ISSN 2324-7878 (online)
palrap.org

PaLA College & Research Division (CRD)

Pennsylvania Libraries: Research & Practice

Practice

Out of the Pickle

Promoting Food Science and STEM in Public Libraries

Dawn States

Dawn States is Teen Program Coordinator at Martin Library, York, PA, dstates@yorklibraries.org

This article explores the popularity of the Science, Technology, Engineering and Mathematics (STEM) movement and provides related statistical information as well as a projection of the future importance and impact of STEM. This article summarizes the significance and need for STEM both locally and nationally, focusing on food science in public libraries to increase and maintain interest among secondary school students. This article furnishes an overview of how a food science program was implemented at Martin Library and how this same programming is scalable for any size library. In addition, this article provides an overview of how libraries across the nation and Martin Library are providing vital STEM programs to communities.

What is STEM?

What exactly is Science, Technology, Engineering and Mathematics (STEM) and what is it all about? STEM is the study or combined study of one or more of these core subjects: Science, Technology, Engineering, and Mathematics. STEM is gaining national traction and in 2012 the number of jobs available in STEM fields was predicted to drastically increase within three years (MyCollegeOptions & STEMconnector, 2012). In order to keep the nation competitive in an international job market and within a global economy, it is of the utmost importance for the United States to invest in future STEM workers. Not only has STEM become a priority nationally, it also has a definite statewide and local impact.

Economic Impact of STEM

In 2018, it is projected that 8.65 million jobs in the United States will be focused on STEM, while Pennsylvania is anticipated to see 314,000 of those STEM-related jobs (MyCollegeOptions & STEMconnector, 2012). Students interested in STEM are more likely to have a higher grade point average, be the first in their families to attend college, and choose to attend a local college (MyCollegeOptions & STEMconnector, 2012, p. 8-9). These statistics indicate that STEM interested students have the potential to enhance their lives, enrich the local economy, and become part of the newest breakthroughs in their fields.

If STEM is becoming a revolution, the next step is to maintain, foster, and introduce STEM programming in an accessible and fun manner, especially among high school students. Beginning high school students often express an interest in STEM fields, but then lose interest at an alarming rate. According to one study, only 21% of high school seniors still indicated a strong interest in STEM (MyCollegeOptions & STEMconnector, 2012). With the growth of STEM jobs on the rise, these issues need to be addressed through as many creative avenues as possible. This is where programs like the food science initiative at the Martin Library answer the call to action.

Food Science

Food science is the study of the chemical compounds within food, the physical makeup of food, and the biological components within food (Institute of Food Technologists, 2015). Martin Library introduced the food science program, not with STEM in mind directly, but to answer the needs of the population served: a group of hungry teenagers. The food science program's success was twofold: feeding teens and teaching science concurrently. This is a form of recreational education and underscores the fact that learning can and should be entertaining so that interest is maintained.

Some examples of food science programs at the Martin Library have included the following foods: caramels, hot cocoa, root beer floats, chocolate, mug cakes, honey, and pickles. All of these foods are teen favorites, easily available, and scalable for multiple libraries. Along with the ease of access to libraries in different geographic locations, these foods also have plenty of scientific properties that can be discovered with research and experimentation. Figures 1-8 provide some illustrations while Appendices A, B, and C at the end of this paper offer further instructions and recipes.

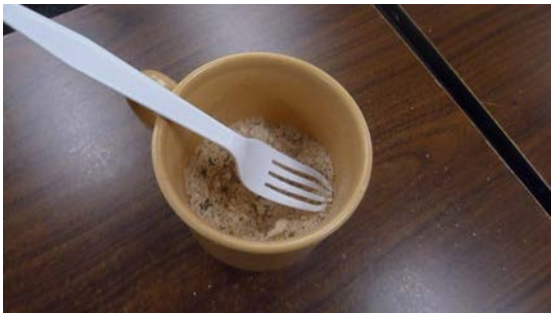

Figure 1

A mug cake recipe examining the effects of withholding milk from the recipe [1]

