Science and Clover Kids

Resource Guide for Camps and Day Programs

Using an Inquiry Approach and Starting Young to Build Those One Million New Scientists!

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Investigations

- Pop the Top Off!
- The Magic of Color
- Penny Boats
- Quick Science Engineering and Technology (SET) Ideas;
  - Fastest Melter, Shoe Shoe, Chart Your Favorite, Guess How Many, Build a Tower
- Bubbles, Bubbles, Everywhere
- Dancing Raisins and Twisting Spaghetti
- A Balloon and a Bottle

Appendix

- Inquiry and Science Process Skills with Children in Grades K-3
- Levels of Inquiry
- Children's Literature as a Springboard for Teaching Science

Investigation 1: Pop the Top Off!

A fizzing, popping investigation using Antacid Tablets and film canisters

Supplies:

*antacid Tablets (Alka Seltzer)

*film Canisters

*pitcher or bottle of water

*paper towels

*book: *What is a Scientist* by Barbara

*safety glasses

Investigation Information:

1. Explain: Today you get to be scientists. Chemistry is the "scientific study of matter and how it interacts. Today we'll be studying the three types of matter and what happens when you combine them.
2. What do scientists do? Read book: *What is a Scientist?* (Barbara Lehn, author).
3. What is matter: Everything in our universe is made up of matter – either solids (like a basketball), liquids (like juice) or gas (like natural gas that can heat a home).
4. One of the things scientists do is investigate things – they try to figure something out by doing something or observing something. In our first activity, we are going to investigate what happens when we combine a liquid

(water) with a solid (a tablet of antacid, or commonly known by the trade name Alka Seltzer).

5. Pair youth in teams of two. Each team gets a film canister, 2 tablets, a small pitcher or bottle of water, and a paper towel. Each student needs to wear safety glasses.

6. Talk about safety issues: safety goggles need to be worn to protect your eyes when working with chemicals or chemical reactions. Listen carefully to directions before beginning any experiments. Use only the equipment and supplies provided.

7. Talk about the Scientist Log and that scientists must count and measure exactly and record data (results). Youth will use the Scientist Log for this activity (see handout – give one copy to each person).

Investigation #1 Steps:

What happens when you combine ¼ antacid tablet and water in the canister?

1. Fill the canister ½ full of water. Drop ¼ of the tablet into the canister. Put the lid on tightly and as quickly as you can. Stand back and count the seconds until the lid pops off of the canister.

2. Repeat experiment and observe what happens. Did the explosion take the same amount of time? Why? Write the number of seconds it took in your investigation log.

3. If your times were different, talk about why.

4. Discuss the word variable. This is a word scientists use to talk about what part of an experiment or investigation changed. What are the variables in your investigation? (size of tablet was different, amount of water was different, etc.) Even though the differences were very small, it could affect the experiment).

Investigation #2 Steps:

How many times can you get the lid to pop off in 2 minutes?

1. Teams have 1 ½ tablets left. You can use as much of the tablets as you wish. Talk with your partner about how you want to conduct this investigation. What combination of water and tablets will get the lid to pop off the most? Make a prediction of what you think will happen. A prediction is a guess about what might happen. Make a plan and write it in your scientist log.

2. When you are ready, put your goggles on and get ready to test your prediction. Youth may need help from volunteers to get the lids back on as quickly as possible. The group leader should yell "GO" when it is time to start and give time cues until the two minutes are up (1 minute left, 30 seconds left, etc.)

3. Write down the number of pops on your scientist log.

4. Share as a group what happened. What strategies did the teams use? Describe the different variables (i.e., amount of water, amount of tablets, crushing the tablets, temperature of water, etc.). Did any strategies seem to make a difference in the number of pops?

Scientist's Log—Mini Explosions

Name of Scientist________________________________

Investigation #1- How long until the top pops off?

What we used: ¼ tablet & ½ full water

	Trial 1	Trial 2	Observations:
# of seconds til pop off			

Investigation #2-How many pops in 2 minutes?

Draw or write how much water and amount of tablet(s) you used:

Predict the number of pops you will have:
Actual number of pops:

Investigation #3- How Many Pops in 2 minutes? (trial 2)

Draw or write how much water and amount of tablet(s) you used:

Predict the number of pops you will have:
Actual number of pops you had:

Investigation: The Magic of Color

Create a new color in each of the 24 little compartment of the containers or trays by mixing only red, yellow, and blue colored water. Use the plastic pipettes to measure out drops of water to create new colors.

