## Discovering Matter, Crystals, and Reactions

*Esther Donat-Mas*
Piney Point Elementary School

### INTRODUCTION

As I thought of ways of writing my unit, I asked my self what I wanted to discover. What will the kids want to discover? Wouldn't it be better to start by discovering the way kids learn to make it much easier when it comes to teach?

When I first came to Houston to teach, I never realized I would find such a variety of ways to work with the students and to give them an opportunity to learn about amazing things they would never imagined that happen. That is what we discover in science and especially in chemistry, or what was once called Alchemy. The first sorcerers used to make experiments to find the sorcerer's stone, a magic substance that would turn any mineral into gold.

They would also experiment in their laboratories and spend hours trying to reproduce the same steps in a process to get similar results in obtaining a new mineral or compound they had previously discovered.

This is the way they finally got, by Mendeleyev's time, to the periodic table, and they are still discovering substances every day to complete this Russian chemist's work. In a similar approach, children learn every day in the classroom, and I like to think of them as alchemists as we prepare to make another experiment in the science classroom.

By the time children begin school, they have probably developed ways of learning that run more along the lines of some intelligences than others. Although it is true that each child possesses all eight intelligences by which they learn and can develop all eight to a fairly high level of competence, children seem to begin showing inclinations from a very early age.

Thomas Armstrong has long studied the way children learn and he has established through his studies that there are eight different types of intelligence:

- Intra-personal: meditates and reflects about important questions.
- Naturalistic: loves to learn through nature, living systems and projects.
- Musical: is always singing and whistling and learns by putting things to songs.
- Interpersonal: learns by getting involved in activities
- Spatial: is good artist. Enjoys illustrated books and visualizing.
- Bodily-kinesthetic: learns by hands-on experiences and games.
- Linguistic: enjoys reading, word games and talking.
- Logical-mathematical: enjoys brainteasers and can easily compute numbers.

Children who learn in a naturalistic way or bodily kinesthetic way are more likely to be gifted and talented in science. We can see that through their natural curiosity and desire to know more of what is going on all around them, outside and especially with living organisms.

Teachers should take advantage of that wanting to know more to extend the children's knowledge and nurture their willingness to absorb these concepts. This type of learner enjoys more observing, spending time in the field and looking for bugs, exploring new ways of getting things done, or just reading about natural sciences in their free time.

From my experience I would like to point out the case of Erick. This was one of my most challenging students in a first grade environment. He learned from a naturalistic approach and was also bodily-kinesthetic. This means he loved to learn through nature, living systems and projects but also that he learned by hands-on-experiences and games.

He was not hyperactive but was being exposed to a very unstructured environment at home. This is another factor teachers have to deal with nowadays in public schools, where the families of the students belong to a very socially and economically depressed community within the inner city. We need to provide children with routines and safety rules so they can deal better in their future life events.

Erick was always sticking his nose on the aquarium. He used to listen very carefully when we spoke about any scientific matter, especially when it had to do with the fish in the water. Then he would ask inquisitive questions about the snails that had appeared in the habitat by spontaneous generation, taking care that they would not take all the oxygen the fish needed and reminding me to clean the aquarium. Once I noticed his interest, I had him cleaning the water and getting any waste with the net. This seemed to be his favorite time during the day.

However, he liked to play a lot and wouldn't listen in other areas that were not science. He used to bother his peers and always found something better to pay attention to than his teacher. Apart from this, if he was caught not being good, he would turn moody and stayed like that, not seeming to realize he should have been listening and focused on instruction.

The best way to identify students' most highly developed intelligences is to observe how they *misbehave* in class. The bodily-kinesthetic student will be fidgeting, and the naturalistically engaged student might bring an animal to class without permission! These students are telling us through their behavior: "This is how I learn, teacher, and if you do not teach me through my most natural learning channels, guess what? I'm going to do it *anyway*."

This was the case of Erick, and it is a perfect example of why teachers should get involved in hand-on experiments to teach science that is also a perfect way of keeping the students busy and not misbehaving. Therefore, I had to find a way to get the maximum of Erick's way of learning as I found he was my top science student and was missing something due to his severe attention deficit.

