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Cooking Up the Scientific Method

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Introduction

The scientific method is a strategy that scientists use to find answers to questions. It is the process of thinking through the possible solutions to a problem and testing each possibility for the best solution. [1] This straight-forward and accessible format guides scientists and students through the excitement of discovery and the experience of verification. Teachers use this method as they present their science curriculum, providing demonstrations and allowing for experimenting opportunities. It is, though, a challenge in the primary grades to teach the scientific method as an important component of what scientists do. Teachers are programmed with scheduling constraints, often making it easier in the interest of time to just show the students the "correct answer." This of course does not allow for true discovery. With food and cooking as a foundation, this unit will demonstrate the use of the scientific method, allowing the students to learn about the process as well as the product.

I am a first grade teacher in a self-contained classroom at Edgewood Magnet School in New Haven. My class consists of 26 mostly six and seven year olds with an occasional eight year old. The school has an enrollment of about 450 students with approximately 60% African-American population, 12% Hispanic population and the remaining 29% Caucasian and Asian with about half of the school qualifying for free or reduced lunch. Edgewood has a very high average daily attendance rate of 96%. Our neighborhood/ magnet setting is a rewarding environment, with kindergarten through eighth grade students coming to school from a variety of home circumstances and with differences in academic levels. As a result of these variables, the children have differing types of background knowledge and life experiences. Each classroom has a mixture of varied ethnicities, economic strata and social and emotional strengths and weaknesses. Because the curriculum in first grade focuses necessarily on literacy, it becomes a challenge for the classroom teacher to include science enrichment and experimentation.

The New Haven science department circulates kits of materials and lessons from school to school for kindergarten through sixth grade students. These kits support the curriculum designed by the district and allow for sharing of the resources as opposed to stocking and supplying each school each year. The first grade kits include Living Organisms, Sun and Shadows, and Comparing and Measuring, arriving in no prescribed order. It is as an enrichment piece to the comparing and measuring focus that I am designing this cooking curriculum unit. The lessons will align with the content and time requirements of two 45-minute science lessons per week using food and cooking as the focus to introduce the basic units of measure and also to include some additional mathematical skills and concepts such as estimation and fractions. The medium of food is a logical connection to use with young children who are curious about how things are made and where they come from. This very tangible and tasty experience will help the students learn that they can be part of the process.

Understanding the developmental levels of first grade learners must be considered when designing lessons with the intended goal of true comprehension. I want to be able to have the students experience their learning in a concrete and sensorial manner by creating the opportunity to learn through real materials and purposeful experiences. Even for adults often an abstract experience is not as memorable as it could have been if the learning environment was instead purposeful and directed. Because the six- to seven-year old has not achieved abstract thought and has not had enough relative experience at their disposal, the event or experience needs to be visual, auditory, and/or tactile to "stick." [2] Cooking is perfect for these young learners! For students of this age, seeing is believing and touching is knowing and understanding.

Rationale

Teachers in primary grades sometimes feel challenged when it comes to teaching science. Because most are not trained scientists, there can be a bit of intimidation for the less scientifically comfortable teachers. My initial intent is to design a unit that helps with that reticent feeling. Most adults have developed some kitchen skills and can appreciate the ability to create something edible. We also know that it is often through trial and error that we achieve a desired result, generally something that tastes and looks good! This is where the scientific method connects to day to day life - understanding that experiments may not be successful the first, second, or third time but learning that making adjustments based on results is truly the goal. This curriculum unit is designed to reach some developing scientists through a very common experience - eating the food we prepare! The focus will be learning and practicing the scientific method, a strategy that young students will need for their future science classes and experiences. Our annual science fair is a requirement for each classroom, thus participation requires learning about and executing the scientific method in every grade, kindergarten through eighth grade. The goal of this unit is to provide a set of experiences that will introduce a basic understanding of this method at work.

The instruction will begin with some introductory lessons on the basic units of measure and some hands-on experiences using tools for cooking. The unit then moves into learning the steps of the scientific method and carrying out these steps with lessons in measuring, mixing, and cooking, or more generally, physics and chemistry. Throughout the unit, data will be collected to create individual science journals detailing experiences just as scientists in a lab would do.

Science should be fun and interesting and should present experiences that get students thinking critically. Using the scientific method is a fundamental way for this to happen. By performing science experiments and analyzing the data, students are learning to become creative thinkers. Through the steps of the scientific method, students will learn how to define a problem, observe situations, take notes, synthesize the results, and come to a logical conclusion based on objective results. Certainly much of the time will be spent on direct instruction to explain and model the different parts of the scientific method. It will take some practice and experience for the students to get used to the science "discussion" and to learn how each of the parts of the method works. Using and understanding this process will help the students become more curious learners as well as analytical thinkers, a skill needed for all subjects.

Scientific Method

So why does the scientific method seem so mysterious? One possible reason could be the name itself. The word "method" implies that it is something rather secret or sacred only available to highly trained scientists and no one else. Of course, this is not the case. The scientific method is something all of us use. In fact, engaging in the basic activities that make up the scientific method - being curious, asking questions, seeking answers - is a natural part of being human. The scientific method is a systematic process of empirical investigation.