Supplies:

color mixing trays

pipettes (or medicine droppers)

color mixing tablets OR food coloring

*water

*clear plastic cups or tubs for water

*paper towels

*table cloths

*book – *Mouse Paint* by Ellen Stoll Walsh

Procedure:

1. Begin by reading *Mouse Paint by Ellen Stoll Walsh*
2. Engage the youth in a discussion about the book and the three primary colors. What happens when two primary colors are mixed?
3. Wonder aloud the question: "I wonder how many different colors we could create using the three primary colors?" Tell the youth they are becoming "color scientists". A color scientist is someone who invents new colors or studies how colors are used. A color scientist might work at the Crayola Company or a paint company.
4. Put one color tablet and water in each plastic cup. Youth use a pipette to squeeze drops of colored water to put in a compartment of the color mixing

tray. Fill each of the 24 compartments in the tray with different combinations of the colors red, yellow and blue to get different color tones.

5. Draw or write on a piece of paper (a science journal) something you observed about color.

6. **Questions to consider….**

a. What were you able to create?
b. How many different colors do you think you could create?
c. Have you ever created new colors with paint?
d. What happens if you mix a whole bunch of different paint colors together?
e. Did anyone create black?
f. If you wanted someone else to be able to make the exact color you did, what would you need to do?
g. What happens if you add white paint to another color?
h. What happens if you add black paint to another color?

(Source: 4-H Operation Military Kids curriculum)

*Activity Resources: Mixing trays, pipettes and color tables are available from: Steve Spangler Science catalogue (www.stevespanglerscience.com) or 1-800-223-9080, or other science supply companies.

Investigation: Penny Boats

Supplies:

*a partner

*12" X 12" piece of aluminum foil

* Pennies

*a tub of water

Procedure I:

1. With the sheet of foil, design and create a boat that will hold the most pennies.
2. After you make your boat, estimate (guess) how many pennies your boat can hold before it sinks.
3. On a piece of paper (science journal) draw a picture of your boat and write down your estimate or guess.
4. Put your boat in the water and see how many pennies your boat can hold by adding pennies one at a time before the boat sinks.
5. Write down the number of pennies it held.

Questions to Consider

1. How many pennies did you think your boat would hold (your estimate)?
2. How many pennies did it hold?
3. Did it hold MORE or Less than you thought it would?
4. If you could remake your boat what would you do differently?

Procedure II:

Get another piece of aluminum foil and create a new boat to see how many pennies your new boat design will hold before sinking. Draw a picture of your new boat. Write down you estimate (guess).

Questions to Consider

1. What did you do differently? Did you change your design?
2. What did you learn about sinking and floating? What shapes hold the most weight? Why do you think that made a difference?
3. What do you wonder?
4. Why are different boats shaped in different ways? (canoes, ships, barges, etc.)

Investigations: Quick SET Ideas

Fastest Melter – observing, investigating

Challenge: What is the fastest way to melt an ice cube?

Supplies: 1 small zip lock baggie per team, 1 ice cube per team

Procedure: What is the fastest way to melt an ice cube? Discuss the different methods each team used.

Shoe Shoe – sort and classify

In groups of 6-10 have youth take off one shoe and put in a pile in the middle of their circle.

Challenge: Ask the youth to decide how they could sort the shoes and what categories they would use.

Supplies: one shoe from each youth in the group

Procedure: Ask the children to sort their shoes into categories and explain why they put each shoe in the category that they did. Chart the categories and the amount in each category.

This activity can be done with a variety of objects: buttons, fall leaves, marbles, shells, etc. The facilitator's role is to assist the children as they figure out the many ways they could categorize their sorting.

Chart your Favorite – data collection and recording

Challenge: Use a chart to record data gathered from the youth. Youth will gain skills that enable them to create their own charts and identify questions they want the group to answer

Supplies: chart paper and pencils

Procedure: Pose a question such as "what is your favorite fruit?" or "what is a chore that you do at home?" or "what is your favorite color?" or "how many people are in your family?" Record the answers the youth give on the chart paper. Use the chart to talk about how scientists gather and analyze data.

Guess How Many - estimation

Supplies**:** marbles OR cereal OR beads OR popcorn, clear jar

Procedure: Fill a jar full of any of the above materials. Have each youth guess how many items are in the jar. Before the youth make their estimation, count out 10 of the objects on the table so they can see what 10 looks like.

Build a Tower – design and build

Challenge**:** Working in teams of two, design and build a tower that is at least 12 inches tall.

