Eureka — Stories and Songs for Science

Exciting stories about
science, scientists and experimentation,
and the distinction between non-fiction and fiction

A Teacher's Guide
by Mark Binder

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Goal: to educate, entertain and inspire elementary school students about science.
Curriculum elements: Volume and displacement, the scientific process, sound, temperature, local fauna and weather patterns, microorganisms, conservation and the environment.

Notes to librarians and teachers
This program is adjusted according to the age group of the students. The teacher's guide is not. In other words, not all stories discussed in this guide may appear in the performance your school hosts. I've tried to adjust the questions according to difficulty.

Please keep in mind that I'm a storyteller, not a teacher's guide writer. This teacher's guide is a work-in-progress.

BONUS FOR YOU: If you use this teacher's guide or come up with any suggestions, corrections, or additions, email them to me and I'll send you a FREE story.

RI Benchmark notes: The benchmarks included are taken from the RI Science curriculum.

Og Invents Science

I was wondering who was the first person that came up with the scientific process… Obviously, it was Og.

> Science: The observation, identification, description, experimental investigation, and theoretical explanation of phenomena.
> - American Heritage Dictionary

(RI Grade 3-5 Benchmark 1 of 5)

> *Technology has been part of life on the earth since the advent of the human species. Like language, ritual, commerce, and the arts, technology is an intrinsic part of human culture, and it both shapes society and is shaped by it. The technology available to people greatly influences what their lives are like.*

Discussion questions:

- Was Og a scientist? Why or why not?
- What sort of a life did Og and Marsha have?
- What kinds of scientific inventions would you miss if you lived in a cave?
- What wouldn't you miss?
- Bonus: What other scientific discoveries could a caveman (or woman) make?

Eureka! Archimedes discovery

Structure of Matter
(RI Grade 3-5 Benchmark 1 of 2)
No matter how parts of an object are assembled, the weight of the whole object made is always the same as the sum of the parts; and when a thing is broken into parts, the parts have the same total weight as the original thing.
Technology and Science:
(RI Grade 3-5 Benchmark 1 of 4)
Throughout all of history, people everywhere have invented and used tools. Most tools of today are different from those of the past but many are modifications of very ancient tools.
(Benchmark 3 of 4)
Measuring instruments can be used to gather accurate information for making scientific comparisons of objects and events and for designing and constructing things that will work properly.

Background:
Archimedes was one of the most famous mathematicians of Ancient Greece. Born in Syracuse on the island of Sicily, (287-212 BC) he was known for his many inventions, including the water screw (used for irrigation in less developed nations even until this day) as well as his weapons of war. Archimedes refined the catapult, enabling these crude missile launchers to be adjusted for distance. He also developed levers capable, it is said, of lifting ships out of the ocean, and dropping them on the rocks. Once story said that he used mirrors to reflect the sun's light and set the Roman ships on fire.

Archimedes second most famous quote: "Give me a long enough lever, and I can move the world."

Amazingly enough, Archimedes also discovered many of the principles of calculus thousands of years before Newton. He also devised a method for developing the first estimate of pi (3.14), by measuring the perimeters of polygons set inside and outside a circle.

The story about Archimedes discovery of volume displacement is probably not 100 percent true. During the reign of King Hiero II, a kinsman of Archimedes, a crown was commissioned. When the finished crown (a wreath made of gold) was presented to the king, he grew suspicious. Had the goldsmith used all the gold the king had given him, or was he stealing?

The King summoned Archimedes and posed the problem. Archimedes solves the problem, but not immediately.

Scientific principles illustrated:
- Trial and error
- The process of inspiration and discovery
- The distinction between volume and mass

Archimedes most famous quote, "Eureka!"

Q: How much heavier is gold than silver?
A: Almost twice as much.
On the Periodic Table, Silver (Ag) is #47 and has a Standard Atomic Weight of 107.86.
Gold (Au) is #79 and has a standard atomic weight of 196.97

Follow-up questions:

Note: Be careful to validate unusual ideas rather than dismissing them. Since this is about the process, even unworkable ideas are worth considering.

1. What did Archimedes do to solve his problem?
2. Can you think of any other methods that Archimedes could have used to solve the problem?
3. Why was his solution the most practical?
4. What sorts of tools do we have today that could solve the problem?
5. What other sorts of materials could Archimedes test be used for?
6. What kinds of materials would the test not work with?