Another good observational indicator of students' learning style is how they spend their free time in school. In other words, what do they do when nobody is telling them what to do? Bodily-kinesthetic students might gravitate towards hands-on building activities, and naturalistically inclined students toward the gerbil cage or aquarium. Observing kids in these student-initiated activities can tell a world about how they learn most effectively.

We can plan and teach to the multiple intelligences by showing products made by students in the school that required the use of each of the intelligences. Examples might include three-dimensional projects (body smart); cooperative projects (people smart); individual projects (self smart) or simulations of ecosystems (nature smart).

The Multiple Intelligence teacher provides hands-on experiences, whether this involves getting students up, passing an artifact around to bring to life the material studies, or having students build something tangible to reveal their understanding. Where it's possible, the teacher should create opportunities for learning to occur through living things or in the midst of the natural world. The teacher who makes dramatic gestures as she talks (bodily –kinesthetic), asks questions that invite spirited interaction (interpersonal), and includes references to nature in their lectures (naturalist), is using Multiple Intelligence principles within a traditional teacher-centered perspective.

Here are some problem-solving strategies that could be used by students in a school setting:

- bodily-kinesthetic intelligence: using one's hands, fingers or whole body to solve problems
- naturalistic intelligence: using analogies from nature to envision problems and solutions.

Another important factor during my years of teaching was the fact that students were Spanish speaking and had had few experiences outside with the world surrounding them in either their country of origin or here in the United States.

I encountered here a double challenge in trying to teach these children earth science or physical science. Most of the concepts in this area are universal when the students get to middle or high school, but in the elementary class the vocabulary has to be taught, yet with ESL methods. In a bilingual classroom it is very important to incorporate these skills as soon as possible (first or second grade) so kids become familiar with the terms and lose their fears against the foreign language.

On the other hand, these same scientific words are only used in a scientific setting, like a laboratory in a enrichment period or in the science classroom. You don't get the chance to make an experiment in the afternoon when you get home every day and practice the vocabulary with the support of your parents in the kitchen. Moreover, many of the parents do not have enough knowledge or culture to practice or help their kids at home, with their homework, not even the basic core subjects like reading, mathematics or language arts. So what about science? I would really like to approach this issue so that science is not displaced and becomes the forgotten island of the instructional day in today's schools.

The only way to learn about science and communicate in an appropriate scientific language is to have the kids practice and use these words when they make statements about their experiences in and out of the classroom. Otherwise they will forget them, and it is really hard to build up basic concepts in any area if they do not know the foundations of science.

When I was young at school in Spain, we did not have even half of the materials and resources public schools can access in this country. We should take advantage of this and use them, or improvise to get them and have the kids realize the importance of the matter when connecting our experiences in the classroom to the real life and their exposure outside the education center.

**Background**

As a teacher I intend to do something about the fact that students in our schools often do not like science. They are immersed in a chemical world and they don't like the study of it? No. When you mention chemistry people sometimes cringe? It shouldn't happen. They remember classes in school that were horribly boring. They remember memorizing lists of vocabulary words and following long lists of recipe-type procedures that meant nothing to them.

This problem is compounded in the Houston area by the fact that 25% of our population is not native to the U.S. and 42% of our students live below the poverty level. These language and economic barriers fight against the study of science because science has a language that has to be learned and it also has a wealth of physical experiences that contribute to its understanding. If your parents did not have time to take you to the park because they were working two jobs you may not have experienced the see saw that is the quintessential 1$^{st}$ class lever. Or if you didn't have a yard you may not have had a chance to dig in the dirt and make mud pies and manipulate the natural realm in such a way as to become familiar with it.

In school it becomes essential that we give our students many opportunities to see, touch, taste, hear and smell nature so as to discover the processes at work. As an educator I want to nurture and foster the natural curiosity my students bring to the classroom. Since I teach first grade, my goal is to start small, introducing my students to ideas like the changes in state that matter undergoes as energy is added. Allowing students to watch and measure the temperature as a beaker of ice on a hot plate changes into a beaker of water and then into an empty beaker because all the water has entered the gaseous phase is something students may have watched at home, but then again they may not have because pots are often closed and cannot be viewed. Encouraging students to use their senses as a gauge for what is happening in the world around them is perhaps a simple concept but one that is often ignored because it takes time and effort to set up situations in which this skill can be developed.