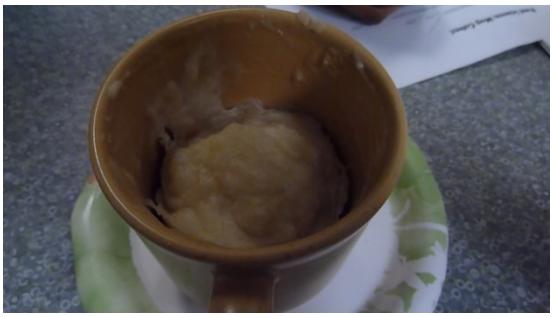

Figure 2

A mug cake recipe examining the scientific effects of withholding baking soda from the cake

Figure 3
A jar of honey, demonstrating the heavy density of honey, which opened the discussion of what density means

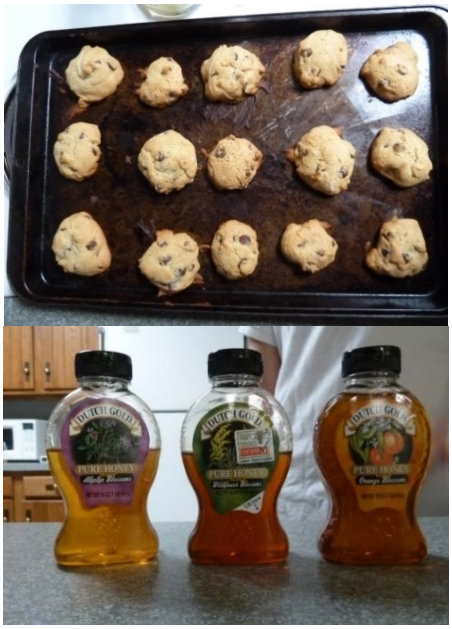

Figure 4
Cookies made with honey and the different types of honey used for experiments

Methods

The methods for each of these programs follows the same process: select a food, discover scientific information about the food subject, and perform different tests. Teens are given handouts during the program. These handouts include the experiment's directions, facts about the food, several scientific terms with the definitions, and room to write down a hypotheses as well as space to record what really happens. Occasionally, a quiz and prize are offered as part of the program. At the program's conclusion, all participants leave with a copy of the handout, food, and tools to explore the scientific aspects of their daily lives.

There are some precautionary steps that a library should take before embarking on this program. The instructor must be aware of common foods that cause allergic reactions, and the food selected should be thoroughly researched to discover if it may cause a problem. A complete first aid kit should be on hand during the program. Promotional materials should reflect what food is tested, and teens should be informed that they are responsible for making the program coordinator aware of any known food allergies.

The room or kitchen that hosts the program should be clean and have proper ventilation. At Martin Library, the kitchen is private and does require inspection. It is also available for rental and must meet building codes. Since Martin Library participates in the Summer Food Service Program which provides free lunches to children and teens over the summer, the kitchen was inspected for food safety compliance beforehand, which includes the refrigerator being at the correct temperature and the room having appropriate ventilation. In addition, the teens are shown appropriate food handling techniques, which include hand washing, washing fruits and vegetables, and washing all equipment.

Once all necessary precautions have been met, it is time to proceed to the science portion of the program. Pickling is a great activity where teens learn about a fermentation process in which good bacteria are encouraged to grow while harmful bacteria are suppressed. They also learned that pickling is an exchange process of liquids between the vegetables and the brine that makes up the pickling liquid. This exchange by osmosis causes the production of lactic acid, which helps preserve the vegetables. Pickling is essentially just a large chemical reaction. As the teens made jars of pickled vegetables to take home, we discussed the science of pickling. In addition, we reviewed the history of pickling, including the origin of the phrase "got oneself into a pickle" (see Appendix A). The activity takes approximately an hour start-to-finish and is easily replicated on multiple scales for libraries of any size.

