Chemistry — Session I

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Chemistry

Focus areas

Historical: Dr. Marie Curie, Dr. Dorothy Crowfoot Hodgkin, Dr. Reatha Clark King

Scientific: Experiment with changing properties of matter.

Conduct tests to classify substances as acids, bases, or neutral

Issues: Circular relationship between math and science, self-esteem, and career aspirations

Activities included in this section

Those marked with ✕ are essential to the goals of this session.

- ✕ What is Chemistry — a word game — a daughter facilitates
- ✕ The Magical Egg Experiment
- Skits — mothers
  - Dr. Reatha Clark King
  - Dr. Marie Curie
  - Dr. Dorothy Crowfoot Hodgkin
- ✕ Demonstrations — daughters
  - Candle, candle burning bright
    - A Different Form (facilitator)
  - Now you see it, now you don't
  - Making Crystal Ink
- ✕ Identifying acids and bases — setting up investigative sites — all
- ✕ Identifying acids and bases — testing and recording results — all

Supplies needed for facilitator — standard for all sessions

- name tags
- clipboards (or use a heavy piece of corrugated cardboard with a #1 "Ideal" clamp)
- pencils, pens, marking pens
- masking tape
- attendance sheet
- handouts (stack in order)
- marking pens for flip charts
- presentation and activity sheets
- camera and film (nice to have)
- blank paper
- facilitator's manual
- 6 copies of ***The Scientist Within You*** for use of participants
- Folders for each mother-daughter team for collecting handouts and activity sheets. (These may have been provided at Organizational Meeting.)

General supplies needed for science lab table

- container with assorted measuring cups and spoons
- safety glasses and latex or vinyl gloves
- garbage bags
- heavy duty extension cord
- supplies for clean up
- first aid kit
- hand cleaning supplies

Supplies needed for "Magical Egg" — Collect in a box.

- 1 glass bottle (1 to 2 quart with opening a little smaller than an egg)
  (also used with "A Different Form."
- 2 balloons (or more)
- 2 tissues (Kleenex type)
- 2 hard boiled eggs
- wooden matches
- 1 turkey baster (use only with "A Different Form.")

Supplies needed for "Candle, candle . . ." — Collect in a box and add instructions.

- 1 candle in holder
- 2 eight-oz. glass jars
- white vinegar (Also use with "A Different Form.")
- baking soda (Also use with "A Different Form.")
- wooden matches
- 1 Tablespoon measure (from general science supplies)
- 1 teaspoon measure (from general science supplies)

Supplies needed for "Now you see it . . ." — Collect in a box and add instructions.

- 1 hot pot (or saucepan if stove or hot plate is source of heat)
- 2 pot holders
- metal pizza pan or large metal lid
- red food coloring
- glass measuring cup (from general science supplies)
- one cup water
- something to stir with
- a white or clear glass bowl
- heavy-duty extension cord (from general science supplies)

Supplies needed for "Crystal Ink" — Collect in a box and add instructions.

- electric fry pan & rack or toaster oven
- heavy-duty extension cord (from general science supplies)
- table salt
- water
- 1/4 cup measure (from general science supplies)
- 1 tsp. measure (from general science supplies)
- small yogurt cup to hold solution
- 2 water color-type paint brushes
- Assorted pieces of dark construction paper

Supplies needed for acids and bases — Collect in a box

- newspapers (to cover work surfaces)
- safety glasses and latex gloves (from general science supplies)
- 12+ small yogurt containers or baby food jars
- 12+ plastic spoons or coffee stirrers
- masking tape (from check in table supplies)
- cabbage indicator paper (see instructions)
- tumeric indicator paper (see instructions)
- pH indicator paper with color chart
- 1 bottle distilled water
- assortment of household substances (borax, lemon (juice), orange, Epsom salt, vinegar, ammonia, wood ash aspirin, baking soda, soap, cleaners, cream of tartar, tap water, rain water, etc.

Pre-session preparation

Make cabbage & tumeric indicator paper — unless done after organization meeting by mothers and daughters.

Photocopies: Handouts

6 Definition of Chemistry sheet
6 Making Cabbage Indicator Paper
6 Making Tumeric Indicator Paper
6 The Issue of Self-Esteem
12 Evaluation sheets

Photocopies: Presentations & Activity Sheets

6 What is Chemistry
1 What is Chemistry Answer Sheet
2 Making Crystal Ink instructions — in plastic — place in box with the supplies
2 Candle, candle . . . instructions for two — in plastic — place in box with the supplies
2 Now you see it, . . . instructions for two — in plastic — place in box with the supplies
1 A Different Form (or use instructions from this manual)
12 Investigation Work sheets

Visuals

- A Universe of Questions (from Organizational Meeting)
- What does it take to be good in science? (from Organizational Meeting)

Room Layout

- Each mother and daughter should share a desk for small table. You need to locate the electrical outlets for two of the demonstrations.
- Set up the Science Lab Table so it can be accessed from all sides.

  Materials for experiments such as measures, ingredients for testing, safety glasses, etc. should be placed on this table. Items boxed for a specific demonstration can be placed under the table. Tape a garbage bag to the table.
- Set up Check-in/Supplies Table close to door.

  Supply box can be placed on this table. The first participants can unload supplies and place box under the table.
- Set up Facilitator's Table in a place convenient to you. Have your chair nearby.
- As mothers and daughters arrive, ask them add their supplies, etc. to the Science Lab Table.
- Collect the cabbage indicator paper and tumeric indicator paper. Keep these and the pH indicator paper on your facilitator's table.
- Ask a mother and daughter to tape visuals to wall.

A Different Form

Use this activity to demonstrate that vinegar and baking soda when combined actually do produce a gas.