First graders may not be able to understand exactly what a chemical change means at a molecular level but they can certainly see with their eyes and draw conclusions as a result of seeing that changing ice into water is a reversible process and therefore a physical change whereas frying an egg is not a reversible change and is therefore a chemical change because new substances have been formed that are quite different from the substances that were used in the beginning. Mixing sand and water together is reversible; the water can be evaporated and the sand reclaimed. Students can feel the sand before and after. They can smell it and touch it. They can let nature speak for itself. They can decide based on their own senses and experiences whether a new substance has been formed or not.

Allowing children time for this kind of learning bothers some people because they are worried about “covering” enough material. I would counter that real science learning cannot take place without it because the realm of science is the realm of the senses and without sense data there can be no progress in understanding the universe and how it works.

No matter what experiences children bring with them to the study of science; it is usually true that they know more science than we think they know. Students know that jumping from the top of the building is not a good idea whereas jumping from the fifth step is a survival experience. Even though the laws of motion and the laws of gravity have not been formally introduced to them, they have already, through trial and error, gained an appreciation for these laws. They began learning them as toddlers and have refined their knowledge with each passing year.

Likewise in chemistry, children can appreciate the difference between eating a gel (Jell-O), a crystalline solid (hard candy), a liquid (Kool-aid) and breathing air. They can relate to what they have experienced, and in my unit I am planning ways to enhance their experiences and to help them think about their experiences in a scientific way, making predictions and then using their senses to determine the validity of their predictions.

First graders can understand the concept of matter. They already have an appreciation of the concept of matter because they have experienced the reality of touching and lifting a metal rod for example. The metal rod has a lot of matter in a small space. On the other hand, a bottle of air has very little matter in approximately the same amount of space.

It is also possible to help young children verbalize a concept that they have already witnessed. The fact that matter changes if you add energy to it is not a foreign concept to them. Children change when you add energy. Give them big doses of energy-rich compounds like sugar and you will see them change before your very eyes. They will begin to flow around the room at a more rapid pace. Likewise if you add energy to water, it will begin to flow more rapidly. Ice that is put onto an energy source, like a hot-plate, will begin to flow around in its container. It will begin moving more and more rapidly the more energy you supply to it. It is important to bring a hot plate to school, or to use a Bunsen burner or an alcohol burner to serve as a source of energy, in this case, heat energy. Children need to *see* how water responds to a continuous supply of energy.

The students can listen to the vocabulary of science if they are looking at a real thing, like water changing state from a solid to a liquid to a gas. If you just tell students that matter can change its state, they will not learn anything, but if you sit around a boiling pot of water and say, "Look! The water molecules are getting very excited as they absorb the heat. They are moving around and around in the beaker and some of them are moving so fast they are escaping from the beaker altogether. Look at this. Water gets moving when energy from heat is supplied. Look at that water go!! Wow. I wonder if the same is true for people. Take off your shoes and show me how you would walk across the floor if it was very, very hot. You would move quickly, wouldn't you? Energy is always required if motion changes. You will get tired and need more energy if you run across the floor quickly."

"Water will get 'tired' and stop bubbling if we remove the energy source, the hot-plate. You will get very tired and stop moving if you stop providing yourself with energy from food."

"Let's try it. Let us take the beaker off of the hot-plate. Look. The water is slowing down. It quit bubbling and rolling. Let's put it back on the energy source. It needs energy so it can move fast. Now let's watch what happens from start to finish. Let's start with a fresh beaker of water that is very cold. We call very cold water ice. Tell me what you think will happen if I put the beaker of ice onto the energy source, the hot-plate. The water is moving very, very slowly in the ice. It is moving so slowly we cannot see the motion with our eyes. Matter that is moving really, really slowly (on an atomic or molecular scale) is said to be solid. Ice is a solid because we cannot see the tiny particles of water moving. Now look, the water is starting to move more rapidly. Heat energy is causing the water particles, tiny pieces of water are called molecules of water, to move more rapidly. When a substance gets more energy it can then move more quickly and the state or condition of the matter changes and becomes liquid. When water has enough energy to be a liquid, it can flow and it can change its shape. If we pour the liquid water into a different container like this one (actually pour the water into a different container), notice the water molecules just flow around in the new container and take the shape of the container. Now let's pour the liquid water back into the beaker and set it back on the hot plate so it can absorb more heat energy. I can't wait to see it start moving around even faster and bubbling and boiling and even jumping right out of the container."