It is important to define what we are talking about. First of all science is an academic journey based on observation. Scientists use all of their senses to gather information about the world around them. Sometimes they gather this information directly, with no intervening tool or apparatus or at other times equipment may be used. Either way, scientists will write down what they see, hear and feel. These recorded observations are called data. Making observations and collecting data are not the ultimate goals rather what are needed to understand the world around us. Analyzing results requires inductive reasoning, or the ability to make generalizations based on specific observations. Also, science makes predictions and tests those predictions using experiments. Generalizations are powerful tools because they enable scientists to make predictions. And science is systematic, requiring tests to be repeated so that results can be verified. [3]

So, science can be thought of as a way of thinking, but also as a way of working -- a process requiring scientists to ask questions, make hypotheses and test their hypotheses through experimentation. This process is the scientific method, and its basic principles are used in every discipline, in every part of the world. Think about chemists developing new medicines, engineers designing new materials, ecologists working on waste management ideas. They are all armed with knowledge from science that has already been established and it allows them to build on that base. This process allows the world to progress, evolve and grow with today's advancements based on the achievements of scientists who have already done great work. One simple example: we know water (H_2O) is made up of one oxygen (O) and two hydrogen atoms (H). Because many scientists have confirmed this fact through repeated tests, it is now considered a building block of knowledge, useful as a base for new experimentation. [4]

The scientific method actually has its roots in philosophy, as does science itself. Some names that we are aware of from history include Aristotle and Galileo who each played a part over time, in the development of this process. Of the many great thinkers and scientists, it is Aristotle who is credited with the beginning of modern scientific thought. He introduced syllogism, which means thinking from the general to the specific to draw a conclusion for example humans are mortal, I am human, therefore, I am mortal. Using observations and collecting data to learn about the world phenomena was the beginning of science. This was, of course, over 2000 years ago when Aristotle's search for knowledge and love of wisdom inspired people to think and learn about the idea of universal truths. Many centuries later, in the 1500's Galileo began to set up experiments to actually test these truths, one in particular being that heavy objects fall faster than light ones. Galileo rolled marbles down a ramp, and dropped various weighted cannon balls from the Tower of Pisa. Galileo experiments proved that objects will fall at the same speed regardless of weight in the absence of air pressure. So we now have observing, wondering, testing, and concluding. Throughout the 19^{th} and 20^{th} many scientists used the method and formed it into a consistent and accepted way to prove ideas through repeatable experiments. [5]

To specify and clarify each component or stage, these are the backbone steps or stages of the scientific method. And even though the scientific method is a series of steps, remember that new information or thinking might require you to back up and repeat steps at any point during the process.

Step One - Explore and Observe

Almost all scientific inquiry begins with an observation that piques curiosity or raises a question. This inquiry begins the same for scientists as it does for students - by exploring. By the time children start school, they have developed a variety of interests and understandings about things and happenings in their world. As children are innately curious, they are exposed to a range of phenomena in around them as they observe and explore. Using this excitement about the world gives teachers an opportunity to guide students through the process of obtaining answers to what interests them.

Step Two - Ask a Question

Coming up with scientific questions isn't difficult and doesn't require training as a scientist. Being curious about something or wanting to know what caused something to happen is already the beginning of a question that could generate a scientific investigation. Its helpful to guide students to start with a standard question word: what, when, why, who, where, and which.

Step Three - Make a Prediction / Guess

What could the answer to the question be? The great thing about a question is that it seems to ask for an answer, so the next step in the scientific method is to suggest a possible answer in the form of a hypothesis. A hypothesis is basically an educated guess or a working assumption because it is generally informed by what is already known about a topic. So the hypothesis is stated in a way that can be easily measured and of course in a way that will help you answer your original question.

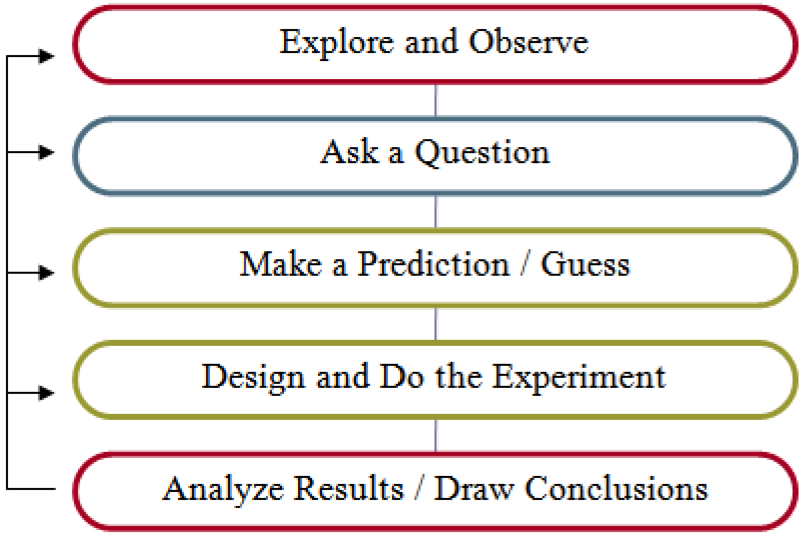
Step Four - Design and Do the Experiment