Supplies: toothpicks, gumdrops, tarp or table to work on, ruler

Procedure:

Teams design and build a tower that is at least 12 inches tall.

Investigation: Bubbles, Bubbles, Everywhere

Common household ingredients such as baking soda and vinegar can produce some very simple yet interesting reactions.

If there are more than eight youth, divide them into smaller groups to do the experiment (with help from an adult or teen). This will allow each child to see the jars as ingredients are added. Let youth help measure, stir and add ingredients.

Supplies:

*Clear glass or jar (16oz. or larger, for each group)

*Measuring spoons (for each group)

*White vinegar

*Water

*Baking soda

*Small plastic metal or plastic spoon (one for each group)

*Dishwashing liquid

*Tray (to catch spills)

*Sponge or towels

Procedure:

1. Tell the youth they are going to make bubbles. Have each group perform the experiment. Note: Warn the youth that the chemical reactions may occur quickly. It is important to have the youth ready to watch what happens before the last ingredient is added.

2. Fill a glass or jar half full with water or about one cup.

3. Add 2 tablespoons of vinegar to the water.

4. Add 1 teaspoon of dishwasher liquid and stir with a spoon.
5. Add 1 tablespoon of baking soda.
6. Watch what happens. Ask the youth to describe what is happening.

Questions to consider:

1. What happened when you added the baking soda to the mixture of water, vinegar, and dish soap?
2. What did the mixture of water, dish soap, vinegar, and baking soda look like?
3. Why did the glass overflow?

(Source: Exploring the Treasures of 4-H, Helper's Guide)

Investigation: Dancing Raisins and Twisting Spaghetti

Supplies:

*Clear glass or jar (two 16oz. or larger clear jars)

*Dry spaghetti (five 1-inch pieces for each group)

*Tablespoons

*Raisins (five per group)

*Baking soda

*White vinegar

Procedure:

1. Tell they youth that they are about to watch some science magic that can make raisins, spaghetti and even mothballs perform dances!
2. Fill two jars half full or about 1 cup with water.
3. Add two tablespoons of baking soda to each jar and stir with a spoon.
4. Add two tablespoons of vinegar to each jar.
5. Remind the youth to watch what is happening. Ask them to touch the glass jar to see how it feels.
6. When the mixture is clear and stops fizzing drop five raisins into one jar.
7. Add the five 1-inch pieces of dry spaghetti to the other jar.
8. Watch what happens. Be patient! It will take a few minutes before any movement occurs.
9. Ask the youth to describe what is happening.

10. The raisins and spaghetti should rise and fall for about 15 minutes.

Questions to consider:

1. What happened when you added the vinegar to the water and baking soda?
2. What happened to the raisins and spaghetti? What did they do?
3. What did the mixture of water, baking soda, and vinegar look like?
4. Why did the spaghetti move around more than the raisins?
5. Why did the raisins and spaghetti go to the surface (top of the liquid in the jar) and then fall to the bottom of the jar?

(Source: Exploring the Treasures of 4-H, Helper's Guide)

Investigation: A Balloon and a Bottle

More chemical changes occur in the kitchen than in any other room of the house. Almost every cooking activity requires some type of chemical reaction.

Supplies:

*book, *The Magic School Bus Gets Baked in a Cake* by Joanna Cole

*one cup vinegar

*¼ cup baking soda

*Measuring spoons, tablespoons

*Clear, empty soda bottle

Procedure:

1. Read the *Magic School Bus Gets Baked in a Cake* to the youth.
2. Youth pour about ½ cup of vinegar into a soda bottle.
3. Spoon about two tablespoons of baking soda into an un-inflated balloon.
4. Carefully help youth fasten the balloon over the lip of the soda bottle, making sure none of the baking soda falls into the vinegar.
5. On the count of three lift the balloon up so that the baking soda falls into the vinegar.
6. Watch the chemical reaction.
7. Repeat the activity varying the amounts of baking soda and vinegar.

Questions to Consider:

1. Were you surprised by what occurred?
2. What was created in the bottle that caused the balloon to inflate?

3. How are baking soda and vinegar used in cooking?
4. Do you think you can make the balloon inflate even larger? How?

(Source: Youth Experiences in Science, University of California 4-H curriculum)

INQUIRY AND SCIENCE PROCESS SKILLS WITH CHILDREN IN GRADES K-3

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What Is Inquiry?

Inquiry is an approach to learning that involves a process of exploring the natural or material world, and that leads to asking questions, making discoveries, and testing those discoveries in the search for new understanding. Inquiry, as it relates to science education, should mirror as closely as possible the enterprise of doing real science.