You can talk science to students who are very young if their attention is focused on real things. Today the object to be observed may be a beaker of water in the various states as it absorbs energy from a hot-plate. Yesterday they may have had their attention focused on three balls of equal volume with different densities. Balls of this type can be purchased from the hobby store, or if necessary from an industrial supplier for the metal ball bearings. Tomorrow it may be the day to let children predict what will happen if we add vinegar to water.

For first graders I will introduce the concept of matter and their different states. I would like to make different experiments with the children to explore the concept of dissolving, solution, and change of different states of matter: solids and liquids into gels.

First graders could be introduced to the process of discovery by experimenting with liquid solutions and coming up with different substances. It is crucial at this age to start to distinguish between chemical and physical changes. Liquids and solids are both observed in the curriculum, as states of matter present in reality. Our kids know both take up space. However, one of the differences is that while solids have their own shape and size, liquids do not have a shape of its own; they take the shape of the container they are in. Now, what happens when we put them together—either a liquid with another liquid or a solid with a liquid? What is the result? We could analyze two liquids, for example water and vinegar and see that when mixed together they have the same volume. Volume is a physical property because conserves its quantity. But what about the quality? We have come up with a mixture where the acid, vinegar, dissolves into water, and we have a new liquid, substance, with different composition and chemical properties. Does it change the water at all? What is different about the water with vinegar in it and the water that does not have vinegar in it? Vinegar is a relatively harmless liquid that can be given to small children without much fear of accident.

They may remember having to eat vinegar on a salad. They may have eaten pickles that were preserved in vinegar. White vinegar looks a lot like water when it is in a glass. Students can observe this. It does not SMELL like water, however. Students can observe that. How does vinegar act when it meets other chemicals? Does it act like water? Students can observe the way water acts when it is added to baking soda. They can compare this behavior with how vinegar acts when it is combined with baking soda. They may look the same, but they sure don't smell the same, and they do not always act the same. They certainly don't taste the same. Both are made of matter, but they are quite different substances. Substances have different properties. First graders can understand that, but only if they have their attention focused on real things.

Therefore, my unit will teach these differences through making crystals and gels. First of all, I will teach the concept of dissolving and mixtures or solutions from a naturalist and visual approach. Children need to experience science in a hands-on way at all times. To activate prior knowledge we can start asking them to wonder about what would happen to the solid in the liquid. They could give examples from their lives of solids dissolving at home in the kitchen. At this age kids are very close to their parents and observe carefully the cooking that it is going on at home. So let's take advantage of that.

Simple acids, like vinegar, or salts even other condiments (saffron or pepper) give us a perfect setting to perform our experiments. Once we have made clear the differences between a solid and a liquid and have been exposed to different ways of dissolving a solid into a liquid (salt-water, pepper-water, or saffron-water) or a liquid into a liquid (vinegar-water, oil-water) we can challenge the students to use the concept and process skills developed to understand a different dissolving situation –one that takes place more slowly.

Another example of a concept that students encounter is exploring mixtures and solutions. Students could mix salt and pepper in water, and observe most of the salt dissolve while most of the pepper does not. All of the salt *should* dissolve, if the stirring is enough. In practice, however some students tire of stirring, observe that there are still a few grains of salt visible in their mixtures, and conclude that this small amount will not dissolve. Conversely, while pepper would seem to be insoluble in water, there must be some water-soluble component in pepper, as the solution turns slightly brown. Later, the water is evaporated from the solution, leaving re-crystallized salt behind.

Gelatin, unlike salt, sugar, or many other solutes, is a large protein and therefore has special properties. Because of these special properties, the gelatin forms a syrupy liquid when first dissolved and then forms a gel. This occurs because the long molecules in the gelatin mix to form a large mass of tangled strands that might be compared to a pile of spaghetti. So when very little liquid is used, the gel is very dense, and, in time, most of the water evaporates, leaving behind a hard, clear, disk. In this case, the molecules of gelatin are still linked in a large matrix, but due to the loss of water, a solid with less flexible properties is formed.