Testing it out / Conducting the experiment - This is the step-by-step process needed to test the hypothesis. Often an experiment is thought of as something that takes place in a lab. While this can be true, experiments don't have to involve laboratory workbenches, Bunsen burners or test tubes. They do, however, have to be set up to test a specific hypothesis and they must be controlled. Controlling an experiment means controlling all of the variables so that only a single variable is studied. The independent variable is the one that's controlled and manipulated by the experimenter, whereas the dependent variable is not. As the independent variable is manipulated, the dependent variable is measured for variation. It is important that the test is designed to determine if the predictions were correct but it is also important that others are able to repeat the experiment to verify results.

Step Five - Analyzing the Results / Drawing Conclusions

After collecting the data you need to determine what it tells you about your hypothesis. The ultimate goal is to improve the hypothesis and, in doing so, define further experiments which will allow you to answer the original question.

These steps are organized to get scientists, even young ones, through the process but also understanding, as in the diagram below that this is in fact a cycle that can and should be repeated and retried from any and all steps. [6] This is not unlike the adage, if at first you don't succeed, try, try again. And it should be stressed that the success is in doing to experiment and learning new information from it and not necessarily in getting the answer you think it should be.

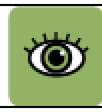
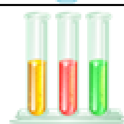


Strategies

To practice working with the scientific method, this unit will use recipes as science experiments to develop an understanding of the process of trying to answer a question. The main objective for each activity is that through testing we will discover whether foods will combine or not combine, or the question being can we separate the ingredients after performing the experiment. The students will talk about what they know, determine the question for the experiment, develop a hypothesis, conduct the experiment and find their results. Does just stirring things together mean they can be separated? If heat is part of the process, will that change the outcome? What happens when we use a blender? Do the ingredients make a difference in taking foods apart? What does mixing together do to dry ingredients? wet ingredients? wet and dry together? Actually doing the experiments will help the students begin thinking about new questions and hypotheses.

The general plan for this unit is to pace it out over eight weeks or roughly one marking period with lessons twice a week. It will begin with an introductory discussion about becoming cooking scientists, sharing family stories they may have of preparing food, what kinds of foods they enjoy, describing foods by shape, color, size, where food comes from. This somewhat unstructured discussion will end with the "announcement" that we are going to be turning our classroom into a cooking laboratory, showing the students some of the tools, equipment and supplies we will be using. It is important to let the students know that this unit will take several weeks and that they will be practicing and learning to work with the tools and equipment before they actually begin working with food. This is the time to introduce an ongoing discussion of kitchen safety and working with food. Also during this first week, there will be two read alouds, Munch, Crunch, What's for Lunch by Janice Lobb and What is a Scientist? by Barbara Lehn which will continue to introduce the unit and our focus of food and science.

In the second week, after a review of the book What is a Scientist?, the students will be introduced to the steps of the scientific method, learning that this process will help them make discoveries. As the steps are discussed, the class will generate a chart together, further defining what each step means and how this whole process helps us keep track of our scientific work. This chart will be a great resource for the students for the duration our unit. They need to create a copy of the chart which will be part of their science journals. Discuss with the students what things can they observe, what questions they might have, can they make a guess about the answer, how should we do our experiment, what will our results be like?

1	Observe	
2	Ask	
3	Guess	
4	Experiment	
5	Results	

Now the students can begin to have some fun working with cooking tools, naming them, and adding them to the science word wall. They will learn and practice proper measuring techniques using cooking equipment - measuring cups and spoons. To provide some background knowledge and experience, the students can practice measuring, mixing and separating ingredients that are not food. One strategy is to collect various objects used daily in the classroom, such as math counters, crayons, erasers, pennies, or any small objects. Put them all in a big tub or bowl, mix them together, and have the students sort, or to use our objective term, separate the objects. It is helpful to have the recipe available, written on the board or on chart paper or at the work tables for the students to follow. For example: 1 cup of counting bears, ½ cup of pennies, 7 crayons and so on depending on the ingredients chosen. This is also an opportunity to suggest new vocabulary for use throughout the unit - pieces, chunks, large, small, hard, solid, liquid.

The next four weeks will be focused on conducting the experiments from the classroom activities. The choices of experiments in this unit are the result of cooking experiences from my classroom. Throughout the school year, as either cultural or seasonal extensions to curricula, food has been used to enhance learning in various subject areas. Because these recipes have been successful for me in the past, I have chosen them to use as an introduction to the scientific method for first graders. Hands-on participation is important for the students. They must be involved and connected by actually doing the experiment, not just watching a demonstration. They need to measure, mix, stir, pour, scoop, cut, and serve. And then of course, eat.