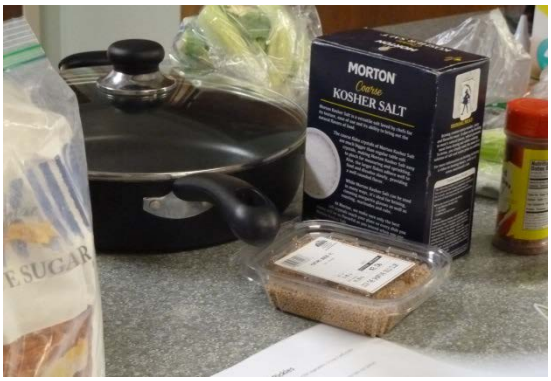

Figure 5
The supplies for pickling

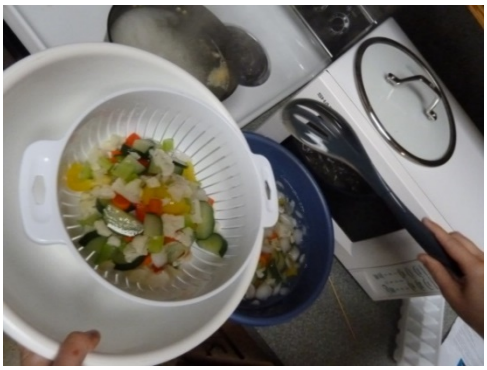

Figure 6
The process of transferring pickles from the boiling water to an ice bath

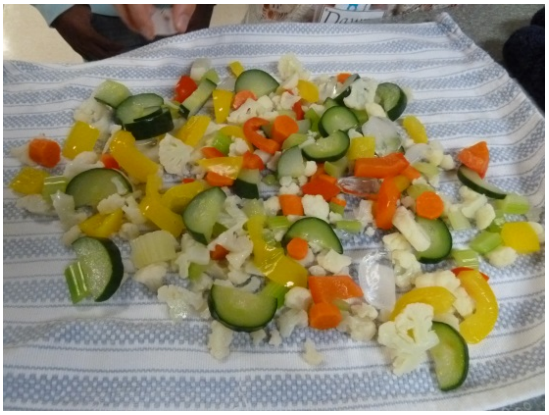

Figure 7
Vegetables that have been boiled and placed in the ice bath are then allowed to air dry before being added to the pickling liquid

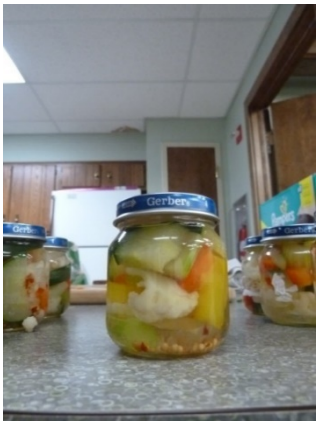

Figure 8
Once the boiling, cooling, and drying processes are complete, the vegetables are added to the pickling liquid and sealed in a jar. Thoroughly cleaned baby food jars are an easy, accessible option for pickling containers

Food Science and the Correlation to STEM

While the food science program at the Martin Library did not start as a STEM initiative, it did develop into STEM programming to meet a need. It is important to incorporate these subjects in library programs and to make programs appealing for students entering a highly STEM-driven workforce and to keep them engaged with STEM for a future that will be largely STEM based, even if they do not enter into a directly STEM-related field. Food science activities engage their minds, spark their interests, and keep STEM meaningful for them. Most importantly, it serves a real need for the teen population attending, provides a local base for STEM interest, and answers the national push for more STEM-related jobs.

STEM and Food in Other Libraries

Starting STEM programming is a challenge that many libraries can and should accept. When starting STEM programming it is important not to get overwhelmed and caught in the focus around STEM. There are many funding opportunities for STEM related programming, and the possibilities associated with STEM programming are limitless. STEM is not just a fad. It is a national priority. Libraries can and should provide STEM programming to contribute to the development of national STEM initiatives.

Libraries are doing exactly that, bridging gaps in STEM interest by providing quality STEM-related programming. For example, the Ephrata Public Library (Pennsylvania) hosted a collaboration between the "Discover Earth: A Century of Change" exhibit and The Pennsylvania STEM Girls, and organized a forum called "Role Models Matter" that introduced girls to successful female STEM professionals (National Girls Collaborative Project). The Spokane Public Library (Washington) created a "Discover Tech" program that focused on engineers (National Girls Collaborative Project). This program highlighted several engineers and partnered with other community organizations to unite the program.

