Title: Math in a Bottle
Grade: 3
Subjects: Science, Social Studies, Math, Language Arts
Time: Two 40 minute session on two different days

Objectives:

- Explain the need to reduce the amount of trash they generate, and describe ways in which they can make changes in their actions to support waste reduction.
- Predict, observe, record, and draw logical conclusions during simple investigation.
- Communicate their ideas in writing and inform readers about their actions to reduce waste.
- Identify and describe the life cycle of consumer products.
- Collect, record, organize, interpret and analyze data using a variety of graphic representations and draw logical conclusions.

Standards:
Geography Standard 16: Understand the changes that occur in the meaning, use, distribution and importance of resources.

- Benchmark # 5: Know advantages and disadvantages of recycling and reusing different types of materials.

Geography Standard 18: Understand global development and environmental issues.

- Benchmark # 2: Know ways in which resources can be managed and why it is important to do so (e.g., conservation practices, recycling non-renewable resources).

Science Standard 12: Understand the nature of scientific inquiry.

- Benchmark # 3: Plans and conducts simple investigations.

Language Arts Standard 8: Use listening and speaking strategies for different purposes.

- Benchmark # 3: Respond to questions and comments (e.g., gives reasons in support of opinions).

Mathematics Standard 3: Use basic and advanced procedures while performing the process of computation.

- Benchmark # 5: Perform basic mental computations (e.g. addition and subtraction of whole numbers).
- Benchmark # 6: Determine the effects of addition, subtraction, multiplication and division on the size and order of numbers.

Mathematics Standard 6: Understand and apply the basic and advanced concepts of statistics and data analysis.

- Benchmark # 1: Understand that data represents specific pieces of information about real-world objects or activities.
- Benchmark # 4: Organize and display data in simple bar graphs, pie charts and line graphs.
- Benchmark # 5: Read and interpret simple bar graphs, pie charts and line graphs.
- Benchmark # 6: Understand that data comes in many different forms and that collecting, organizing and displaying data can be done in many ways.

Materials:

- An empty plastic water bottle
- Reusable water bottle
- Interview form provided below
- Math worksheet provided below
- Worksheet with cut outs of plastic bottles or reusable bottles provided below

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- A copy or multiple copies of “Where Does the Trash Go ?: Revised Edition” by Paul Showers

Overview: The average US citizen generates approximately one ton of trash annually, but seldom gives it any thought once they throw it away. So what happens to it all? Well, it goes into the waste stream where it is collected and hopefully, disposed of in a manner that least impacts the environment. This process is known as solid waste management.

The Environmental Protection Agency has designed a plan for this process, which they refer to as “integrated solid waste management”, and has identified five ways to properly handle waste materials: a) source reduction and reusing, b) recycling, c) composting, d) converting to energy, and e) burying it in a sanitary, engineered site. The EPA emphasizes that there is no definitive approach to waste management and encourages communities to combine these five methods to effectively address the issue.

In most communities across the country waste materials end up in at least one of three locations: a) a materials recovery facility, b) a waste-to-energy facility, or c) a landfill. A materials recovery center is where recycled materials are sent. Once at an MRF glass, metal, plastic and paper are sorted, separated, and baled. Then they are transported to manufacturers, processed, transformed into useful items and placed back on the shelves for consumers to purchase once again. A waste-to-energy facility burns the waste material and converts it to energy. The trash is used as fuel to produce heat energy, turning water into steam. The steam is channeled to turbine generators, which in turn produce electrical power. A landfill is a long-term disposal solution that buries trash in as safe and sanitary manner as possible. In a landfill trash is deposited and compacted overtime, burying layer upon layer of waste material and leaving it to decompose. The EPA recommends land filling as a last resort, after all other methods have been exhausted; however many communities find the other options too costly or impractical, and use a landfill solution as one of their primary methods of disposal.

While the technologies driving these methods have greatly improved in recent years, they still present a number of environmental problems; so the most desirable methods for reducing waste are composting and source reduction/reuse. According to reports from the EPA almost 70% of solid waste consists of organic materials, such as paper, food and yard waste. These materials can be composted by individuals or on the community level, using municipal solid waste composters. Either way, the result is a product that can be added to enrich and improve the quality of soil. Compost is a valuable agricultural resource.

However, even with all these other options source reduction is, by far, the most preferred method of solid waste management. It uses fewer resources, less energy and is essentially free. Unfortunately, it is also the most difficult concept to communicate to consumers. For manufacturers, source reduction means looking at and reducing the waste they generate during production, and the materials they use in packaging products. For individuals, it means reevaluating current practices, learning to do more with less, using what already exists responsibly, and recognizing the difference between needs, wants and what is ultimately best for the environment and the future of mankind.