The cooking activities are designed to be completed over two days as sets of comparative experiences: using similar ingredients to create two different outcomes. These experiences will show that they learn as they go and that as scientists conducting experiments, they are making discoveries. The first activity of making trail mix and granola bars will initiate an understanding that making simple changes in ingredients can result in a big change. They will find that separating trail mix after mixing the ingredients together is possible, but that separating the ingredients for the granola bar is not. Each set of recipes will generate this comparison - fruit salad can be separated, smoothies and applesauce cannot; vegetable soup can be separated, vegetable dip cannot; and finally hardboiled eggs (not including the shells!) can be taken apart and put together, scrambled eggs cannot. Generating a hypothesis for each experiment should become a more accessible task for the students; they can begin to make better predictions. The basis for the progression of experiments and recipes is to demonstrate that the scientific method will generate background knowledge and with that allow the students to be better informed scientists with each lesson.

This plan of action is not easily done alone. This unit is a great way to involve families through many avenues. Before the first week even begins, make sure the families are aware of the activities planned for the coming weeks. Encourage them to contribute their time, their equipment, and ingredients if they are able. It is also important that they know you will in fact be safely working with food and that we are making healthy choices for their children to enjoy. This open communication is essential and will result in an added level of excitement and enjoyment for the students. I have been successful with preparing a schedule of activities with family sign-up times to send home with the students. My experience has been that not only do they offer to help on a certain day or for a particular activity but are happy to bring equipment and help supply ingredients for that day.

Science Journals

Children this age have a genuine excitement for big changes, generally because at their young age it is a first experience, or the first one they remember. The more dramatic the experiments, certainly the more memorable they become. Making fun and tasty foods -- applesauce, smoothies, granola bars - that show exciting new forms during the experiment will be exciting for them. As we work through our experiments the students will, as does any scientist, keep track of their data and findings by maintaining a journal of processes and results. This will include illustrations and writing, as they use the generated charts and the word wall as resources.

As the students learn to collect, organize and record data, reading, writing and science will come together. The students will have knowledge and use of food vocabulary, scientific terms to use in their writing, and comprehension to discuss their findings. The journals, of course, will all be age appropriate. Each lesson or experiment will require three pages as follows. Based on student level and ability, they can either choose to write the recipe from the classroom copy or use a prepared printed version for their notebook.

Recipe	Question	Draw the experiment
	Prediction	Results and Conclusion

Page 1 - Recipe

Page 2 - Ask the question and make the prediction

Page 3 - Draw the experiment and write results and conclusion

Measuring

Before any cooking can begin, the students need to prepare with some basic cooking knowledge. This connection to the comparing and measuring curriculum is an exploratory investigation for the students. An introduction to measuring tools should be hands on activities that include practicing using measuring cups and spoons, working with liquids and solids, or wet and dry ingredients. This allows for discovery and experience, initiated by teacher demonstration of measuring techniques. To ensure that everyone has an opportunity for discovery, there will need to be a supply of several sets of measuring cups and spoons, which the students can bring from their own kitchens at home, another way to connect to real life for them.

Ingredients are measured in three different ways: by counting (four apples), by measuring volume (1/2 cup of applesauce) or by weight (a pound of apples). This unit will use only the first two methods but the students should be aware that, when reading recipes, the third method, the weight of ingredients, may be used.

It is most comfortable for the teacher and the students to begin with dry "ingredients" to practice accurate measuring. After covering the work surfaces with newspaper or tablecloths, place out bowls containing bird seed, sand, aquarium rocks, Styrofoam packing peanuts, and other non-food choices for the students to measure with cups and spoons. The reasoning is twofold for these choices - first, it is important to teach the students not to waste food and as this practice will not create anything to eat, we won't be wasting. Secondly, these items, or similar items that are readily available, do not require a monetary investment and will serve the purpose well. So we don't waste food or money to practice these skills!

Explain to the students that when we measure dry ingredients for cooking, everything goes to the top of the cup or spoon, not over or below but just right to the top. To accomplish this exactness, demonstrate that by using the back of a plastic butter knife, you can scrape the excess off the top of the overfilled cup or spoon to get the most accurate measurements. This lesson is designed for practice and should last for about 45 minutes from demonstration to clean up. All students should have an opportunity to try various ingredients to experiment with volume and density, what pours out well and what doesn't and other characteristics that they will observe while they practice.

Using vocabulary such large, medium, small, smaller, etc. instead of precise fractions is enough at this introductory lesson to discuss comparing amounts. This will help them record the day's activity in their science journals, using words and pictures to log in their experience with measuring. This is an important habit for the students to develop, writing down observations and questions, drawing pictures of results and conclusions, and thinking about what they might do next - the scientific method!

