience.org/

RI.8.8	Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient; recognize when irrelevant evidence is introduced.
SL.8.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
SL.8.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.
SL.8.5	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims & evidence, and add interest.

NGSS Crosscutting Concepts for Middle School Social Studies:

WHST.6-8.1	Write arguments focused on discipline-specific content.
WHST.6-8.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; quote or paraphrase the data and conclusions of others while avoiding plagiarism.

WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research.

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