The process by which gelatin gels is obviously more complicated than just plain dissolving – too complicated for most students of this age to understand. My students will understand best what they can see for themselves. The observable properties of gelatin powder and warm liquid, and what they notice when the two combine, provide the basis for their understanding of dissolving. The changed results (either a cup of jiggly gelatin or a clear, hard, disk) help them understand that the gelatin does not really "disappear" when it dissolves, but remains in the liquid in another form (Barber 45-47).

## Content

Dissolving is a process in which a solid, when mixed with a liquid, seems to disappear. The solid is pulled apart by the liquid into small pieces, too tiny to see. The dissolving solid is referred to as the ***solute***. The liquid into which the solid dissolves is called the ***solvent***. The mixture of the liquid and the dissolved solid is called a ***solution***. Solids that won't dissolve in a particular liquid are referred to as ***insoluble*** in that liquid. Gases can also dissolve in liquids, as in the case of soda pop, where carbon dioxide is dissolved in flavored water.

A crystal is a solid substance with a regular geometric shape. Each type of crystal has its own shape. Salt crystals are cubic. When students look at table salt, however, they will often observe shapes that are more rounded than cubes or that look oblong. This is because the salt crystals fracture and their corners get worn down over time. However, when a salt crystal first forms, it will always be cubic. The shape of a crystal reflects the shape of a molecule. Just like salt crystals, salt molecules are cubic.

While crystal *shape* remains constant, *size* varies according to the conditions under which a crystal is formed. The longer the amount of time a crystal has to form, the larger the crystal becomes. When a crystal "grows," layers are added to layers on what is referred to as the original crystal unit cell. This is why "seeding" a solution will result in the formation of more and bigger crystals – a single salt crystal will provide a base on which the subsequent layers are built (Barber 42-44).

## LESSON PLANS

### Lesson 1

Physical change: <u>*Balls that float?*</u>

This lesson will determine if all three balls displace the same amount of volume if placed into water.

#### *Observation*

Students may begin an investigation with a question, an observation, or a specific purpose. First graders choose to express this in a picture format. They can touch and lift a metal ball that is 1 inch diameter. Then they can touch and lift a wooden ball that is one inch in diameter followed by a Styrofoam ball that is one inch in diameter.

#### *Hypothesis*

Here is the question: Will the different balls sink or float if we put them into the water?

Students should make a prediction prior to any procedures being completed. To do this students should have a reasonable idea of what the activity or project entails based on prior knowledge or classroom discussion of the content.

The experience of touching and lifting three balls that are exactly the same volume is something first graders can appreciate. What is the difference? Is there a difference? Is the color different? Maybe we will have to paint them all the same color. What is different? If not the color, then what? Are the balls the same or are they different? After first graders have struggled to put into words the difference between Styrofoam, metal and wood, then a teacher can begin to help them develop the vocabulary to deal with the differences.

Students should also prepare or have a list of what they will need and what will be done.

***Materials***:

- 3 transparent measuring cups
- water
- metal ball (1-inch diameter)
- wooden ball (1-inch diameter)
- Styrofoam ball (1-inch diameter, non-pourous)

***Procedures:***

- Fill all three cups with the same amount of water.
- Place them in a row.
- Place the Styrofoam ball into water.
- Place the wooden ball into water.
- Place the metal ball into water.
- Measure the rise in the water level.

***Results***

Students then compile various data sets, to formulate results. Draw a picture of what happens. Compare what happens. Which one floats? Which one goes to the bottom?

Students should insure that this information is labeled.

- 1st the Styrofoam ball floats or displaces a little bit of water.
- 2nd the wooden ball floats too but sinks a little bit more than before.
- 3rd the metal ball sinks completely displacing the most amount (volume) of water.

***Conclusion***

This is an area of evaluation. Students should state the facts as they experienced them. The students should state whether they met the outcome predicted in the hypothesis. As a result they can share an opinion. This is also an area where students can discuss future investigations.

If the metal ball is heavier, why is it heavier? Weight is different though size is the same. That statement means that mass (the amount of matter in the object) is different too. The amount of matter is different too. First graders can receive this concept if they have the three balls to experience. It is not enough to show them the balls.

It is important to point out here that, after the experiment, all substances (balls) keep being the same because it is a physical change (position, movement) in opposition to chemical changes that we will discuss further on the unit.