- The Exploratorium Institute for Inquiry

The inquiry process is driven by one's own curiosity, wonder, interest, or passion to understand an observation or to solve a problem.

"Inquiry" comes from the Latin words in, or "inward," and quirer, which is the verb "to question." So inquiry is not just asking questions, it is questioning **into** something.

Science Process Skills

A wide array of interpretations on the science process skills exist in science literature. One commonly accepted interpretation of science process skills is offered by Harlen and Jelly. These seven skills seem most appropriate to focus on when working with children in grades K-3rd:

Observing—watching carefully, taking notes, comparing and contrasting
Questioning—asking questions about observations; asking questions that can lead to investigations
Hypothesizing—providing explanations consistent with available observations
Predicting—suggesting an event in the future, based on observations
Investigating—planning, conducting, measuring, gathering data, controlling variables
Interpreting—synthesizing, drawing conclusions, seeing patterns
Communicating—informing others in a variety of means: oral, written, representational

The Inquiry Process with K-3rd graders

When working with children in grades K through 3rd grade (4-H Cloverbuds), try using the following questions:

- What is your question?
- What is your prediction?
- Why do you think that?
- How will you find out?
- Can you make a list of materials you need?
- Can you show me in a drawing what you will do?
- Can you draw what happened or what you found out?

"The greatest discoveries in the world began with the question: "I wonder why..."
-Albert Einstein

Works Cited

Exploratorium Institute for Inquiry. (n.d.). Retrieved April 8, 2009, from www.exploratorium.edu/ifi
Harlen, W. & S. Jelly. (1997). *Developing science in the primary classroom.* Essex, England: Addison Wesley Longman, LTD.
Torres, A and D.Vitti. (2007). *A Kinder-Science Fair.* Science and Children, December 21-25.

Appendix

MINNESOTA 4-H

Levels of Inquiry

A four-level continuum can be useful in understanding the level of inquiry in an activity.
In general, the less direction offered by the facilitator and the greater level of self-directed learning by the learner, the higher the level of inquiry experience.

Figure 1. Four Levels of inquiry and the information given by the facilitator at each level.

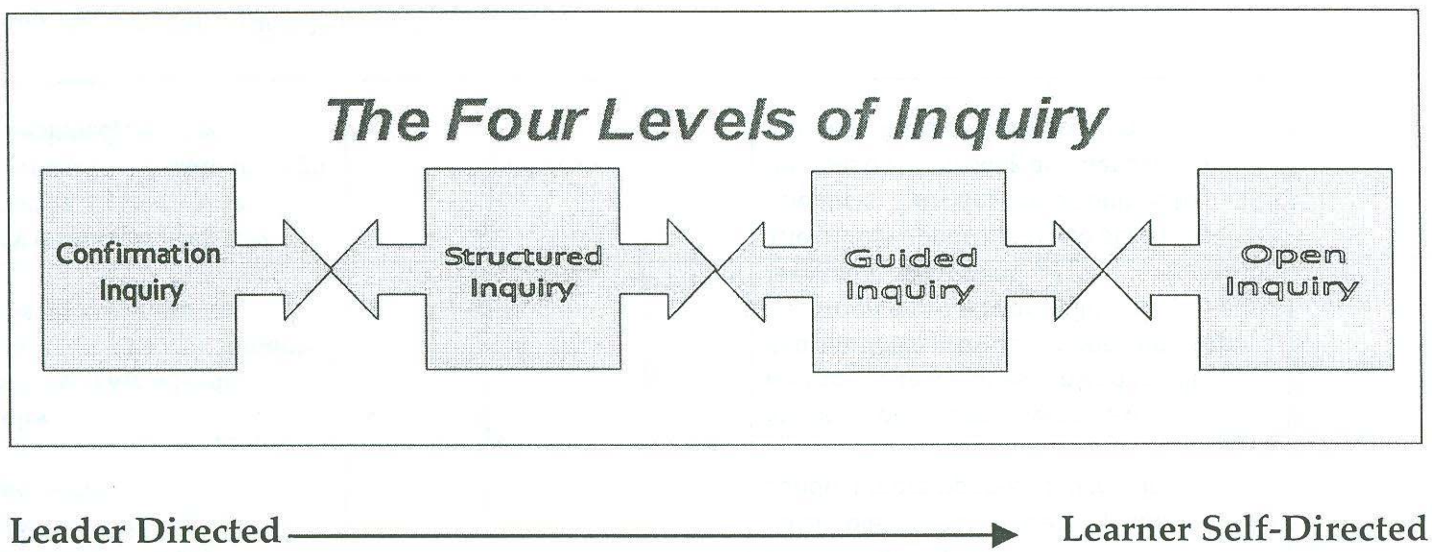
Inquiry Level	Question	Procedure	Result	Useful For:	Examples
1- **Confirmation Inquiry** Participants confirm a principle through an activity when the results are known in advance.	X	X	X	To reinforce a previously introduced idea; To have children practice a specific inquiry skill such as collecting and recording data; To introduce children to the experience of conducting investigations	
2- **Structured Inquiry** Participants investigate leader-presented questions through a prescribed procedure.	X	X		To help children learn to use evidence to generate an explanation To enable children to develop abilities to conduct more open-ended inquiry	
3- **Guided Inquiry** Participants investigate a leader-presented question using participant-designed/selected procedures.	X			Students practicing how to design a method to test a question and resulting explanations; provides opportunities to transition more responsibility from facilitator to student.	
4- **Open Inquiry** or **Student-Initiated Inquiry**- Participants investigate questions that they formulate through participant-designed/selected procedures.				The purest opportunities to act as real scientists. Provides opportunities to demonstrate thinking and behaving in scientific ways to solve problems.	

