

## Teacher's Notes For Middle School Mixtures

### Sequence of Activities:

Number	Name	Type of Activity	Basic Rationale	In Class Time
1	Separate a mixture	Laboratory	Elicit student ideas about mixtures, begin to establish patterns about types of mixtures.	50 minutes
2	Powers of 10 video and Zooming In and Out Worksheet	Video, student worksheet, class discussion	Students will gain an understanding of the scale of objects.	60 minutes
3	Powers of 10 Poster	Student group discussions and Whole class discussion	Students discuss where certain items would be placed on a poster displaying the Powers of 10. This helps them get a visual of the scale of objects.	30 minutes
4	Solutions Bead Lab	Whole Class discussion, Laboratory activity	This activity helps students visualize how substances dissolve in solutions at the molecular level	40 minutes
5	Solutions and Suspensions	Whole class discussion, Laboratory activity	This lab allows students to establish patterns that will lead them to identification of the different types of mixtures.	80 minutes

6	Take Home Lab: Solutions and Suspensions	Student Homework, Whole class discussion	This activity allows students to relate mixtures to their everyday lives. The whole class discussion will allow the teacher to assess student understanding as well as offer further information.	20 minutes
7	Making a Solar Still	Laboratory activity and questions	The activity is meant to help students relate the water cycle to the phenomena witnessed in the previous activities.	Set up and run time- a few hours to a few days Questions -20 minutes.

### **Activity 1:**

#### Separate a Mixture Using Observations

##### **Rationale for activity:**

This activity is to serve as an introduction to how observations can help us understand mixtures, solutions, and suspensions. When the separate parts of the mixture are put into water they form different types of mixtures. The salt will form a solution and the dirt forms a suspension. Students can use this among other observations to help them separate the mixture.

##### **Time:**

Introduction to lab

~ 5 minutes

Performing Lab

~ 40-45 minutes

***Total Estimated Time***

***~ 50 minutes***

##### **Materials need:**

Student copies of Separating a Mixture Using Observations Lab

For each lab group:

1. sandwich bag containing a small amount of play sand (Play sand can be found at any hardware store)
2. sandwich bag containing a small amount of salt

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3. spoon
4. two Dixie cups for water
5. Dixie cup containing mixture of both substances

### Procedures/Suggestions:

1. Split students into lab groups consisting of 2 to 3 students per group. Students will remain in these groups throughout the unit.
2. Help students to identify the problem in the lab. Explain that their task is to separate a mixture of sand and salt. Do not tell them how to accomplish the task. Explain that they will have to figure out how to separate the mixture using their observations of the separate components.
3. You may choose to discuss individual student plans or observations after completion of the lab. Make sure the students explain their reasoning for their plan. You can use this discussion as an introduction to the next activity (Powers of Ten video). You may choose to elicit student ideas about why the salt was able to dissolve and the sand was not.

### Answer Key Notes:

Observation	Sand	Salt
visual	possible answers include: brown, hard, small pieces	possible answers include: white or clear, cubes
in water	Will not dissolve, settles to bottom	dissolves

### Plan:

Students should develop a plan in which they place the mixture in water: the salt will dissolve and the dirt will sink to the bottom. Students should give an explanation as to why their planned worked. At this point they may not use words like dissolved, you may notice that they refer to the salt disappearing; this is a great opportunity to preassess your students' understanding of the content.

### Activity 2:

Powers of 10 video, Zooming in and Out worksheet

### Time:

Introduction: What does "system" and "scale" mean to you? ~ 10 minutes  
Powers of 10 video ~ 20 minutes  
Discussion of video and scale ~ 10 minutes  
Zooming in and out: What can you see? ~ 20 minutes

**Total Estimated Time**

**~ 60 minutes**

**Rationale for Activity:**

This lesson introduces students to the idea of using multiple scales to describe and connect systems. The lesson begins by eliciting students' understanding of atomic-molecular, microscopic, macroscopic, and large-scale systems. An understanding of scale is essential to the being able to define different types of mixtures

**Materials:**

1. Powers of 10 DVD
2. Student copies of Zooming In and Out Worksheet
3. Transparency of Zooming In and Out
4. Overhead projector & vis a vis markers

**Procedures/Suggestions:**

**Introductory discussion: Systems and Scale**

Before watching the video, it is important that students have some understanding of 'system' and 'scale'. You should spend the first 10 minutes developing reasonable definitions for these terms with your students. Some possible discussion questions might include:

In science we look at many different "systems". What does this term mean to you? What do systems have in common that make them "systems"? Possible definitions to use (you can use these before the video or wait until the discussion after the video, but at some point the class needs to understand how we are using the terms 'systems' and 'scale')  
System: an arrangement or an organized structure for arranging or classifying; Set of connected and mutually interacting components.