Discussion
What makes something a "good idea" or a "bad idea" when it comes to science?

How Rabbit Drank Boiling Water and Married the Princess

Based on an African folk tale from Benin told by Raouf Mama from the collection, "More Ready To Tell Tales from Around The World."

Diversity of Life (RI Grades K-2Benchmark 3 of 3)
Stories sometimes give plants and animals attributes they really do not have.

Human Identity (RI Grades K-2Benchmark 2 of 3)
People need water, food, air, waste removal, and a particular range of temperatures in their environment, just as other animals do.

Follow-up Questions:

- Can animals really talk?
- Why didn't rabbit die when he drank the boiling water?
- How does Rabbit know that the water is cool enough?
- How long do you think it would take for the water to cool? What kinds of factors would be involved? (How hot it is outside, the thickness and material of the container, etc.)
- How hot can water be without killing you? (or hurting you?)
- When would boiling water be a good idea?
  Answer: To kill bacteria
- How hot is boiling water?
  Answer: About 212 degrees Fahrenheit or 100 degrees Centigrade
- Is boiling water always that hot?
  Answer: No. For every 500 feet above sea level, the temperature of boiling water drops by 1 degree Fahrenheit.
  On mars, where the air pressure is 6/1000 that of earth (.6 percent) water will boil at 50 degrees Fahrenheit!
- How else could the Rabbit have cooled the water?
- At what temperature will water boil in Denver, CO (Mile High City)
  Answer: About 201 degrees. Denver is about 5,000 feet above sea level.

Drought

Issues In Technology
(RI Grades 3-5 Benchmark 5 of 5)

Because of their ability to invent tools and processes, people have an enormous effect on the lives of other living things

Water Facts: A leaky toilet can lose 20,000 gallons of water a year – enough to take three baths a day! A leaky faucet that will fill a coffee cup in 10 minutes will waste 3000 gallons of water in a year.

Follow-up Questions:

- Where does your drinking water come from?
- Do we need to conserve water? Why?
- How can you conserve water at home?

Web Link: American Water Works Association: http://www.awwa.org/advocacy/learn/

It Ate my Sister

Diversity of Life (RI Grades K-2Benchmark 2 of 3)

Plants and animals have features [adaptations] that help them live [survive] in different environments.

Questions:

- Do you think putting salt on slugs is cruel? Why/Why not?
- At what point did the story cross over from non-fiction to fiction?
- What would you do to protect your garden from slugs?
- How much vegetation can slugs eat?

The Great Rhode Island Clam Shake

Research and discussion questions:

- Rhode Island is a small state with many different climates and environments: discuss
- What kinds of animals can you find in your environment?
- How intelligent are birds?
- What is the value of clams in our culture? In other cultures?
- Can Rhode Island food cause balloon-like behavior?
- What is the force of gravity, and how fast would the narrator be traveling if he fell from the tip of the Independent Man's spear, 292 feet above the ground?

Great Black-Backed Gull Links
http://www.enature.com/partners/nwf/showSpeciesLG_nwf.asp?showType=4&rgnID=1599&curGroupID=1&curPageNum=120&recnum=BD0073
The http://www.audubon.org/bird/BoA/BOA_index.html
http://www.mbr-pwrc.usgs.gov/Infocenter/i0470id.html

What can you do with a sound?

Motion
(RI Grades K-2Benchmark 3 of 3)
Sound is caused by vibration.

What can you do with a sound?
By Mark Binder

What can you do with a sound?
You can stomp, you can clap, you can cheer – hooray
Imagine a world without sound
There really isn't much you could say.

A sound is composed of vibrations.
It's a force resonating through the air
In space no one can hear you speak
Because there is no air way up there.

CHORUS

Your voice make sound when the air
From your lungs passes over vocal cords
The shape of your mouth turns aaaah, oooh and uurgh
into words into words into words

CHORUS

The sound of a sound can be high
The sound of a sound can be low
The pitch of sound depends on its frequency
High is fast fast fast and low is slow

CHORUS

Sound is a tool that we use to recognize
Danger or opportunity
When someone tells you not to cross the street
It's probably better to wait and see

What can you do with a sound?
You can stomp, you can clap, you can cheer – hooray
Imagine a world without sound
There really isn't much you could say.
There really isn't much you could say.
Shhh…

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