This table was adapted from Banchi and Bell, 2008.

Works Cited

Banchi, H., & Bell, R. (2008). The Many Levels of Inquiry. *Science and Children* , 26-29.
Northwest Regional Educational Laboratory. (2008). *Is There Only One Way to do Science Inquiry?* Retrieved October 8, 2009, from NWREL: http://www.nwrel.org/msec/science_inq/answers.php

Inquiry Level Model—Work in progress!



Roles of "Learning Facilitator"—visually representing the role of the facilitator at the various levels…..

Children's Literature
as a Springboard for Teaching Science

The books below are a few favorites which can be used as part of science learning. You will know of or can discover many others!

Title	Author	Copyright Date	Publisher
Planting a Rainbow	Lois Ehlert	1988	Harcourt Brace & Company
Growing Vegetable Soup	Lois Ehlert	1987	Harcourt Brace & Company
In the Tall, Tall Grass	Denise Fleming	1991	Henry Holt and Company
Seashells by the Seashore (sorting and classifying)	Marianne Berkes	2002	Dawn Publications
Warthogs Paint - A Messy Color Book	Pamela D. Edwards	2001	Hyperion Books for children
Muncha! Muncha! Muncha!	Candace Fleming	2002	Simon & Schuster
Girls Think of Everything (inventions by women)	Catherine Thimmesh	2000	Houghton Mifflin Company
Colors! Colores! (Eng/Spanish)	Jorge Lujan	2008	House of Anansi Press
What is a Scientist?(science process skills)	Barbara Lehn	1998	The Millford Press
Mouse Paint (prim. & secondary colors)	Ellen Stoll Walsh	1980	Harcourt Brace & Company
A Rainbow of My Own	Don Freeman	1987	Puffin Books
Who Sank the Boat? (sinking,floating, density)	Pamela Allen	1982	Coward-McCann, Inc
Bartholomew and the Oobleck (matter-solids & liquids)	Dr. Suess	1970	Random House Inc.
Purple Green Yellow, others	Robert Munsch	1992	Bob Munsch Enterprises LTD
Inch by Inch, Little Blue and Little Yellow	Leo Lionni		Harper Children's
The Magic School Bus Gets Baked In a Cake (chemical reactions)	Linda Beech	1995	Scholastic Inc.

"I am often amazed at how much more capability and enthusiasm for science there is among elementary school youngsters than among college students."

~Carl Sagan, Scientist

"What I have found in my research seems to me to speak in favor of an active methodology in teaching. Children should be able to do their own experimenting and their own research. Teachers, of course, can guide them by providing appropriate materials, but the essential thing is that in order for a child to understand something he must construct it himself, he must reinvent it.

Every time we teach a child something, we keep him from inventing it himself. On the other hand, that which we allow him to discover by himself will remain with him visible for all the rest of his life."

~Jean Piaget, 1972

And Albert Einstein said...

"He who can no longer pause to wonder and stand rapt in awe, is as good as dead; his eyes are closed."

"I have no special talent. I am only passionately curious."

"It's not that I'm so smart,
it's just that I stay with problems longer. "

"The important thing is not to stop questioning."

"When you make the finding yourself - even if you're the last person on Earth to see the light - you'll never forget it."
–Carl Sagan