In science we look at things at many different "scales." What does scale mean to you?  
Scale: measurement used to compare the relative size of systems

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**Powers of 10 video**

2. Explain to students that they will watch a short film looking at different systems at different scales. Students might want to take mental notes of what they see in the video, however, the images will change quicker than most will be able to write them down. Let students know that the DVD can be paused to allow them to further discuss particular images.

**Discussion: Systems and Scale**

3. Allow students to reflect on the video and share their ideas regarding systems and scale. What systems did you see in the video? What scales were used to look at these different systems? This is an opportunity to find and discuss images on the video. Ask students for examples of systems and scales at the atomic-molecular, microscopic, macroscopic, and large-scale levels. As a class, develop a common understanding of the terms atomic-molecular, microscopic, macroscopic, and large-scale.

- Encourage the students to dissect the words, for example, discussing what “scopic”, “micro”, and “macro” means. Do all systems fit into the categories microscopic, macroscopic, and large-scale? Usually the idea of something being microscopic implies that it can be seen with any microscope. Establish the idea that there are things that are smaller than microscopic in size and that matter such as electrons, protons, and neutrons are too small for humans to see even with optical instruments.

**Zooming In & Out Worksheet**

- For the remainder of class students will begin thinking about what appears and disappears when moving across different scales and systems. As a whole class you will watch the video again, but this time students will complete the Zooming In and Out sheet that asks them to categorize items from the Powers of Ten video. You will have to pause the video at each Powers of 10 to allow students to complete the handout. The basic goal is for students to understand that when you zoom out or in, new things may appear, but other things have disappeared. You may consider using a Zooming In and Out transparency, to model for students what appears and disappears as you change Powers of 10.

**Answer Key Notes:**

What You See When You Zoom In	Starting Point: What You See	What You See When You Zoom Out
Picnic Blanket	City Park	Chicago
City Park	Chicago	Lake Michigan
Lake Michigan	United States	Earth
Earth	Solar System	Galaxy
Solar System	Galaxy	Universe
Skin	Hand	Body of a Man or Woman
Skin cells	Skin	Hand
White Blood Cell	Capillaries	Skin
Carbon Atom	DNA	Cell Nucleus
Quarks	Carbon Atom	DNA

- What items are microscopic?  
**Skin cells, cell nucleus, white blood cells, capillaries**
- What items would you see at the atomic/molecular level?  
**DNA, Carbon atom, quarks**
- What items are macroscopic?  
**Body of a Man or woman, skin, hand, picnic blanket, City park, Lake Michigan, Chicago**

4. What items are large scale?  
**City park, Lake Michigan, Chicago, United States, Earth, Solar System, Galaxy, Universe**
5. What are the limitations to categorizing items this way?  
**Categorizing items this way is highly relative. It allows you to note how items can be related to each other in terms of similar size without describing how much larger or smaller one system is from another.**

### **Activity 3: Powers of 10 Poster**

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#### **Timing:**

Whole class: Explaining & Modeling Powers of 10 ~ 10 minutes

Student groups /Whole class: Completing Comparing Powers of 10 Poster ~ 20 minutes

**Total Estimated Time** ~ 30 minutes

#### **Rationale for Activity:**

The students have watched the Powers of 10 DVD, a video that shows the relative size of systems, from galaxies to subatomic particles. In this lesson, the Powers of 10 Poster will be used as a framework for comparing systems at different scales, for example, comparing the size of molecules to cells and cells to leaves, etc.

#### **Materials:**

**All materials for this activity can be found on Carbon Cycle website**

1. Comparing Powers of 10 Overhead Transparency: Blank (from master)
2. Comparing Powers of 10 Overhead Transparency: Partial answers (from master)
3. Comparing Powers of 10 Overhead Transparency: Answers (from master)
4. Laminated copies of Comparing Powers of 10 Chart
5. Student copies of Comparing Powers of 10 Cutouts Do **NOT** include picture of sand (few pictures per group)
6. Overhead projector & vis a vis marker
7. Scotch Tape

#### **Procedures/Suggestions:**

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##### **Introduction**

1. After spending about 5 minutes reviewing the previous lesson, introduce students to the Powers of 10 chart using the *Comparing Powers of 10 Overhead Transparency* (blank). Explain the axis on the chart and how to use Powers of 10. Students will learn how to use the Powers of 10 to compare different systems.