After the “Candle candle burning bright” demonstration (which showed that a candle will be snuffed out by the gas produced when vinegar and baking soda were mixed together) bring over the following items:

- balloons
- bottle used for “Magical Egg” experiment
- turkey baster

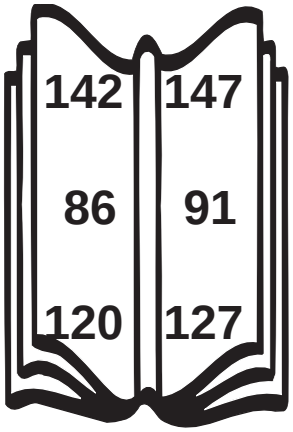
Tell moms and daughters that even though they could not see the gas that snuffed out the candle you can prove it is really there.

- Ask a daughter to measure 1 tsp of baking soda into your jar. (This is for a 1 quart bottle. If the bottle is 2 quarts, use 2 tsp baking soda)
- Measure 1/4 cup of vinegar, then with the turkey baster transfer it into the balloon. (This is usually easier than trying to pour the vinegar into the small opening.)
- Attach the open end of the balloon to the mouth of the bottle. (Don’t let vinegar spill in at this time. Tape the balloon to the bottle if necessary to secure it.
- Raise the balloon to allow the vinegar to pour into the bottle.

As the mixture starts to bubble the gases begin to inflate the balloon.

Agenda

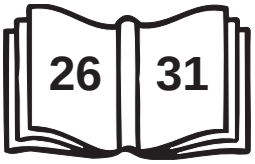
Time	Activity	Instructions
If there was no organizational meeting add 15 minutes to this session and start with these three activities:		
5	Icebreaker	Go around room and ask each person to introduce herself by name and identify her favorite science.
5	What does it take to be good in science?	Go around the room asking each person for her idea, writing one word answers on a large sheet of paper. If someone wishes to pass, mention that she will have an opportunity to add to the list throughout the session. Leave the list up and indicate there are flip chart marking pens in your supplies so if anyone thinks of something to add she can add it to the list at any time.
10	The Universe of Questions	On page 45 are the instructions for giving a brief presentation on Hildegard of Bingen. Skip the next ice breaker and do “What is Chemistry?”
If the group has already been introduced to “What does it take to be good in science?” and the Universe of Questions then begin this session here.		
5	Icebreaker	Go around the room and ask each person to introduce herself again and tell the group what she thinks of when she hears the word “Chemistry.”
10	What is Chemistry?	It helps when everyone is working from the same definition, so here is a simple activity that explains the scientific definition of Chemistry. Ask one of the daughters to hand out the “What is Chemistry?” activity sheet. All mothers and daughters should work together for 5 minutes on answering the questions. Ask the daughter to come back up. Give her the answer sheet. She can read the answers so that everyone can check their definitions.
10	Magical Egg	 As facilitator you will be conducting a very quick demonstration showing how air takes up space and exerts pressure. This pressure can increase and decrease depending on various factors. Air falls into the chemical category of a gas. Ask a mother to perform the experiment while you coach her through the process. Don’t do the 10 steps for conducting experiments.

Time	Activity	Instructions
15	Preparation for presentations	**Task for Mothers:** Present information on women scientists in a creative way. Pair up mothers and give each pair of copy of ***The Scientist Within You*** book. Take each pair aside and quietly tell them their assignments. Refer them to three parts of the Discovery Unit on their scientist: 1. "Key points" on the beginning page, 2) the biography, and 3) the ***Scientific Gazette***. Each presentation should take 2 minutes. When there are six mothers, assign two to work together on each of the following scientists: • **Dr. Reatha Clark King** Format: Celebrity interview • **Dr. Marie Curie** Format: A conversation between her daughters Eve Curie (author) and Irene Joliot-Curie (scientist) • **Dr. Dorothy Hodgkin** Format: Newscast from Stockholm, Sweden, reporting her acceptance of the Nobel Prize.  When there are five mothers, assign 1 to do Dr. Hodgkin. When there are only four mothers, eliminate Dr. Hodgkin. Send the mothers out of the room to work on their skits. **Task for Daughters:** Pair daughters the same as their mothers. Explain to the girls that they will be setting up experiments to demonstrate. If possible, let each experiment be located on a different desk. "Now you see it ..." and "Making Crystal Ink" should be on desks adjacent to electrical outlets. Give girls safety glasses to wear. When the girls are given their assignments, have them begin assembling the supplies. • Candle, candle burning bright — page 48 • Now you see it, now you don't —page 49 • Making Crystal Ink — page 50 When there are five daughters assign 1 to make crystal ink. When there are only four daughters eliminate this demonstration. Help the daughter teams set up their demonstration sites. Let the crystal Ink girls do a test strip and start it drying.
5	Break	When experiments are set up, call mothers in then take a short break.

Time	Activity	Instructions
30	Presentations	**Follow this order:** 1. Mothers: skit on Dr. Reatha Clark King 2. Daughters: Candle, candle burning bright Note: *This demonstrates a chemical reaction combining a liquid with a solid to create a gas.* 3. Facilitator: A different form 4. Mothers: skit on Dr. Marie Curie 5. Daughters: Now you see it, now you don't Note: *This demonstrates the process of distillation. A liquid to a gas (evaporation) and back to a liquid (condensation).* 6. Mothers: skit on Dr. Dorothy Hodgkin 7. Daughters: Making Crystal ink Note: *Evaporation eliminates the water and leaves the salt as crystals on the paper. All salt crystals have six sides.*
	Cleanup	Put things back and clear desks for next activity.
10	Identifying acids and bases	**Setting up investigative sites.** • Cover desks with newspaper. • Place all items to be tested on the floor for all to see. • Indicate the baby food jars (or yogurt cups), stirrers, and distilled water. • Remind moms and daughters that chemical substances are usually classified as an acid, base, or as neutral. In this activity they will be testing solutions comprised of household items using several different indicators. • Hand out safety glasses and latex gloves to all. • Ask each mother-daughter pair to choose two materials to test. Also get two small containers for the solutions they will be preparing and stir sticks to mix the solutions. If the material is liquid, like vinegar, a small amount can be poured into the small container for testing. If the material is solid, like an aspirin or baking soda, distilled water should be added to the container to help form a solution. • Don't use a stir stick for more than one solution. • After solutions are made they should be placed near the end of each desk. Using masking tape, label the ingredients that are being tested.