The National STEM Video Game Challenge had different categories for grades 5-8 and for grades 9-12 and featured cash prizes for the winners, plus recognition at a gaming celebration in Pittsburgh, Pennsylvania (Institute of Museum and Library Services, 2015). "SMART Kids," which is a program at Radnor Memorial Library (Pennsylvania), explores science, math and the arts together in creative programming (Radnor Memorial Library, 2015). "Library Makers," at Madison Public Library (Wisconsin), offers different types of creative making for all age groups (Madison Public Library, 2015).

Chicago Public Library has embraced the concept of Science, Technology, Engineering, Arts, and Math (STEAM) through several creative programs. One of these programs is "STEAM Studio," a week-long maker faire that partners with local community organizations to encourage and facilitate teens making their own fashion, music, and media (Chicago Public Library, 2015). The San Diego Public Library (California) is also involved with STEM. One of their programs is titled "A Week of Wearables, Soft Circuits and More!" This program is for ages 10 and up and focuses on sewing, wearable electronics, and creating circuits. (San Diego Public Library, 2015).

All of these programs share a few similar traits: they reach out to the public, include important topics associated with STEM, are generally free, reach a large age range, enhance the community through various ties and partnerships, and complete the vital mission of providing STEM in a feasible, interesting, and approachable manner. These programs are really something that can be implemented in any library.

Other public libraries, though not always focusing on STEM, have incorporated food in their programming (Boyer, 2013). This website highlights programs for teens like Iron Chef, cookie decorating, and food substitute taste tests to raise awareness about the common foods that cause allergies.

One food based program that incorporated STEM was a "Gingerbread House Workshop" for elementary children that showed the basics of building (Koester, 2012). The Tewksbury Public Library (Massachusetts) hosts a "Food Talk" program for adults covering some topics, such as Italian food and chocolate (Taurasi, 2015). High Point Public Library (North Carolina) has a program for school age children called "Culinary Kids" that focuses on making healthy eating choices (High Point Public Library, 2015). Vanderburgh Public Library (Indiana) had an "Ultimate Teen Chef" competition, which had teens work with various foods (Cherry, 2011). These engaging programs provide food and education for the groups attending.

STEM in Our Library

Martin Library is located in an urban setting and serves a racially and economically diverse population. The school districts within this setting are not meeting educational standards as compared to national, state, or even local levels. Additionally, 90% of students within this population and school district qualify for a free or reduced lunch (York County Community Foundation and York Counts, 2013). Due to budget cuts within the school system and the impoverished area, our library has engaged in unique and inventive ways to pursue bridging the STEM gap within this distressed school district.

One way in which Martin Library has provided STEM programming is by partnering with FIRST Robotics and creating a robotics team for school-age children. This team works with local STEM experts to engage in various STEM activities through the medium of robotics. The STEM initiatives at Martin Library have grown to include the following: a tech club for teens called "Batteries Not Included" where teens learn various technology and computer skills including coding, CAD software use, and game design; an Engineers Week that offers several maker and STEM experiments, one of which included a girl's-only addition of building Little Free Libraries; and a Tech Petting Zoo in which various technological devices were provided for children and teens to use and learn. Martin Library also formulated a vision that includes a continued focus on girls engaging with STEM and projects with the recently acquired 3D printer.

Martin Library has been able to implement some of these STEM programs through grant opportunities, one of which was our local Community Foundation Grant. This grant enabled the library to expand and provide STEM programming. As part of the grant requirements, pre- and post-program interest surveys were distributed and collected. These surveys indicated that many of the students attending would not be exposed to STEM programming through their school. These surveys also suggested that interest in all areas of STEM increased after the programs. These statistics reveal the need and the impact providing STEM programming can have and the comments from teens anonymously surveyed speak for themselves. Comments included:

1. Are you involved in any STEM activities at school?

    Answer: No.

2. Is Science, Technology, Engineering or Math one of your favorite subjects? If yes, which one?

    Answer: Science and Math.