- Although students may be familiar with powers of 10, they may not realize how to use powers of 10 to compare the size of objects
2. Depending on how comfortable you feel with your students familiarity with powers of 10 you may choose to reacquaint them with some basic powers of ten. Using a meter stick demonstrate that the entire meter stick will be the base unit of our measurements ( $10^0$ ), then demonstrate that 10 meter sticks laying side by side would be  $10^1$  – you may want to measure your room to give students an idea of how many 10 meter sticks would be. You can also use this as a review of the prefixes Deka, Hecto, Kilo. Now refer back to the meter stick and show them  $10^{-1}$ , which would be a decimeter. You may want to go down to a millimeter to remind them of the size of each.
  3. Help students with the exponents by reminding them that  $10^2$  actually means  $1 \times 10 \times 10$ . So each time we go up the size scale we increase 10 times. Each time we go down we divide by 10. So for example, a millimeter is  $10^{-3}$  which is  $1/10/10/10$ .
  4. At this time it is important that students see the utility (the 'so what') of using powers of 10. Engage kids in using Powers of 10 by asking them to predict the location of the following items on the chart:
    - a. the length of an average school bus
    - b. the length of a passenger car
    - c. a rain drop
    - d. a sand particle
    - e. a particle of milled flour
    - f. particulate pollution
    - g. a plant stomata

Mark student responses on the transparency using the vis a vis marker. By eliciting predictions, students might see that they need a way to systematically compare the size of systems and objects. Then display the overhead transparency that shows the position of these items on the Powers of Ten Chart (this is the 'partial' overhead). Discuss student responses, focusing on why they thought an object was larger or smaller than it actually is.

### **Putting Together the Poster**

5. Place the laminated poster sized Powers of 10 chart in the front of the class. Divide students into small groups of 3 or 4 (hint: put two lab groups together). Divide the Powers of 10 cards up among the groups, giving each group approximately the same number of cards. Have the groups discuss where their particular cards should be placed on the poster. Once the groups have had about 5 minutes to discuss their ideas, have students apply Scotch tape to the back of the pictures and stick them to the poster. Make sure to have the students explain why he/she chose to place the image at that particular location. Ask the class if they agree and to share their thoughts. Continue in this manner with the rest of the cards.

6. Assess student's understanding of the scale of objects. Ask them questions about the scale of things use the following as example questions: how many times bigger is your hand than a mosquito (10) and how many times smaller is a tobacco smoke from pollen (100 or  $10 \times 10$ ). If you wanted to discuss the size of an ant what measurement would you use? (centimeter)
7. Some cards are particular to substances found in water. You may choose to put these items on the poster as a large group in order to emphasize the kinds of substances you will be discussing in the unit. The cards specific to water are: sand, water molecule, gravel, clay, salt (NaCl), and rain drop. Note: the sand, clay and gravel can be indicative of any substance making a suspension in water. The salt can be indicative of any substance making a solution. Note 2: the salt is separated to  $\text{Na}^+$  and  $\text{Cl}^-$  because ionic compounds dissociate in water. The size of the two ions differ only slightly, both are in the scale of  $10^{-10}$ .  $\text{Na}^+$  has a diameter of about  $2.04 \times 10^{-10}$  and  $\text{Cl}^-$  has a diameter of about  $3.6 \times 10^{-10}$ .
8. If you like you can show the Powers of 10 completed overhead at the end of the activity for students to compare their results.

## **Activity 4:** **Solutions Bead Lab**

### **Time:**

Pre-lab discussion

~5 minutes

Bead Lab

~20 minutes

Post-Lab discussion

~15 minutes

***Total Estimated Time***

***~ 40 minutes***

### **Materials:**

Student copies of Solution Bead Lab

1. For each lab group:
  1. Petri dish
  2. Round plastic beads of one color~ 8mm
  3. Round plastic beads of a different color ~3 mm (must fit in between the holes of the larger beads)
  4. Tupperware dish (the disposable Ziplock kind will work)
  5. Marbles (clear are best – can use the marbles that are used in artificial plant arrangements)

### **Rationale for Activity:**

This activity is meant to help students understand the meaning of dissolving. In this activity students will use beads to represent the atoms and ions present in a solution. The simulation will give students a visual representation of the behavior of molecules. Students will learn what happens to molecules as they dissolve.