Kid’s Speak: The “waste stream” is the movement of trash from homes and businesses that is recycled, burned, or put in landfills. Recycling is one of the 3 R’s. Plastics can be recycled. They are divided into seven types of plastic. Plastics with the numbers 1, 2 and 3 in the circular recycling symbol are usually recycled in most communities. Plastics 4-7 are often times not recycled. Therefore, products that are packaged in plastics other than 1, 2,and 3 may not be good consumer choices.
Reducing and reusing are also important parts of the 3 R’s. It means people may have to change old habits and do with less. They need to put less into the waste stream. People have to consider making good choices to help protect the environment so it’s a healthy place when you are an adult.

Eco-fact: According to the EPA the total generation of paper and paperboard in municipal solid waste has grown from 30 million tons in 1960 to 83 million tons in 2007, an increase of 34 percent since 1960.

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Procedure:
First Day Introduction:

- Teacher holds up a plastic water bottle poses question: What happens to plastic water bottles when people are done with them? Responses will probably include that they can be recycled or thrown in the trash. Students may mention that some people carelessly toss bottles causing litter.
- Teacher can then ask: Can plastic bottles be recycled? Let's look for the symbol and the number to make sure. What happens to a recycled bottle? What happens to a bottle thrown in the trash? Responses will probably include that recycled bottles will be sorted, crushed, melted, reformed into new product. Bottles thrown in the trash will be buried in landfill and some plastics take 500 years break down.
- Teacher says, "I have the perfect book that will help us discover what happens to the plastic bottles in the landfill and what happens to the plastic bottle when it is recycled."
- Teacher will introduce and read book "Where does the Garbage Go?" . Independent or partner reading is an option.

Before Math in a Bottle:

- Teacher then wonders aloud that it would be better if the bottle was never in the "waste stream" at all. Teacher writes "waste stream" on board, gives definition, and examples.
- Teacher poses another question: Can we prevent bottles from entering the "waste stream"? How can we make a difference? Responses may include that we can use reusable water bottles for school and sports. We can also remind others to use reusable water bottles.
- Teacher holds up reusable water bottle and explains to students that not putting something in the waste stream at all is the "R" called reducing. It means less. If you use reusable bottles then you do not have the problem of disposing of the bottle when you have finished your water. You are making less trash or reducing. It is also another of the 3 R's- reusing.
- Teacher poses another question: Why do people choose to use plastic water bottles instead of reusable water bottles? Accept answers from children.
- Teacher may wish to remind students that it is all about making good choices. Making good choices means making a difference in the environment.
- Teacher again wonders aloud that she is curious if people use bottled water or reusable water bottles for school, work, and athletic activities. Let's do a survey and gather some data to answer this question.

Math in A Bottle Interview:

- Using provided interview form students will interview three people of any age. They can interview parents, other relatives, babysitter, friends, teammates, and coaches, etc.
- Inform students of the date when the interview form is due back in school. Tell students that the class will use the data that they collect to determine if more people in their lives carry bottled water or reusable water bottles.
- Ask class to make a prediction as to the more common practice. When we look at the results of your interviews we will determine the most common practice in their environment.
- Explain interview form. Tell children not to go door to door in their neighborhood but to discuss with parents how this task should be accomplished in a timely fashion. Telephone interviews are a good option.

Second Day: Working with Data
Math in A Bottle:

- Tell students we will make a class pictograph. Using cut outs of a plastic bottle or a reusable bottle from provided worksheet make a large class pictograph. Each child will glue either plastic water bottles or reusable bottle onto large class graph corresponding to the results of their interviews. Graph could be constructed horizontally to stretch across board if needed.

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- Count the number of each type of bottle represented on the glass pictograph. Enter data on first section of provided Math worksheet.
- Convert pictograph into bar graph. Each child will use the class pictograph data to construct a bar graph. After constructing graph, do Bar Graph section of Math worksheet. Key for bar graph: Each space equals 2 bottles.

After Math in a Bottle Worksheet:

- Conduct a discussion to wrap up lesson.
- What does the reducing part of the 3 R's mean?
- Why is a good choice to reduce? How can reducing make a difference?
- Why do you think people do not use reusable bottles? What reasons did people you interviewed give for using plastic bottles?
- Students can design posters or a hallway bulletin board to communicate the results of their interviews, observations, and conclusions.

Adaptations:

- Number of interview subjects can be varied.
- Key for bar graph can be varied.
- Students can partner read or read independently rather than teacher reading aloud.

Extensions:

- Students could write their own story problems relating to the data and subject of this lesson. Students could solve the problems written by peers.

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