3. Why did you come to today's program at our Library?

    Answer: CAKE!

Many of the surveys had similar answers to the above example, which indicated that teens did not have access or did not participate in STEM at their school, that they did have interest in STEM topics, and that they attended the programs for various reasons that ranged from: the food science program, being bored, already being at the library, or because they liked the staff. These teens were encouraged to answer truthfully, and it was stressed that these answers did not have to be textbook-style answers. One reserved teen fully showed engagement with the

program by answering the survey questions through the persona of Batman. This teen does not always participate in programming, so to have this teen answer and fill in the numerical data was not only amusing, it also provided valuable data. Another teen who attended every one of the food science programs has since gone onto college and is studying to be a biotechnologist, so these efforts may be making a positive difference. Additionally, these examples seem to indicate that the program is fun, the teens feel comfortable, and that not only are they reading and comprehending, they also have the freedom to learn and discover in ways they may not be encouraged to do in the classroom.

These survey responses show what librarians at Martin Library and in libraries nationwide are trying to achieve by providing STEM programming: save interest in STEM, foster creativity and discovery, reach the community at large with STEM, and provide future STEM opportunities. Librarians may not be super heroes or scientists, but they do not have to be in order to continue to provide organized and consistent STEM initiatives. Libraries are ideal platforms for reaching national consciousness about the need for STEM, and the above libraries illustrate the ways in which libraries are meeting this need.

Conclusion and Further Thoughts

Food science at the Martin Library is a creative program that takes the need for STEM seriously and applies it through engaging studies of food. The evidence implies that similar programs are not only essential, they also have real results. Programming like the food science initiative can be and must be reproduced in other library settings to connect STEM with a population that requires it.

Libraries in Pennsylvania and nationwide are creating innovative and distinctive ways to address the need for STEM programs and foster an interest in STEM. This ingenuity, willingness to provide STEM programming, and commitment to maintain student interest has proven that librarians and libraries can adapt and meet the needs of an ever-changing nation. STEM initiatives not only meet a need, they also provide hope of a brighter future and a way to keep us all out of that proverbial "pickle."

Notes

[1] All images courtesy of the author. (2015).

References

Boyer, K. (2013, May 6). Food programs appeal to library patrons. *Public Libraries Online*. Retrieved from http://publiclibrariesonline.org/2013/05/food-programs-appeal-to-library-patrons

Cherry, M. (2011, July 14). *Sprinkle, mold, blend, create: Cooking programs for teens*. American Library Association Public Programs Office. Retrieved from http://www.programminglibrarian.org/articles/sprinkle-mold-blend-create-cooking-programs-teens

Chicago Public Library. (2015, July 7). *STEAM studio at Chicago Cultural Center*. Retrieved from http://www.chipublib.org/news/steam-studio-at-chicago-cultural-center

High Point Public Library. (2015, September 17). Kids: Programs. Retrieved from http://www.highpointpubliclibrary.com/index.php?page=programs

Institute of Food Technologists. (2015). *Learn about food science: Food science and technology*. Retrieved from http://www.ift.org/knowledge-center/learn-about-food-science.aspx

Institute of Museum and Library Services. (2015, July 2). *National STEM video game challenge announces winners of fourth annual competition*. Retrieved from https://www.imls.gov/news-events/news-releases/national-stem-video-game-challenge-announces-winners-fourth-annual

Koester, A. (2012, December 21). Gingerbread house workshop: A holiday STEAM program [Blog post]. *The Show Me Librarian*. Retrieved from http://showmelibrarian.blogspot.com/2012/12/gingerbread-house-workshop-holiday.html

Madison Public Library. (2015). *Library makers: Hands on learning for all ages*. Retrieved from http://librarymakers.blogspot.com/search/label/CraftLab

MyCollegeOptions & STEMconnector. (2012). *Where are the STEM students? What are their career interests? Where are the STEM jobs*? Retrieved from http://www.discoveryeducation.com/feeds/www/media/images/stem-academy/Why_STEM_Students_STEM_Jobs_Full_Report.pdf