The second part of this measuring experience is to have the students use wet ingredients. The goal is the same, filling the cup or spoon to the top, or in the case of a "pitcher" style measuring cup, placing the cup on a flat surface and filling to the proper line then checking by looking at the cup at eye level. It is again important to demonstrate the procedure and allow for practice, in this case is to work on pouring as well as scooping. Keep a supply of paper towels handy and use colored water, a non-sticky ingredient. For variety, make the water choices different colors to keep the interest, putting some in bowls or pans and some in small pitchers to pour into measuring cups. This again is to prepare for working with real ingredients so it is important to practice and have the students feel prepared.

Classroom Activities

Before beginning the classroom activities, remind the students of the importance of handling food safely (Appendix B). As they will be the scientists studying and learning, it is important that the students themselves conduct the "experiment" with assistance from the teachers. Each numbered activity is intended to be covered in two 45-minute lessons. The procedures are extremely consistent to ensure that the students will learn the steps by repeating the process from beginning to end. They will enjoy becoming skilled at knowing how to implement the scientific method.

Activity One - Trail Mix and Granola Bars

Objective: To use the scientific method to determine if the ingredients can be separated after the experiment is complete.

Materials for Trail Mix: raisins, cereal, M&M's, and nuts

Procedure for Trail Mix: Discuss with the students the steps to be completed during the lesson and their (1) background knowledge and experience with separating food. What do they already know? After reading the recipe, have the students write in their journals the (2) question we are testing - can we separate the ingredients after we mix them together? They need to then state a (3) hypothesis which will be if we mix these ingredients together, then we will either be able to separate them or we will not be able to separate them. Now the (4) experiment can be done. The students will mix ¼ cup each of raisins, cereal, M & M's, and nuts in their individual bowls. On a paper towel, they will separate their ingredients to show their test. The students can determine the (5) results of their experiment and determine if their data supported their hypothesis. The students need to record their scientific method process in their journals making sure each step included. They can enjoy their trail mix with their friends!

Objective: To use the scientific method to determine if the ingredients can be separated after the experiment is complete.

Materials per group for Granola Bars: 2 ½ cup quick rolled oats, ½ cup Rice Krispies, ¼ cup shredded coconut, ½ cup M&M minis, ½ cup brown sugar, ½ tsp salt, ½ cup butter, softened, ¼ cup honey, ½ tsp. vanilla, 8x8 pans, knife, small plates

Procedure for Granola Bars: Discuss with the students the steps to be completed during the lesson and their (1) background knowledge and experience with separating food. What do they already know? After reading the recipe, have the students write in their journals the (2) question we are testing - can we separate the ingredients after we mix them together? Talk about what is different in this experiment and how they are changing their thinking. They need to then state a (3) hypothesis which will be if we mix these ingredients together, then we will either be able to separate them or we will not be able to separate them. Now have the students perform the (4) experiment. This activity should be done in groups of four to six students. Add all of the ingredients and mix together until combined. Press into a square 8×8 greased pan. Bake at 350° for 18-20 minutes. Cool for 10 minutes and score into bars. Let it set completely and then cut into bars. After distributing a granola bar to each student they will determine if they can separate or not separate the ingredients or (5) analyze the results, draw conclusions. The students will record their process and results in their journals and enjoy their granola bar.

Activity Two - Fruit Salad, Fruit Smoothies and Applesauce

Fruit salad and fruit smoothies can be made in all in one day or over two days. Having the students cut up twice as much fruit will allow for both experiments to be done in one day.

Objective: To use the scientific method to determine if the ingredients can be separated after the experiment is complete.

Materials for Fruit Salad: bananas cut in halves or thirds, pears, quartered, apples quartered, kiwi peeled and halved or quartered, strawberries, blueberries, melons, peeled, seeded and quartered, any other fruit choices, paper plates, spoons, plastic knives, cups, (ripe, soft fruit works best as it is easier to cut with plastic knives)

Procedure for Fruit Salad: Discuss with the students the steps to be completed during the lesson and their (1) background knowledge and experience with separating food. What do they already know? After reading the recipe, have the students write in their journals the (2) question we are testing - can we separate the ingredients after we mix them together? Talk about what is different in this experiment and how they are changing their thinking. They need to then state a (3) hypothesis which will be if we mix these ingredients together, then we will either be able to separate them or we will not be able to separate them. The students can perform the (4) experiment. Before working with the fruit have the students wash their hands. Each student needs a paper plate, knife, cup, and spoon. Using the paper plate as a cutting board, distribute three or four choices of fruit to each student for them to cut into bite-sized pieces. These pieces go into the cup for a fruit cup snack. Their plate will be empty which is where they will now separate the ingredients. (5) Analyze the results, draw conclusions. The students will record their process and results in their journals. Now they can eat their fruit snack!