Time	Activity	Instructions
20	Identifying acids and bases	**Testing and recording results.** • **Handout:** Investigation work sheets • Provide clipboards if available. • Everyone should be wearing safety glasses and latex or vinyl gloves. • Set out the cabbage indicator paper. Have the mother and daughter who prepared it explain how it works. (Information is on the directions.) • Moms and daughters work together. • When teams are beginning to finish testing with the cabbage indicator paper, set out the tumeric indicator paper. The team that prepared it should explain how it works. • Moms and daughters continue testing using the new indicator paper. • When teams are completing the testing, start giving out strips of pH indicator paper. Also have the color charts available. 1 is most acid, 7 is neutral, 14 is most base (or alkaline). • If there is time left, have the moms and daughters combine some of the solutions to see if they can neutralize the acids and bases. Use the pH indicator paper to check the results.
	Clean up	Return materials to supply table. Return safety glasses and gloves. Newspapers go in the garbage bag. Any items that can be reused should be collected together for washing. Participants should collect their personal items to take home.
10	Wrap up	• Are there any questions to add to the ***Universe of Questions*** collage? • Are there new items to add to the "What does it take to be good in science?" sheet? • Who will be bringing what for the next session? • Folders (bring back to each session) • Handouts • Evaluations ❖ ❖ ❖

Hildegard of Bingen



The **Universe of Questions** Collage is explained in detail in Discovery Unit 5 of ***The Scientist Within You***. Look through the information on the life of Hildegard of Bingen (see both the biography and the Scientific ***Gazette*** and prepare a brief “Once upon a time ...” -type presentation.

This will be the first woman scientist to be introduced to the group. Be simple. Several times during The Mother And Daughter Science Club participants will be making impromptu presentations. Since copies of ***The Scientist Within You*** will be available throughout the sessions — participants also have the option to purchase their own copies at a discounted price — moms and daughters can read further about her at a later time.

This presentation is just a “teaser.” The important point to get across is her curiosity, her enthusiasm, and her ability to ask questions. Scientists are always asking questions, forming hypotheses (their best guess), conducting experiments, forming new hypotheses, asking more questions, etc.

The **Universe of Questions** collage will be built throughout the sessions. It assures that science questions are not lost. It can serve as a “springing off” place for new exploration.

The **Universe of Questions** collage also takes the responsibility away from the facilitator to “know all the answers.”

After your brief story ask the moms and daughters what attributes they see in themselves that help them to identify with Hildegard.

Point out the **Universe of Questions** sheet on the wall.

As moms and daughters have science questions they should add them to the collage. Encourage them to be creative in their use of colors, illustrations, etc. when adding to the collage.

❖ ❖ ❖

What is Chemistry?

Fill in the sentences using the words given below. Check your answers with one another.

Chemistry is the __ __ __ __ __ of __ __ __ __ __ __ and the ways __ __ __ __ __ __ __ __ __ __ __ __ __ __.

Matter is what our known __ __ __ __ __ __ __ __ is composed of. It can be categorized into __ __ __ __ states: __ __ __ __ __ __, __ __ __ __ __ __ __, __ __ __ __ __, and plasma.

The principal classifications of __ __ __ __ __ __ __ __ substances are __ __ __ __ __ and __ __ __ __ __ and the __ __ __ __ __ produced by the reaction between these two substances .

Vocabulary:

acids	matter (2)	study
universe	four	solids
liquids	salts	chemical
gases	bases	changes

What is Chemistry?

Fill in the sentences using the words given below. Check your answers with one another.

Chemistry is the __STUDY__ of __MATTER__ and the ways __MATTER__ __CHANGES__.

Matter is what our known __UNIVERSE__ is composed of. It can be categorized into __FOUR__ states: __SOLIDS__, __LIQUIDS__, __GASES__, and plasma.

The principal classifications of __CHEMICAL__ substances are __ACIDS__ and __BASES__ and the __SALTS__ produced by the reaction between these two substances .

Vocabulary:

acids	matter (2)	study
universe	four	solids
liquids	salts	chemical
gases	bases	changes

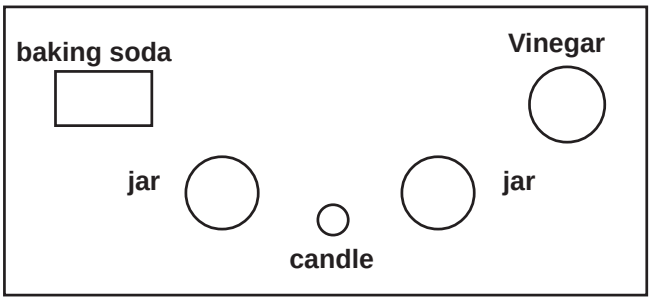
Candle, candle burning bright

Use when 2 daughters are doing this demonstration.

Materials needed:

candle	2 eight-ounce glasses or jars
candle holder	2 Tblsp distilled vinegar
matches	1 tsp baking soda

Set up demonstration: Candle in the center towards the audience. One jar on each side of the candle. Baking soda to one side and vinegar to the other.



1st person: Light candle.

2nd person: Measure 2 Tblsp vinegar into one of the jars.

Ask: When the vinegar is held next to the flame, what do you think will happen? [Wait for guesses.]

Tilt the jar with vinegar so both the jar and vinegar are approximately 1/2-inch from flame. Hold for 15 seconds.