National Girls Collaborative Project (n.d.). *STEM in libraries: Libraries as STEM education centers*. Retrieved from http://ngcproject.org/sites/default/files/edlab_libraries_wp_web.pdf

Radnor Memorial Library. (2015, August 19). *SMART kids: Science, math, and the arts at Radnor Memorial Library*. Retrieved from https://radnorlibrarysmartkids.wordpress.com

San Diego Public Library. (2015). Week *of wearables, soft circuits, and more!* San Diego Public Library Calendar of Events, Retrieved July 11, 2015 from http://sdpl.bwcs-hosting.com/cal/event/showEventMore.rdo

Taurasi, L. (2015, February 3). *Food and cooking programs featured in February at the library*. Retrieved from http://patch.com/massachusetts/tewksbury/food-cooking-programs-featured-february-library-0

York Community Foundation and York Counts. (2013). *A new education model for York*. Retrieved from http://www.yorkcounts.org/uploads/4webFinalEducationReport2013.pdf

Appendix A

Food Science Handout: Pickles

Everyone will be divided into three main groups, Group 1 will prepare the vegetables, Group 2 will make the pickling liquid, and Group 3 will prepare the vegetables for jars!

Group 1:

Prepare the various vegetables for pickling by washing and cutting the vegetables into bite size pieces. Place the vegetables on the cutting board to chop them, and use the knives carefully!

Group 2:

For pickling liquid take these ingredients:

2 1/2 cups distilled white vinegar

3 cups water

3/4 cup sugar

5 tablespoons kosher salt

1 teaspoon yellow mustard seeds

1/2 teaspoon dried hot red-pepper flakes

Mix together in a sauce pan and bring ingredients to boil. Stir until the sugar is dissolved then transfer the ingredients to a large bowl to cool.

Group 3:

Bring six quarts of water to boil and have ready a bowl with ice and cold water. Add cauliflower and cook for 2- 4 minutes (until the veggies are tender, but crisp) before transferring with a slotted spoon to the ice bath. Cook all the other vegetables the same way for 2-4 minutes each. Drain the vegetables using a colander and pat the vegetables dry.

Now all the groups add the vegetables and the pickling liquid in a baby food jar. Put the lid on and keep the jar in the refrigerator for at least a day. Pickled veggies will keep for up to a week. Enjoy!

What is Pickling?

Pickling is the act of preserving food through the use of a solution, usually salt and sometimes vinegar. The science involved is allowing the good bacteria to produce the flavor of a pickled object while suppressing the harmful bacteria. Pickling is a fermenting process. Fermentation is the process of a carbohydrate being broken down by organisms. In the pickling case, bacteria is breaking down the vegetable carbs and converting the carbs into a lactic acid, which is what helps preserve the vegetables.

What Happens During Pickling?

During pickling, the food undergoes some different scientific changes! One change is in the taste and texture of the food, the other is in the pH of the food or the acidity. The texture changes due to osmosis, where the water in the vegetables moves out of the vegetables into the salty brine. The lactic acid that becomes present during pickling changes the taste of the vegetables. Interestingly, this process halts the growth of undesirable bacteria that leads to food spoilage, but it does nothing to halt chemical changes. This means pickling is a chemical process!

Veggie Care: Or Keeping Out the Gross Bacteria

Keep the veggies sealed! Air on the first day will encourage the growth of bad bacteria. Keep the jar sealed for at least one day to let the pickling process take place and to protect the veggies from the bad bacteria! Be sure to keep the vegetables covered with the pickling liquid while they are in the jar and just chilling in the fridge. Afterward, you can open the veggies and start to eat them in approximately four days .They should be pretty pickled within a week.