Materials for Fruit Smoothie: bananas cut in halves or thirds, pears, quartered, apples quartered, kiwi peeled and halved or quartered, strawberries, blueberries, melons, peeled, seeded and quartered, any other fruit choices, paper plates, ice, spoons, straws, plastic knives, cups, blender (again ripe, soft fruit works best as it is easier to cut with plastic knives)

Procedure for Fruit Smoothie: Follow the same procedure for fruit salad for Steps 1, 2 and 3. Step 4 is repeated up until the separating activity. Instead of separating the results, the students will, in groups of four, pour their fruit into a blender, adding several ice cubes to help with blending the fruit. A small amount of water may need to be added as well. The results will be poured back into the cups to (5) analyze the results and draw conclusions. The students will record their process and results in their journals and drink their fruit smoothie!

Materials for Applesauce per group of four: 4 medium apples, ½ cup water, ¼ cup sugar, electric burner, stock pot, large wooden spoon, cinnamon, cups, plates, plastic knives and spoons.

Procedure for Applesauce: Discuss with the students the steps to be completed during the lesson and their (1) background knowledge and experience with separating food. What do they already know? After reading the recipe, have the students write in their journals the (2) question we are testing - can we separate the ingredients after we mix them together? Talk about what is different in this experiment and how they are changing their thinking. They need to then state a (3) hypothesis which will be if we mix these ingredients together, then we will either be able to separate them or we will not be able to separate them. Now the (4) experiment can be done. Before working with the ingredients, have the students wash their hands. Peel, core, and slice apples. Cut the apple slices into small chunks using paper plates as cutting boards. Put the apples in the pot with the water and simmer for 15 minutes while stirring. Add sugar and a few sprinkles of cinnamon. Wait until applesauce cools. Scoop serving portions into cups for students to (5) analyze the results and draw conclusions. The students will record their process and results in their journals.

Activity Three - Vegetable Soup and Vegetable Dip

Objective: To use the scientific method to determine if the ingredients can be separated after the experiment is complete.

Materials for Vegetable Soup: 4 large can of chicken broth, baby carrots, frozen peas, small pasta like orzo or ditanili, large stock pot, can opener, ladle, cups, electric burner or access to a stove top, spoons, cups, strainer, large bowl

Procedure for Vegetable Soup: Discuss with the students the steps to be completed during the lesson and their (1) background knowledge and experience with separating food. What do they already know? After reading the recipe, have the students write in their journals the (2) question we are testing - can we separate the ingredients after we mix them together? Talk about what is different in this experiment and how they are changing their thinking. They need to then state a (3) hypothesis which will be if we mix these ingredients together, then we will either be able to separate them or we will not be able to separate them. Now the (4) experiment can be done. Before working with the food have the students wash their hands. Open the cans of broth and pour in the stock pot. Bring it to a boil and add the carrots and pasta. Boil for about 5 minutes, and add the peas. Remove the soup from the heat and let sit for a few minutes. Ladle the soup into the cups making sure all ingredients are in each cup cups for students to (5) analyze the results and draw conclusions. The students will record their process and results in their journals. Note: set aside 1-2 cups of cooked vegetables for the next recipe.

Materials for Vegetable Dip: 1 cup of reserved carrots and peas from soup, 2 cups sour cream, items dipping (carrots, celery, crackers, breadsticks), food processor, large bowl, wooden spoon, paper plates

Procedure for Vegetable Dip: Discuss with the students the steps to be completed during the lesson and their (1) background knowledge and experience with separating food. What do they already know? After reading the recipe, have the students write in their journals the (2) question we are testing - can we separate the ingredients after we mix them together? Talk about what is different in this experiment and how they are changing their thinking. Remind them that they will be using ingredients from the soup to complete this recipe. They need to then state a (3) hypothesis which will be if we mix these ingredients together, then we will either be able to separate them or we will not be able to separate them. (4) Place carrots and peas in food processor and mix together until well blended. Put sour cream in large bowl. Add carrots and peas and mix together with wooden spoon. Put spoonful of dip on plates for students to (5) analyze and draw conclusions. The students will record their results in their journals and enjoy their dip with vegetables and crackers.

Activity Four - Hard boiled eggs and Green Eggs and Ham

Objective: To use the scientific method to determine if the ingredients can be separated after the experiment is complete.

Materials for Hard Boiled Egg: eggs (one per student), stock pot, slotted spoon, large bowl, water, electric burner, paper plates, plastic knives

Procedure for Hard Boiled Eggs: Discuss with the students the steps to be completed during the lesson and their (1) background knowledge and experience with separating food. What do they already know? Have pictures of eggs in the shell and eggs cracked open in various states to show the inside of an egg, that there are two separate parts, the white and the yolk. After reading the recipe, have the students write in their journals the (2) question we are testing - can we separate the ingredients after we mix them together? Talk about what is different in this experiment and how they are changing their thinking. They need to then state a (3) hypothesis which will be if when we work with this ingredient (the egg), then we will either be able to separate them or we will not be able to separate them. Now the (4) experiment can be done. Before working with the food have the students wash their hands. Place the eggs in the stock pot with enough cold water to cover them. Bring the water to a rolling boil. At this point, turn off the heat and remove the pot. The eggs need to sit in the hot water for 15 minutes to finish cooking. Using a slotted spoon put the eggs immediately into cold water; this will help with peeling the shells. After they are cooled and can be peeled, pass the eggs out to each student to have them peel over a paper plate. Using their plastic knives, they can cut the egg in half and (5) analyze the results and draw conclusions. The students will record their process and results in their journals.