1st person: Measure 1 tsp baking soda into the other jar.

Ask: When the baking soda is held next to the flame, what do you think will happen? [Wait for guesses.]

Tilt the jar with baking soda so both the jar and baking soda are approximately 1/2-inch from flame. Hold for 15 seconds.

2nd person: **Ask:** When the baking soda and vinegar are combined and held next to the candle flame, what do you think will happen? [Wait for guesses.]

Both: Pour the vinegar into the baking soda. Immediately tilt the jar so its rim and bubbling mixture are 1/2” from the candle flame. Hold for 15 seconds.

Explanation: When vinegar and baking soda are combined, carbon dioxide is produced. Fire needs oxygen to burn. When the carbon dioxide fumes covered the flame, the oxygen could not get to it and the flame went out. This is an example of a chemical reaction.

This is also an example of a chemical reaction that shows the combining of a liquid and a solid to create a gas.

Now you see it, now you don't

Use when 2 daughters are doing this demonstration.

Materials needed

hot pot w/cord	heavy duty extension cord
1 cup water	metal pizza pan or large metal lid
food coloring	small bowl (clear glass or white)
hot pads	

Set up demonstration Plug cord into hot pot, but not into an electrical outlet until liquid is placed in it. Fill measuring cup with water. Add several drops of food coloring to the water.

1st person

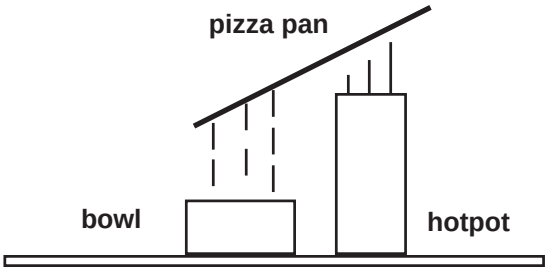
- Show everyone the colored solution in the measuring cup.
- Pour colored solution into the hot pot.

Ask: What color is the solution in the hot pot? [Wait for answers.]

2nd person

Ask: If you boil this solution and the steam rises and cools on a lid, what color will the cooled liquid be? [Wait for answers.]

- Plug hot pot into an electrical outlet — or into the end of an extension cord and then into an electrical outlet.
- Turn hot pot to high and put the hot pot lid back on.
- When solution comes to a full boil, carefully take the lid off.
- Place the small bowl beside the hot pot and hold the pizza pan over the top of the hot pot and the bowl at an angle.



1st person:

Explain: We are demonstrating a process called distillation. In this demonstration distillation changes a liquid (water, in this case) to a gas (evaporation) and back to a liquid (condensation).

- After some of the liquid has collected in the bowl, unplug the hot pot and show the liquid to everyone.

2nd person:

Ask: What color is this liquid? What do you think happened to the color? (If no one has an answer, add this question to the "Universe of Questions."

Making Crystal Ink

Materials needed

3 tsp. table salt

1/4 cup water

small jar or cup

mixing spoon or stirrer

Assorted pieces of dark-colored construction paper

2 water color brushes

electric fry pan with a metal rack, or toaster oven, or microwave oven, or stove with an oven

Procedure

- In the small jar combine the salt and water and stir until dissolved.
- Warm oven to 150º or electric fry pan to 300º
- Using the water color brushes write a word on a piece of construction paper. Be sure to stir the solution with the brush prior to making each letter.
- If using an oven: Turn off and place paper on top of oven racks. Paper should heat until dry (about 5 minutes).
- If using the fry pan and rack: Lay paper on rack and cover with lid. Keep heat on. Check frequently until paper is dried. Turn fry pan off.
- If using a microwave, set paper on a paper plate and microwave on high in 30 sec. increments until dried (about 2 minutes).

About the crystals

The water molecules in the solution started to evaporate as they were heated up. When this water evaporated the dry salt crystals were left on the paper. Evaporation is the process by which matter changes from a liquid to a gas.

If you will examine the salt crystals through a magnifier you will notice that these crystals all have 6 sides.

Crystals occur when atoms, like miniature building blocks, arrange themselves in patterns. Millions of atoms make one crystal large enough for us to see.

Set up this experiment and start making crystal ink. While you are waiting for the paper to dry read the information in the box above. When it comes your turn to do a demonstration:

- Explain what you did and show the results.
- Share information about crystals.

Investigative Worksheet

Test Solution	Indicators	Color Change	Solution type	pH #
Ammonia	Cabbage	*Blue*	*Base*	*10*
	Tumeric	*Red*		
	Cabbage			
	Tumeric			
	Cabbage			
	Tumeric			
	Cabbage			
	Tumeric			
	Cabbage			
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	Cabbage			
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Chemistry — Some definitions

Chemistry: The science that deals with matter and the ways matter changes.

Matter: The substance of which things are made. Matter takes up space and has inertia and mass.

Inertia: The property of a material that resists any change in its state of rest or motion.

Types of matter: solids, liquids, gases, and *plasma*.

Properties of matter:

- a solid has a definite shape and a definite volume
- a liquid takes the shape of its container and has definite volume
- a gas takes the shape and volume of its container

Some chemical reactions:

- "Candle, candle burning bright" — combining a liquid with a solid to create a gas
- "Now you see it, now you don't" — distillation — a liquid to a gas (evaporation) and back to a liquid (condensation). Did all the water change to a gas? What was left behind?
- "Making crystal ink" — evaporation eliminates the water and leaves the salt as crystals on the paper.

Crystals: A solid "pure stuff" — all molecules the same.

Acid: A material that tastes sour, neutralizes bases, and turns purple cabbage juice red.

Base: A material that tastes bitter, neutralizes acids, and turns purple cabbage juice green and turns tumeric paper red.