***Safety***

- Read all the directions.
- Listen to your teacher for special safety directions.
- Wash your hands with soap and water before and after an activity.
- Wipe up a spill right away, or ask your teacher for help.
- Tell your teacher if something breaks. If glass breaks, do not clean it up yourself.
- Don’t eat or drink anything during an experiment.
- Dispose of things and put equipment back the way your teacher tells you to.
- Clean up your work area after the activity.

**Lesson two**

Physical Change: *How can you make crystals?*

This lesson will teach the students about the formation of crystals and their importance in the composition of matter.

***Observation***

Here's a science activity that children can *taste*! Rock candy crystals, made from sugar and water, can introduce your scientists to forms of matter, how to make a solution and the process of evaporation. The end result of their experiment is edible, although not of the greatest nutritional value. But, at least tasting the crystal candy is for the good of science!

First I would explain to the children that things like sugar, salt, sand and gems are made or crystals. They will have to use a magnifying glass to examine the sugar. Then ask these questions: What do you see? What shape are the crystals? Make them also compare salt and sugar crystals. Do they look the same?

I will want students to draw what they see and post the observations, as recording data is an important part of the investigation process, so eventually they could be able to reproduce the same facts under similar circumstances. After recalling the solids they have dissolved in previous experiments I would introduce the hypothesis question.

***Hypothesis***

Do you think a candy will dissolve in a liquid? Making predictions, or what is known in the scientific method as a hypothesis, allows the children to think, based on what they already know, of new events that may happen, and finally check the results and draw conclusions. If we dissolve sugar in hot water, what happens to the sugar? What makes it disappear? Do you think that the sugar will come back?

***Materials***

- food coloring
- magnifying glasses
- a clear container
- sugar
- hot water
- pencil
- string or thread
- paper clip
- spoon
- bowl

***Procedures***

- Fill the container with very hot tap water.
- If you use a glass container, put a spoon in it before pouring the water to prevent the glass from cracking.
- Pour a teaspoon of sugar into the hot water. Stir it until it dissolves. What happens to the sugar? What makes it disappear? Do you think that the sugar will come back?
- Continue to add teaspoons of sugar. Stir the water after adding each teaspoonful until the solution is saturated (that means no more sugar dissolves) and sugar collects at the bottom of the container.
- To keep the water in the container hot, place it into a bowl of very hot water.

- Wash off a large paper clip and tie it to the end of the thread to a pencil. Place the pencil across the top of the container. Adjust the length of the thread until the paper clip is hanging in the sugar solution.
- Let the sugar solution sit undisturbed at room temperature or in a dry, warm spot at least for a week.

***Results***

After the students have made and recorded their observations, we have to review the reports of the student teams.

- The water will continue to evaporate and large crystals will grow slowly. The kids will discover that the water will slowly leave the container and that the sugar will be left. How do they think this can happen?
- Examine the container every day for crystals.

***Conclusions***

When the crystals are large enough, let each student take a piece. Examine it under a magnifying glass. Does it look the same as sugar? Have them taste the crystal. What does it taste like?

I also would have them summarize the results and conclusions, comparing what they found.

Now, when a sugar dissolves in hot water, the demonstration of dissolving is more abstract than any previous experiment in the sense hat it happens slowly, over several days. While the students can see that the sugar has dissolved, they don't actually see it happening.

Some students will come out to articulate that some solids dissolve, while others don't, and some solids dissolve quickly, while other solids dissolve over days. Some students will be able to explain that though a dissolving solid *seems* to disappear, it actually remains in the liquid. Therefore, students will improve their ability to observe and describe substances. Moreover, students will demonstrate increased confidence in predicting/guessing what might happen in an unknown situation. Thus, students will improve their ability to describe changes that take place after solids and liquids are mixed.

***Extension***

Make different-colored sugar crystals by adding food coloring to the sugar solution.

***Safety***

- Be careful around a hot plate. Know when it is on and off.
- Keep your hands dry around electrical equipment.

### Lesson 3

Chemical change: *Mixtures & reactions*

This lesson will introduce the students to the difference between a physical change and a chemical change and allow them to see the new product that forms when a reaction takes place.