Pickling Background:

Pickling has a long history as a good way to preserve food, all the way back to Neolithic times! The phrase to "get oneself in a pickle" is from the Netherlands. I like the way Shakespeare says it best, "How camest thou in this pickle?" Pickling is also present all around the world.

http://www.exploratorium.edu/cooking/pickles

http://www.finecooking.com/item/58953/the-science-of-pickles

http://www.motherjones.com/blue-marble/2011/12/science-pickles

http://cookingsciencetradition.blogspot.com/2011/02/brining-or-pickling.html

Appendix B

Food Science Handout: Root Beer Floats

Take a pre-survey form and fill it out before you begin. Be sure to read all instructions before beginning each experiment! Write down a one-sentence hypothesis before trying the experiment. For example, "I think the cup of root beer will foam over, sprout tiny legs, and walk off with my pencil". Spoiler alert: that hypothesis is wrong.

Experiment 1: Root Beer Float

In one cup, add ice cream first and then add the root beer. In the second cup, add root beer first and then add the ice cream. What do you think will happen? What happens? Is there any difference? Take notes here, and then write your experiences on the big post-it at the front of the room.

Hypothesis (What do you think will happen?):

Observations (What do you see happen?)

Experiment 2: Fancy Cups

Coat the inside of one cup with vegetable oil and one with sugar, then pour in your root beer. What do you think will happen? When you try it, what do you observe - does the coating on the cup make any difference? Take notes, and then put down your observations on the giant post-it.

Hypothesis (What do you think will happen?):

Observations (What do you see happen?):

Experiment 3: Got Milk?

Pour a cup of root beer, and then add some milk. What do you think will happen? What actually happens? Write down your observations here, and then write them on the giant post-it.

Hypothesis (What do you think will happen?):

Observations (What do you see happen?):

Experiment 4: Wishing Well

Pour a cup of root beer, and then drop pennies into the cup. What do you think will happen? What do you see happen? Record it here, and then put it on the giant post-it at the front of the room.

Hypothesis (What do you think will happen?):

Observations (What do you see happen?):

Experiment 5: Just Kidding, Go Have a Root Beer Float.

When you're finished with all four experiments and recording your results at the front of the room, go to area #5 and make yourself a celebratory root beer float. Good sciencing!

Appendix C

Food Science Handout: Honey

Bees work together, so "bee" a team player and form a group of 3-4 people. Working together as a group, test the experiments and write down each of your observations as individuals on your worksheet.

Experiment 1: Density

Take a clear jar and the 1/8 measuring cup. Pour 1/8 cup of the following liquids into the jar one at a time SLOWLY and CAREFULLY in THIS order. Pour these liquids in the center of the jar, being careful not to pour liquids down the side of the jar. (The liquids that are clear or lighter in color can have food coloring added to them to see them better.)

1. Honey
2. Dish soap
3. Water
4. Vegetable oil
5. Rubbing alcohol

What did you think would happen?

What actually happened to the liquids in the jar?

What does density mean?

Experiment 2: Viscosity

Pour a bit of honey in the bottom of one jar (just enough to cover the bottom of the jar). Heat up an equal amount of honey for ten seconds in the microwave in the glass or glass measuring cup. Test the temperature of both types of honey, then pour the heated honey in a jar and drop a penny into the jar of heated honey and the jar of room-temperature honey.

Record temperatures here _____ Room _____Heated

What happens?

Which penny sunk first?

Why is this?

What does viscosity have to do with how fast the pennies sink?

Experiment 3: Taste Test!

Take a spoon and put a drop of one of the three different kinds of honey on the spoon. Taste it, record your observations, and then repeat with the other two flavors of honey.

Orange Blossom Honey

Alfalfa Honey

Wildflower honey

What was your favorite honey?

Why?

Honey Chocolate Chip Cookies

Continue working as a group and decide on a honey to use in your cookies. Preheat the oven to 350 degrees. Then combine these ingredients in a bowl and mix the ingredients together thoroughly.

½ cup honey

½ cup butter

1 egg

1 tsp vanilla

Then add all of these ingredients to the above ingredients and mix them all together:

1 ½ cups flour

½ tsp baking soda

¼ tsp baking powder

½ tsp salt

Chocolate chips

Drop the cookies onto a cookie sheet using a spoon and bake 10-12 minutes or until golden brown.

What do you think will happen to the cookies?

What would you typically use in cookies instead of honey?

How do these cookies taste?

Did you notice anything different about the texture or color of these cookies?