Some other ways to change the properties of matter:

- liquid to a solid —> freeze
- liquid to a gas —> heat
- gas to a solid —> freeze (dry ice)

Making Cabbage Indicator Paper

An “indicator” shows you something. Red cabbage shows you whether things are acid, base, or neutral. Acids and bases are principal classifications of chemical substances.

Acids were recognized originally by their sour taste in water and because they could attack and dissolve some metals. Acids can neutralize bases and will turn purple cabbage juice red.

Bases are substances that are often soapy to the touch and can neutralize acids. Bases will turn purple cabbage juice blue or green.

To make cabbage indicator paper you will need to gather the following:

1/2 head of red cabbage

water (distilled if you have it)

sauce pan & stove

strainer

flat bowl (Pyrex® rectangular baking dish works great)

cone-type coffee filters

cookie sheets with aluminum foil to lay in the bottom.

Cut the cabbage into small pieces. Place in sauce pan (up to 3/4 full). Barely cover with water.

Place on stove and heat to boiling.

Turn heat off and allow mixture to cool.

Line the cookie sheet with foil so that the filters won’t touch (and absorb) any greasy residue left from previously baked items.

When cabbage juice has cooled, strain through a colander catching liquid in a flat bowl.

Dip coffee filters into the cabbage juice and allow them to absorb the liquid thoroughly. Lift filters out of juice draining excess back into solution. Prop wet filters up like teepees onto aluminum foil and allow to air dry.*

After filters are dry, cut into 1/3” strips. Store in a ziplocked sandwich bag.

* Alternate drying methods:

- You can speed up the drying time by placing the cookie tray into an oven that was preheated to about 150º then turned off. Keep your eye on these filters. If the temperature is too hot and if the filters stay in heated oven after they have dried out, they will begin to scorch around the edges.
- You can also dry filters quickly in a microwave. It takes only about 2 minutes if the filters are opened into cones and microwaved on high. Again, watch these carefully.

Store excess cabbage juice in a lidded jar or covered plastic container. Freeze until ready to make more cabbage indicator paper.

Making Tumeric Indicator Paper

Indicators are materials that have a specific color change. Tumeric is an indicator for a base. The color change is from yellow to red.

Acids and bases, and the salts produced by the reactions between them, are principal classifications of chemical substances. Acids tend to taste sour, they neutralize bases, and turn purple cabbage juice (another indicator) red. Bases tend to taste bitter, neutralize acids and turn purple cabbage juice green or blue. Bases also turn tumeric paper red.

To make tumeric indicator paper you will need to gather the following:

1/3 cup rubbing alcohol

1/4 tsp tumeric powder (from the spice section of the grocery store)

glass cup or jar

flat bowl (Pyrex® rectangular baking dish works great)

cone-type coffee filters

cookie sheet with aluminum foil to lay in the bottom

Measure 1/3 cup alcohol into the glass cup or jar.

Measure 1/4 tsp tumeric powder and add to alcohol. Stir until dissolved.

Pour solution into flat bowl.

Dip coffee filters into the tumeric solution and allow them to absorb the liquid thoroughly. Lift filters out of juice draining excess back into solution. Prop wet filters up like teepees onto aluminum foil and allow to air dry.*

After filters are dry, cut into 1/3” strips. Store in a ziplocked sandwich bag.

* Alternate drying methods:

- You can speed up the drying time by placing the cookie tray into an oven that was preheated to about 150º then turned off. Keep your eye on these filters. If the temperature is too hot and if the filters stay in heated oven after they have dried out, they will begin to scorch around the edges.
- You can also dry filters quickly in a microwave. It takes only about 2 minutes if the filters are opened into cones and microwaved on high. Again, watch these carefully.

Store excess tumeric solution in a lidded glass jar until ready to make more tumeric indicator paper.

The Issue of Self-Esteem

When the poll ***Shortchanging Girls, Shortchanging America*** was first released, several articles and editorials were published refuting the premise that self-esteem was a major problem with girls, and reminding people that Title IX has provided access to all programs for years.

The release of ***The AAUW Report: How Schools Shortchange Girls***, publicized years of research on the subject. Consequently the media began looking at the problem more deeply and came up with more evidence that girls are opting out of math, science, and technical courses — the very courses that prepare students for greater opportunities after they are through their schooling.

Self-esteem is now being examined from multiple aspects: from a ***People*** magazine article in March 1993 on Chelsea Clinton's 13th birthday and the problems she faces (citing the AAUW Report); to a shocking exposé of the changing story line of Nancy Drew.

In ***Ms*** magazine an article titled "The Mystery of Nancy Drew" claimed that *"The symbol of female independence has been replaced by a Barbie Doll detective."*

In a revised series, a description of Nancy is as follows: *"The tight jeans looked great on her long, slim legs and the green sweater complemented her strawberry-blond hair. Her friend Bess sighs, 'You'll make the guys absolutely drool.'"* (In the original series, Nancy's appearance was dismissed with one word: *"attractive."*

In a comparison between two versions of ***The Case of The Whispering Statue*** we read the following: (Original) *"Nancy's fingers were not idle as she listened to the amazing tale. Presently she had freed one arm. Then it became easy for her to loosen her other bonds. Next she jerked off the gag."*

(Revised version) *"'Break this open!' Ned ordered Michaels. With no choice but to obey, Michaels jumped inside. From a back pocket he took out a small chisel and hammer. Within a few minutes Nancy's head was exposed. Ned yanked the gag from her mouth."*

The ***Ms*** article was published in its November-December 1992 issue. In April 1993 a story hit the wire services about a conference devoted to the exploration of Nancy Drew as a role model.

Although girls and boys start out on an equal footing in elementary school, girls' self-esteem declines much more significantly. Girls end up much less confident about their abilities, much less likely to value themselves for their talents, much less likely to think they are good at things and can get things done.