### **Procedures/suggestions:**



## Teacher's Notes

### Pre – lab discussion:

1. Begin with explaining to students that this lab will deal only with solutions. They will be using beads to simulate the behavior of the molecules in a solution. You may want to give an analogy: Tell students to imagine the room is filled with beach balls. What would happen if someone were to add golf balls? Would they fit? How could this analogy help us understand what is happening in solutions?

### Lab:

1. Watch for students who try to pile too many beads in the Petri dish. They should only have one layer of beads. When they add the smaller beads they should fit into the empty spaces of the beads, not sitting on top of the larger beads.
2. Finding beads that will give you successful results for this lab can be difficult. The size listed in the materials is just a suggestion. Make sure that the smaller beads will fit in between the spaces of the larger ones. Round beads work best. Do not buy square beads or beads with large holes in the middle.

### Post-lab discussion:

Use the following questions to discuss the lab with students:

1. What happened when they added the small beads to the large ones?
2. How is this similar to the beach ball analogy?
3. Have a few students draw their answer to question 3c on the board. Ask students to explain their drawing to the class. Question 3c from student pages: *When salt dissolves in water it breaks apart into  $\text{Na}^+$  and  $\text{Cl}^-$ . The large circle in the picture below represents a small area of a salt solution blown up. In the large circle draw a picture of what you think happens to the  $\text{Na}^+$  and  $\text{Cl}^-$  atoms when they dissolve in water. Use the following symbols to draw your picture. Note in the questions above the larger beads represent the water molecule and the smaller beads could represent the  $\text{Na}^+$  and  $\text{Cl}^-$ .* NOTE: In reality the size of the  $\text{Cl}^-$  and water molecule do not differ as greatly as suggested in the simulation. However, the intention of the simulation was to show how molecules fit in between each other during the dissolving process. This is the big idea intended for students.
4. Ask students how the first simulation with the beads and second simulation with the marbles are different.

### Answer Key:

1. Obtain a Petri dish. Place some of the larger sized beads in the bottom of the dish. Add as many as you can so that they only make one layer. No beads should be overlapping, every bead must be touching the bottom of the dish.

Question: Can you see any part of the bottom of the Petri dish? Why or why not?

Explain.

**Yes, students will be able to see the bottom of the dish in some places because there are holes between each bead. The beads do not fill in the entire space of the Petri dish.**

2. Drop 4 or 5 of the smaller beads into the Petri dish with the beads.

### Questions:

- a. When you dropped in the beads, where did they go?

**The beads went in the spaces between the larger beads, filling in the holes.**

- b. Could you fit more small beads in the Petri dish without beads overlapping or making a new layer? Why or why not?

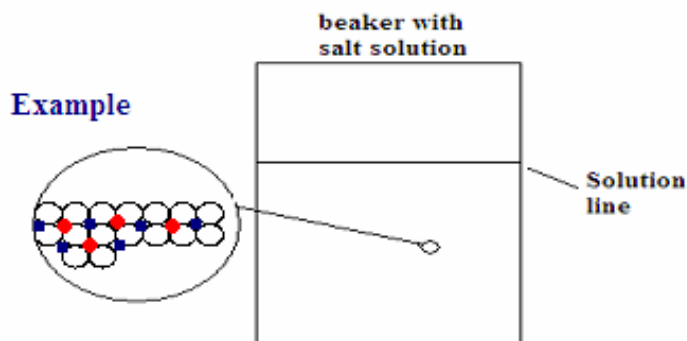
**Yes, more beads can fit because there are still spaces for them to fit into.**

- c. When salt dissolves in water it breaks apart into  $\text{Na}^+$  and  $\text{Cl}^-$ . The large circle in the picture below represents a small area of a salt solution blown up. In the large circle draw a picture of what you think happens to the  $\text{Na}^+$  and  $\text{Cl}^-$  atoms when they dissolve in water. Use the following symbols to draw your picture. Note the water molecule is larger than the  $\text{Na}^+$  and  $\text{Cl}^-$ .