Materials for Green Eggs and Ham: eggs (one per student), green food coloring, sliced ham (or turkey ham), large bowl, whisk, skillet, wooden spoon, non-stick spray or butter, paper plates, plastic knives and forks

Procedure for Green eggs and Ham: Begin this lesson by reading Green Eggs and Ham by Dr. Seuss and discussing how you might make green eggs. Review the previous experiment with eggs to determine their (1) background knowledge and experience with separating food. What do they already know? After reading the recipe, have the students write in their journals the (2) question we are testing - can we separate the ingredients after we mix them together? Talk about what is different in this experiment and how they are changing their thinking. They need to then state a (3) hypothesis which will be if we work with these ingredients together, then we will either be able to separate them or we will not be able to separate them. Now the (4) experiment can be done. Before working with the food have the students wash their hands. Crack the eggs into a large bowl and use the whisk to scramble them. Add several drops of green food coloring and mix well. Spray the skillet with non-stick spray or melt the butter, then pour in the eggs and stir while the cook. Place one scoop of eggs each plate adding a small piece of ham. Students will (5) analyze and draw conclusions. The students will record their results in their journals.

Notes

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[1] Stephen S. Carey. A Beginner's Guide to the Scientific Method. (Wadsworth Publishing, 1998)

[2] Chip Wood. Yardsticks: Children in the Classroom Ages 4-14 (Northeast Foundation for Children, 2007)

[3] http://science.howstuffworks.com/scientific-method.htm (accessed May 23, 2009)

[4] Biology4Kids. http://www.biology4kids.com/ (accessed June 2009)

[5] http://science.howstuffworks.com/scientific-method.htm (accessed May 23, 2009)

[6] http://www.sciencebuddies.org/ (accessed May 2009)

Teacher Resources

Barnham, Peter. The Science of Cooking, Springer, New York, 2001.

This book presents great straight-forward information on the physics and chemistry of food and cooking. There are many anecdotes and suggested experiments to illustrate scientific principles.

Carey, Stephen S., A Beginner's Guide to the Scientific Method. Wadsworth Publishing, 1998.

This book provides accessible reading for the understanding of the scientific method. Written by a philosophy of science professor, the first chapter in particular is helpful with a great overview of the logic and reasoning for using the scientific method.

Cobb, Vicki and David Cain. Science Experiments You Can Eat, HarperCollins, 1984

This is a great kitchen chemistry book for teachers and students that explains through experiments why cakes rise, how sugar turns into caramel, and what makes popcorn pop. Easy to understand and fun to use for reference.

D'Amico, Joan and Karen Eich Drummond. The Science Chef: 100 Fun Food Experiments and Recipes for Kids, Wiley, 1994.

This cooking resource for students is arranged by topic in the form of a question, such as Why Does Toast Brown? An appropriate experiment is suggested followed by several recipes to create and enjoy. The first chapter, which covers cooking skills and kitchen safety, is helpful background information for teachers and students.

Hauser, Jill Frankel. Science Play!: Beginning Discoveries for 2- To 6- Year Olds, Williamson Publishing, 1998.

This functional teacher resource using basic household materials encourages young students to get right in and participate in active learning. The Change It chapter includes some chemistry in the kitchen activities useful for this unit.

Hillman, Howard. The New Kitchen Science: A Guide to Know the Hows and Whys for Fun and Success in the Kitchen, Mariner Books, 2003.

Straight-forward language and a logical sequence make this a quick-find resource for cooking methods for various foods, with an added piece of mistakes that cooks make, discussing for example why the eggs got rubbery. These mistakes are excellent examples of using the scientific method, how mistakes lead to retrying and finding the why and how.

McGee, Harold. On Food and Cooking: The Science and Lore of the Kitchen, Scribner, New York, 2004.

This complete text serves as a bible for cooks and food lovers. It provides an excellent foundation for the understanding of the chemistry of foods and cooking in "cook-friendly" language

McPherson, Guy. "Teaching & Learning the Scientific Method." The American Biology Teacher. 63(4):242-245. 2001.

Meredith, Susan. Science in the Kitchen, Usborne Books, 2007.

Great photographs of several kitchen experiments leveled for first and second grade readers making it appropriate for independent reading.

Muller, Eric Paul and Eldon Doty. While You Are Waiting for the Food to Come: A Tabletop Science Activity Book: Experiments That Can Be Done at a Restaurant, the Dining Room Table or Wherever Food is Served, Orchard Books, New York, 1999.

Too challenging for students to read but great for teachers to get ideas for science experiments related to food and eating. The organization of the book is fun using the courses in a meal for chapters and cooking terms for conducting the experiments - good example for connecting scientific method to everyday activities.