A lower self-esteem among girls is a sign of less confidence in their own talents. Approximately half as many girls as boys refer to their talents as what they like most about themselves. Girls are nearly twice as likely as boys to mention a physical characteristic — appearance, hair, or clothes — as the thing they like most about themselves. This reflects society's messages that these are the things for which women are valued.

The AAUW survey underscores this tragic fact: As girls grow up, they lose confidence in their abilities, expect less from life, and lose interest in challenging courses of study and rewarding careers, particularly pursuits involving mathematics and science.

On the other hand, boys perceive that they *can* accomplish things. This confidence in their abilities contributes heavily to their self-esteem.

The AAUW survey found a crucial — and circular — relationship among self-esteem levels, interest in mathematics and science, and career aspirations.

The ***Ms*** article says that revisions of the original mysteries are showing a less self-reliant Nancy — a Nancy who is described more in terms of her looks and their effect on the guys than in terms of confidence and spunky female independence.

Girls see themselves in Nancy Drew. What other subtle messages are we giving today's girls?

Written by Mary H. Thompson for the Oregon AAUW Educational Equity Project: Awareness to Action — 1993

Evaluation by participants

Chemistry Session **Group** _____

Date _____

What I liked best about today is

I wish we could have

I learned that I

I am still curious about

Please ✔ one: ❒ I'm a mom ❒ I'm a daughter

Engineering — Session II

Overview

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Engineering

Focus areas

Historical: Industrial engineer Nancy Wallace

Scientific: Conduct a time and motion study
Build a structural model and replicate it in larger scale

Issues: Spatial skills in females
Female strengths — cooperative learning & problem solving skills
The gender gap in technology

Activities included in this section

Those marked with **✕** are essential to the goals of this session.

- **✕** Stop the Watch activity — all
- Structural strength exercise — a daughter facilitates
- **✕** Design Lab — mother-daughter pairs
- **✕** Design Competition — all
- **✕** Construction Site — mothers build one structure, daughters build the other

Supplies on science lab table

- 6 - 8” stack of newspapers
- 2 rolls masking tape
- 100 + straws
- box of toothpicks (400+)
- 12 index cards
- hand cleaning materials

Supplies handy to facilitator

- stop watch
- soft ball
- colored dots
- handouts
- marking pens - for flip charts
- facilitator's manual
- ***The Scientist Within You***
- Structural strength exercise (in plastic sheet protector)

Pre-session preparation

Photocopies: Handouts

6 What we can learn from girls' computer avoidance

6 Women Inventors

12 Evaluation Sheets (if being used)

Photocopy: Activity Sheet

1 Structural Strength activity (place in plastic sheet protector)

Skill to practise:

- Making a newspaper dowel — page 60

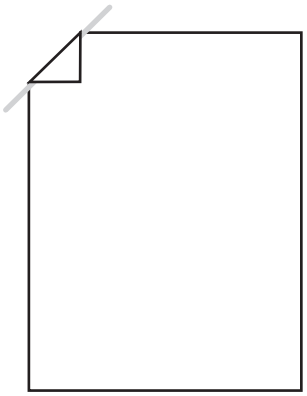
Visuals

- ***A Universe of Questions*** (from Organizational Meeting)
- What does it take to be good in science? (from Organizational Meeting)

Room Layout

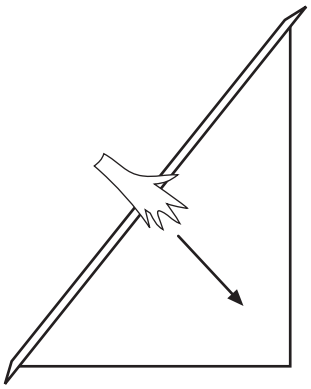
- In this session there should be a large area for use in the "Stop the Watch!" activity and as a construction site. Tables and chairs will facilitate the design lab and spatial activities.
- Science lab table can be off to one side
- Check-in supplies close to the door (if used)
- Set up Facilitator's Table in a place convenient to you. Have your chair nearby.
- As mothers and daughters arrive, they can add materials they are bringing to the science lab table.
- Ask a mother and daughter to tape visuals to wall.
- Ask for their feedback on ***The Universe of Questions*** collage.

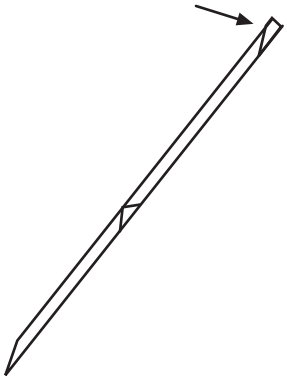
Making a Newspaper Dowel



1. **Lay a firm plastic straw across the corner of a large sheet of newspaper. Tape the straw in place with a small cross piece then fold the corner tightly over the straw.**

2. **Press the palm of your hand on the straw and firmly roll towards the far corner of the newspaper. When the dowel has been formed, tape the loose corner down.**





3. **Fold the thin ends down to create a sturdy building “stick.” Attach to others with masking tape.**

Agenda

Time	Activity	Instructions
20	Warm-Up	 Share a few facts from Nancy Wallace's biography Conduct Stop The Watch! Activity
25	Design Lab	Each mother-daughter team gets one index card, a small stack of toothpicks and a handful of miniature marshmallows. They can get extras if needed.
	Structural Strength Exercise	One of the daughters should lead this simple exercise on the stability of geometric shapes. This will serve as a prelude to the rest of the Design Lab.
	Design Lab Continued	Using toothpicks and marshmallows, each mother and daughter as a team or individually should built a 3 dimensional structure with a base that fits on the index card. Structures should not come easily apart nor fall over.
20	Design Competition and Break	Give mothers and daughters two colored dots each to use for voting. They are to place the dots on the cards holding the 2 structures they would like to build.
45	Construction Site	Determine the two winning designs. There will be two construction crews: The mothers will comprise one crew and the daughters a second. Mothers choose first the design they wish to build. Daughters will build the remaining design. The replicas will be constructed using newspaper dowels for the toothpicks and masking tape for the marshmallows. Each team will make its own dowels.
10	Wrap-Up	Additions to the ***Universe of Questions*** collage Additions to "what does it take to be good in science?" Clean up — All Evaluations/Handouts ❖ ❖ ❖

Structural Strength Exercise

Say:

Using the toothpicks and marshmallows make the following simple geometric shapes:

triangle (3 sided figure)
square (4 sided figure)
pentagon (5 sided figure)

(Give people time to make these figures.)