○ = Water molecule

■ =  $\text{Na}^+$  atom

● =  $\text{Cl}^-$  atom



3. Obtain a Tupperware dish.
4. Place a layer of marbles on the bottom of the Tupperware dish. Again do not add too many so they overlap.
5. Add a layer of the larger size beads on top of the marbles.
6. Add another layer of marbles.

Questions:

- a. Can you see the beads in between the marbles?

**Yes, there are spaces between the marbles.**

- b. Where do most of the beads go in relation to the marbles?

**The beads can fit between the marbles, most of them sit in these spaces.**

- c. This simulation is different than the first one in the Petri dish. This one is supposed to simulate the mud and water. Which object (marble or bead) do you think represents the mud and which represents the water? Explain.

**This simulation is a suspension. The marbles represent a sand particle and the bead represents a water molecule. In this one the water goes between the sand.**

## **Activity 5:** **Solution and Suspension Lab**

**Time:**

Pre-lab discussion with Properties chart transparency

~ 10 minutes

Solution and Suspension lab

~ 50 minutes

Post-lab discussion

~ 20 minutes

***Total Estimated Time***

***~ 80 minutes***

**Rationale for Activity:**

In this lab students will use several tests to identify the classification of different mixtures as a solution or suspension. The students will use patterns in the data to help them make the determination. The activity is meant to serve as a way to help students learn the difference between these two types of mixtures as well as provide them with an opportunity to establish scientific data patterns through a real experience.

**Materials:**

For lab activity:

Student copies of Solution and Suspension

For each group:

1. 3 – 250 ml beakers
2. 1 or 2 Spoons
3. 3 Funnels
4. 3 pieces of filter paper
5. Flashlight
6. Grease pencil or tape (for labeling beakers)
7. hot plate

For mixtures:

1. Salt (2 spoonful per group)
2. Play sand (2 spoonful per group)
3. Distilled water

See activity for complete list of materials for Solar Still.

For Post-lab discussion:

1. Powers of 10 class poster

**Procedures and Suggestions:**

Pre-lab discussion:

1. Use this time as an opportunity to remind students of what they already saw in Separate a mixture lab. Ask them what happened when they put salt and sand in water.
2. Preassess your students knowledge by asking them what they think would happen if they were to filter the sand and salt. What happens if you heat up the water and evaporate it all away?

**NOTE: The Solar Still needs several hours to one full day to run and see results activity you should have them set up the still now. See activity 8 – Making a Solar Still for complete instructions.**

Laboratory activity:

1. Remind students of lab safety. They should be wearing goggles during the heating section of the lab.

## Teacher's Notes

- It is important to have students use distilled water. This is important when students have to heat the filtrate.
- You will have to demonstrate how to fold and properly use filter paper for the students.
- Students must save their filtrate from the filtering activity later in the activity.
- Students filter the liquid into 50 ml beakers because later in the activity they have to boil off all the water. Too much liquid will take too long of a time to boil off. Since the beaker is so small you may choose to have students set up a ring stand apparatus to hold the funnel above the beaker.
- You may choose to set up the tests as stations to save on materials. If you choose to run the lab in this way, be aware that the filtering section takes much longer than the others.

### Post-lab discussion:

- Discuss with students some of the basic observations in the lab:
  - What happened to the sand and salt when they are mixed with water?
  - Did the salt disappear, is it still there, how can you tell?
  - Can you see the salt? Can you see the sand?
  - What was in the beakers after you heated them up? What can this tell us about the scale of salt molecules vs. sand particles?
- Place the Powers of 10 Poster in the front of the room. Tell students that you will now help them to answer question 8. Remind students of where they placed the salt and sand cards on the poster. Ask them what they concluded about salt water and sand in water in the lab. Ask them according the Powers of 10 chart about how big are particles that can make solutions and how big are particles that can make suspensions. The chart below depicts the correct answers.