Wolke, Robert. What Einstein Told His Cook, W. W. Norton, New York, 2002.

A witty and clever resource, this book explains the science behind the foods we eat and the tools we use to prepare them. Its question and answer format that makes it easy to locate directly from the table of contents the subject you want to research. It provides a great foundation for some basic cooking knowledge in a clear yet entertaining way.

Wood, Chip. Yardsticks: Children in the Classroom Ages 4-14, Northeast Foundation for Children, 2007.

This book provides clear descriptions of developmental traits of young children. A resource for helping to better understand the students you are working with.

Web Resources

Biology4Kids. http://www.biology4kids.com/ (accessed June 2009)

How Stuff Works "Science." http://science.howstuffworks.com/ (accessed June 2009) Explanations through text and video demonstrations.

National Science Teachers Association. http://www.nsta.org/ (accessed May 2009). Information on science education in our schools.

Science Fair Projects, Ideas, Answers and Tools for Serious Students. http://www.sciencebuddies.org/ (accessed May 2009) Comprehensive site as listed in the title.

The Scientific Method Today. http://www.scientificmethod.com/ (accessed May 2009) Scientific method newsletter written and compiled by Norman W. Edmond.

Student Resources

Glass, Susan. Analyze This: Understanding the Scientific Method (How to Be a Scientist), Heinemann, 2006.

Students will learn through anecdotes how the scientific method has changed our lives. It advises on planning, designing and conducting scientific investigations. This is likely too advanced as an individual text for most young readers but great to read aloud for background knowledge.

Glass, Susan. Prove It: The Scientific Method in Action (How to Be a Scientist), Heinemann, 2007.

Here is another great book in the series that brings the scientific method "to life" for students helping them connect the process to their own questions.

Kramer, Stephen and Felicia Bond. How to Think Like a Scientist, HarperCollins, 1987.

A great read-aloud chapter and reference book for first and second grade. It uses comical real life examples to help children see the benefit of using information to get to the answer as opposed to relying what others tell you or what you would like it to be.

Lehn, Barbara. What is a Scientist?, Millbrook Press, 1998.

First grade students from Willard School in Concord, MA are photographed performing science experiments in their classroom. Page by page the list of what scientists do grows with examples by the children. National Science Teachers Association winner for outstanding science trade book for children.

Lobb, Janice. Munch, Crunch, What's for Lunch, Snapdragon Publishing, 2000.

A fun look at the science of food and explains much of the vocabulary used to discuss food. Lots of food facts with many jokes throughout.

Classroom Materials

Science word wall - mix, stir, pour, scoop, cup, measure, separate, taste, experiment, food, data, compare, pieces, chunks, large, small, hard, solid, liquid.

Ingredients for recipes - Cheerios, Rice Krispies, quick rolled oats, shredded coconut, M&M minis, raisins, sugar, brown sugar, salt, butter, honey, vanilla, cinnamon, bananas, pears, apples, kiwi, strawberries, blueberries, melons, chicken broth, baby carrots, frozen peas, orzo or ditanili, eggs, green food coloring, ham, sour cream, non-stick spray, crackers

Cooking and serving supplies - cups, straws, paper plates, plastic knives, forks and spoons, paper towels, napkins

Cooking utensils - wooden spoons, ladle, can opener, rubber spatula, slotted spoon, whisk

Cooking equipment - electric burner or stove top, oven, blender, food processor, stock pot, large bowl, strainer or colander, skillet

Appendix A: Implementing State Standards

In accordance with the State of Connecticut Science Curriculum Standards, after completing this unit, the students will be able to measure, compare and describe different objects using standard and non-standard measuring tools. Students will choose appropriate tools for measuring the volume of liquids and solids.

Appendix B: Food Safety

This is a unit that includes food that will be eaten with students. Some students have had experience in the kitchen with families or others but to be certain that they all have this important information these are some basic rules include for safety and hygiene for everyone involved in your experiments: keep your hands clean, wash them often in soapy water, don't lick your fingers while preparing food. Always begin by reading the recipe through completely; be sure you understand the instructions. Gather all your ingredients, utensils, and pans that you need before you start. Hot mixtures can burn quickly. Use hot pads when removing food from the oven or microwave, and never lick or handle hot food. If you hurt yourself, tell an adult immediately. And have a first aid kit in the classroom or kitchen. Make sure that pot handles are turned away from the front of the stovetop. If they're hanging over the front of the stove, the pot with its hot contents could be knocked onto the floor, and you. Never taste uncooked food. Don't lick the bowl or the mixing spoon. And be careful when tasting hot food. Foods from the oven should cool for at least 10 minutes for entrees and side dishes, 30 minutes for breads, and 20 minutes for cookies. If the recipe says to cool completely before serving, follow that instruction. When you're done cooking, clean everything up. That means wipe up spills, place utensils and bowls away, and put ingredients away. Before you leave the kitchen, make sure all appliances are turned off and are clean. Unplug mixers and food processors.