Say:

Push and pull each shape without disconnecting the corners.

Ask these questions:

Which ones are rigid?
Which ones change their shape?
How can you make the flexible ones more rigid?

Say:

This exercise should give you some clues on how to build a sturdy structure.

What We Can Learn from Girls' Computer Avoidance

by Jo Sanders

Having worked on computer equity for ten years now, I've learned some things that are I think useful for others who do gender equity work in this and other areas. In this article, I'd like to share with you two of the most important things I've learned. Throughout I'll be talking about computers, but please keep in mind that what I have to say applies just as well to mathematics and science, and for similar reasons.

Find the Culprit

Girls' computer avoidance can seem almost mysterious. Teachers and guidance counselors don't tell them not to take the advanced courses or join the computer club or take part in the computer contest. Parents don't tell them not to study computers or utterly refuse to buy them a computer. The machines themselves don't clank or gurgle or stink or lurch, or do other scary things. Nevertheless, girls' presence around computers seems to melt away inexplicably as they get older.

In some places, teachers, guidance counselors, and parents even express puzzlement and frustration at this situation. They say they want girls to learn computers. They don't understand what the problem is, since there doesn't seem to be any cause for girls' peculiar behavior. In other places, no one even notices that computer courses and labs are filled with boys, much less care very much.

This status quo can—and usually does—go on for years. Needless to say, the consequences to computer-avoiding girls are not good: lowered confidence and self-esteem, poorer preparation for an increasingly technological world, and of course, lower occupational and therefore economic prospects.

The reason teachers, guidance counselors, and parents fail to understand what's happening is that they are looking for a Big Explanation, on the scale of those I described in the first paragraph—Find That Culprit, and stop him or her or it!

But that's not how girls' computer avoidance works. Like Carl Sandburg's fog, it comes on little cat feet, subtly and quietly and even trivially. It is created or reinforced

- when teachers inadvertently ask boys the technical questions, or when teachers wait longer for boys' answers to technical questions than girls' answers.
- when girls see so many men in computer-related roles on television programs and commercials.
- when the programming course is scheduled at the same time as music.
- when fathers and brothers use the home computer more than anyone else.
- when the popular girls in the school are cheerleaders or in the chorus, not in the computer club.
- when boys make fun of a girl's ignorance of a technical term.
- when the newspaper pictures of CEO's of computer companies show only men. (Actually, only white men.)
- when boys aggressively play macho video (i.e., computer) games at school, at home, or in the video arcade.
- when girls notice that many of the boys who hang around computers a lot are not the kind of boys, or even people, they like to associate with.
- when girls see a hint of boredom or disinterest or frustration or incomprehension on a female person's face when it comes to technology

I could go on for pages, but you get the idea. First, that these events and behaviors are inadvertent, unintentional, even unconscious, definitely not on the Culprit scale. Second, that no single event or behavior is at fault or even matters very much, but that the accumulation of the patterns over time matters a great deal and in fact produces the computer-avoiding behavior that is so obvious by the high school years.

What does this teach those of us doing gender equity work? Well, it certainly helps to explain the general lack of awareness of the computer equity problem on the part of educators. Unless the patterns are pointed out to them by someone—by us, actually, it's hard for teachers to recognize such subtleties on their own. It's also true, of course, that in a sexist society educators are not particularly inclined to be on the lookout for gender bias to begin with.

Bad, Bad, Bad!

Those of you reading this have probably had the same experience I've had—that when a workshop or other professional activity on gender equity is offered, mostly women show up and sometimes not even many women. There is a reason for this.

Most men and a lot of women expect us to yell at them, that's why. From the media, they have the notion that anyone concerned with gender bias is, horrors! a feminist, and we all know how terrible that is—shrill, nasty, nit-picky, humorless, and above all, full of resentment and blame. Who wants to subject themselves to an ugly tirade? I'm not excluding the possibility that some people have a guilty conscience, of course, and know they deserve a tirade. Moreover, many men reason that since gender equity concerns girls and women, it's a "woman's" thing; sort of like PMS or redecorating the living room, I guess. No one can learn anything when they're being yelled at. Just being afraid they will be yelled at is enough to keep them from learning.

I've found that the best way to handle this is to let people know right off that girls' computer avoidance isn't their fault. I tell them straight out: "You are not to blame."

Now, of course I know that technically speaking this is perhaps not totally true. We all have to make our little compromises in life. But it's true enough to get by when we recall the inadvertent nature of most gender bias. Really, most teachers don't react to poor defenseless little girls who are dying to learn Pascal by pushing out the door and felling them in thunderous tones never to come back again. That being the case, it's okay to appeal to their better natures.

It's also okay, and pretty much necessary, for me to tell them that I too am sexist. I have sexist thoughts and attitudes and have done sexist things and will probably continue to the rest of my life. We all do these things, and to some extent we can't help it because this is the world we learned starting with the pink and blue receiving blankets. We must have a little compassion and kindness for ourselves, because overcoming sexism is genuinely hard to do. Even though none of us will probably ever eradicate all sexism from our thoughts and actions, we can get rid of a bunch of it if we pay attention. The more attention we pay, the more sexism we'll overcome. And whatever we get rid of will make a real difference to girls' futures.