***Part 1***

**Observation**

A mixture occurs when two or more materials are combined and no reaction takes place. *Homogeneous mixtures* are formed when the two materials mix well and evenly. In this experiment we will analyze what a mixture is.

**Hypothesis**

Do all substances make crystals? Do all substances dissolve in water? Experiment with salt, sand or other substances that children suggest. Have students predict what will happen if they place equal amounts of each pair of substances listed below in a separate baby food jar and shake the contents.

**Materials**

- Baby food jars with lids
- Cooking oil
- Pepper
- Sand
- Water
- Sugar
- Salt
- Vinegar

**Procedures**

- Have students label the baby food jars with the name of the substances they will mix in them.
- Have students mix the substances.
- Shake each jar.
- Make a drawing of what happens with each of the following:
  a. salt and pepper
  b. sand and sugar
  c. oil and water
  d. water and vinegar.

**Results**

- Some solids mix well when shaken. Salt and pepper mix well and the particles of pepper can be seen in the salt throughout the mixture. Sand and sugar also mix well when shaken, but it is more difficult to see the sugar in the sand.
- Oil and water do not mix well. The oil will separate from the water when left still for a few moments.
- Water and vinegar will mix, but the water and vinegar particles cannot be seen.

**Conclusions**

- How do we know the water and vinegar mixed?
- What other substances could you use to make mixtures?

***Part 2***

**Observation**

A solution is created when one material dissolves in another with no reaction. A reaction occurs when two materials combine to form a new substance or substances (chemical change).

**Hypothesis**

How do you know a reaction takes place? How is a reaction different from a mixture or a solution?

## Materials

- Clear plastic cups
- Water
- Vinegar
- Baking soda
- Spoons
- Paper towels

## Procedures

- Give each student a clear plastic cup half-filled with water and place it on a paper towel.
- Have students stir in baking soda until the solution is clear.
- Have students guess what will happen when they pour vinegar into the baking soda and water solution.
- Have students pour ¼ cup vinegar into the solution
- Have students draw what happened when the vinegar was added.

## Results

- The baking soda and water form a clear solution.
- When vinegar is added, the two liquids produce a reaction with a lot of foam.

### *Safety*

- Wear safety goggles before you pour the vinegar into the baking soda.
- Wear a safety apron if you work with anything messy or anything that might spill.

**ANNOTATED BIBLIOGRAPHY**


Agler, Leigh et al. *Liquid explorations.* (LHSGEMS). Berkley: University of California, 2001.
Activities designed to explore the properties of liquids as the students develop science skills.

Barber, Jacqueline, et al. *Involving Dissolving.* (LHSGEMS). Berkley: University of California, 2001.
Activities developed as part of a series of early childhood chemistry classes. Focused on dissolving and crystals. Great to implement science activities.

*Chemicals at the heart of life*. Atofina Public Affairs. Paris la Defense. 2002.
Set of everyday words listed in alphabetical order, sheds light on chemistry in a pleasant and accessible way to all.

Cuff, Kevin et al. *Stories in Stone* (LHSGEMS). Berkely: University of California, 2000.
Activities dealing with examinations of actual specimens of Earth's crust and processes of change in Earth Sciences.

Le Couteur, Penny, and Jay Burreson. *Napoleon's Buttons*. New York: Penguin Group Inc., 2004.
Seventeen molecules that have had a great impact on humanity like glucose, cellulose, salt, and the nitro compounds. Focus on organic chemistry especially carbon-based molecules.

Moore, J.E. *Kitchen Chemistry.* Monterrey, CA: Evan Moor Corp., 1996.
Chemistry experiments in the kitchen and how to do them, observing and recording results, and exploring chemical properties and reactions.

Morris, Richard. *The Last Sorcerers*. Washington, D.C.: Joseph Henry Publishing, 2003. History of chemistry from alchemy to the periodic table.

Rohring, Brian. *Pure Slime: 5 Incredible Ways to Make Slime Using Household Substances.* Plain City, Ohio: Fizzbang Science, 2004.
Step-by-step instructions and the science behind the slime presented with 50 varieties of slime

Strathern, Paul. *Mendeleyev's Dream: The Quest for the Elements*. New York: the Berkley Publishing Group, 2000.
Desription of the history of chemistry. History of how, when and why the theory of scientific thinking developed.