People's relief at this message is almost palpable. They become cheerful and interested and motivated, and then they start noticing all the people who aren't in the room and start resolving to educate the missing ones—because "it wasn't nearly as bad as we thought it would be!" And from there I think real progress in gender equity begins to be made.

I find it fascinating that these simple, homely truths are distilled from so many years and are so powerful. We in the gender equity business have seen our work change considerably. Much as those of us doing civil rights work had to learn that integrating a lunch counter, as much of a triumph as that was, doesn't solve all the problems of racism, we gender equity specialists have had to learn that increasing girls' athletics budgets and appointing some female principals still leaves a lot of sexism.

We are in a new phase of our work in the 90's. Many big victories have been won but women are far from achieving equity. Perhaps the gentle approach I am suggesting will win us renewed progress. The next generation of girls may even thank us.

Jo Sanders is currently at the Center for Gender Equity in Technology, Ccience, and Mathematics Education at the University of Washington. She has presented extensively to in-service and pre-service educators in the U.S. and abroad at the k-12 and post-secondary levels. Ms. Sanders is the author of dozens of books and articles on computers, math and science for girls, and non-traditional employment for women.

Marjorie Joyner (1896 - 1995)

Marjorie Joyner was the first African-American woman to graduate from Molar Beauty School in Mississippi. At age 20 she opened her own beauty shop, which she operated for 30 years. In her business she used the specialized techniques and hair care products that had been created specifically for Black women by Madam C. J. Walker. In 1928, Joyner invented a permanent waving machine that would wave the hair of both white and African-American women. It was electrically powered, with clamp-on metal curling irons suspended from a dome safely above the client's head. The Madam C. J. Walker Manufacturing Company produced and marketed Joyner's permanent wave machine.

Sally Vreseis Fox (b. 1955)

With her Master of Science degree in Integrated Pest Management, Sally Fox was hired to develop insect-resistant cotton. In the course of her work, she became fascinated with a little-known variety of brown cotton. This interest led to her development of several varieties of commercially usable, naturally colored cotton. Starting with just 100 plants in 1982, Sally Fox succeeded in breeding cotton fibers long and strong enough for the commercial textiles industry. Her cotton has natural colors that grow more vivid with age, thus eliminating the pollution caused by the dyeing process. Fox is now president of Natural Cotton Colours, Inc., producing cotton for Levi's and Esprit clothing and working with dozens of farmers in two states to produce her unique "Fox Fibre."

Helen Augusta Blanchard (1840 - 1922)

With 28 patents to her name, Helen Blanchard was one of the most prolific female inventors of the 19th century. Between 1873 and 1901, she often received a patent every year. She registered twelve patents for various types of sewing machines: the Blanchard overseaming machine (precursor of the modern zigzag sewing machine), a device for simultaneous sewing and trimming on knitted fabrics, and a crocheting and sewing machine. Her inventions were used in large textile factories and were ranked among the most remarkable mechanical devices of the age. Blanchard became wealthy from her inventions, and used her money to assist other women.

Ellen Ochoa (b. 1958)

Dr. Ochoa's doctoral work in electrical engineering led to a patented optical system to detect defects in a repeating pattern. This system can be used in manufacturing to inspect intricate parts for quality control. While she was working at Sandia National Laboratories, Ochoa developed an optical system to recognize objects regardless of their position. This can be used in robotic manufacturing, or to guide a robot to or around specific objects. At the NASA Ames Research Center she led a research group in optical processing, working primarily on optical systems for automated space exploration.

Dr. Ochoa is now an astronaut at NASA's Johnson Space Center. Her first space shuttle flight was in April, 1993, on a mission to study the earth's ozone layer.

Valerie Thomas (b. 1943)

Even at an early age, Valerie Thomas was curious about how radios and televisions worked. With a degree in physics, she worked as a mathematical data analyst for NASA. She managed the development of the image-processing system for Landsat, the first satellite to send images from outer space, which were then used to study the earth's resources. She also managed a computer network that connected researchers around the world to study ozone holes and Voyager satellite encounters with Neptune and Uranus. In 1980, Thomas registered a patent for an illusion transmitter that may someday be as popular as the televisions we now watch. Instead of creating a flat image inside the TV screen, her invention produces a three-dimensional image which appears to be right in the room with you, without the use of special glasses or laser technology.

Harriet Williams Strong (1844 - 1926)

Widowed with four children, Harriet Strong turned her boundless energy to cultivating new crops on the family farm in southern California. In 1887 and 1894 she registered patents on flood control/water storage dams and irrigation systems she had invented for use in the Los Angeles area. The dams in her system were designed so that the water trapped behind one would help support the next higher dam, using the pressure of the water itself for structural support and ensuring safety in case of a break. Strong's system was widely adopted, especially for irrigating walnut groves. She became known as "The Walnut Queen" and received an award from the federal agricultural and mining departments for her inventions. Strong also patented several household devices, such as a device for raising and lowering windows.

Mary Engle Pennington (1872 - 1952)

In the early 20th century, transporting farm produce to distant cities was a major problem. Refrigerated train cars could not keep perishable foods cold long enough to prevent spoilage. To solve this problem, Mary Pennington developed a system using both insulation and ice beds to conserve and circulate cold air inside train cars. Her invention was of such importance during World War I that President Hoover awarded her a Notable Service Medal. In 1932, Pennington patented an air-conditioning system for food cold storage rooms that successfully controlled the humidity of the air, regulated air flow, and insured temperature uniformity.

Excerpted from "Inventive Women" a 12 poster set from the ***National Women's History Project*** for distribution in The Mother And Daughter Science Club.

Evaluation by participants

Engineering Session **Group** _____

Date _____

What I liked best about today is

I wish we could have

I learned that I

I am still curious about

Please ✔ one: ❒ I'm a mom ❒ I'm a daughter