	Solution	suspension
particle size	smaller than $10^{-7}$ cm	larger than $10^{-4}$ cm

### Answer Key Notes:

#### Data:

Test	Beaker 1	Beaker 2	Beaker 3
<b>Appearance</b>	clear and colorless, can see through the liquid, cannot see salt	clear and colorless liquid, can see through the liquid, dirt is sitting on bottom	clear and colorless liquid, can see through the liquid, dirt is sitting on bottom
<b>Separation</b>	Nothing left on filter paper, liquid in beaker is clear and colorless	The dirt is left on the filter paper, the liquid in the beaker is clear and colorless.	The dirt is left on the filter paper, the liquid in the beaker is clear and colorless

<b>Effect of light beam</b>	The light goes through the liquid	The light goes through the liquid, maybe scattered a little by some dirt	The light goes through the liquid, maybe scattered a little by some dirt
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**Data:**

**Left behind after heating**

	<b>Beaker 1</b>	<b>Beaker 2</b>	<b>Beaker3</b>	<b>Beaker 4</b>
<b>Observations</b>	White residue is left in the beaker after all the water is gone	There is nothing left in the beaker after all the water is gone	There is a white residue left in the beaker after all the water is gone	The sand is still in the beaker after all the water if gone

**Answer Key:**

**Questions:**

1. What do you think is left behind in the beaker when you heated beaker one?  
Salt is left behind in the beaker.
2. Explain how something could still be in the water even after you filtered it?  
The salt particles must be small enough to go through the wholes in the filter paper.
3. Can salt stick to sand and filter out? Explain your answers using your data above  
No, because all that was left in the salt, sand, and water beaker after if was filtered and heated is a white residue (most likely salt).
4. In the lab you tested a solution and a suspension. The solution you tested was salt water and the suspension was sand and water.
  - a. Name four characteristics of a solution based on your data.
    1. It doesn't settle out.
    2. It does not filter out.
    3. A beam of light can shine through it.
    4. When all the water is boiled off it is still left behind.
  - b. Name four characteristics of a suspension based on your data.
    1. It will settle out.
    2. It does filter.
    3. A beam of light gets scattered by the particles.
    4. When all the water is boiled off it is still left behind.
5. People often like to filter their water before they drink it. Do you think filtering gets everything out of your water? Explain your answer.  
No, because we know from our data that filtering only gets out suspended particles not those in solution.
6. Dirt is a mixture of several things. List some things you think could be in dirt.  
Sand, salt, clay, rocks, gravel,...
7. Do you think dirt could is a suspension or solution? Explain your thoughts.

It is both a suspension and a solution because it is a mixture of several kinds of particles. There are particles that would make a solution and particles that would make a suspension.

8. Answer this question with your teacher. How big are solution and suspension particles?

Answers in post lab questions above.

## **Activity 6:** **Take Home Lab: Solutions and Suspensions**

### **Time:**

Students do work at home

Whole class discussion about findings

~20 minutes

### **Rationale for activity:**

This activity serves as an opportunity for students to apply their knowledge to everyday life. They will look more closely at items in their home and how these items relate to mixtures. The activity is also meant as a way to help students to begin to think about what type of substances dissolve and what dissolving is. This is also a great way to get parents involved with what students are learning in school.

### **Materials:**

1. Student copies of take home lab

Optional follow up activity:

1. color pencils, markers, crayons
2. construction paper or white paper
3. tape
4. Powers of 10 poster

### **Procedure/Suggestions and Answer key notes:**

**NOTE:** The mini lab (activity 7) requires waiting for the lab to complete. You may choose to have the discussion about the take home lab after they set up and begin running the mini lab. There is also an optional follow up activity that you may choose to do while students are waiting.

Use the answer key as a source of discussion. Embedded in the answer key are “teachable moments”, use these to help further students’ understanding of the three types of mixtures.

classification	item	Explanation
Solution	Possible answers: pop, clear juices, some liquid soaps, cleaning products, etc.	The individual parts in the substance cannot be seen. <b>FYI: the “parts” are called phases if you would like to use this terminology with students</b>
suspension	Possible answers:	The individual parts (phases) can be distinguished

	Orange juice with pulp, apple cider, some salad dressings	and some sink to the bottom.
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Part 2: Now, find items in your home to help you understand dissolving.

- a. Find one solid that will dissolve in water. You may not use salt. List the solid below and describe how you could tell it dissolved.

Solid:     baking soda, cleaning powders, bullion cube, sugar

Explanation:

When the substance is put into water, the individual parts are no longer seen.

**Misconception alert:** some students may write that the substance disappears. They may actually think that the substance no longer exists.

- b. Find one liquid that will dissolve in water. List the liquid below and describe how you could tell it dissolved.

Liquid:     dish soap, rubbing alcohol, vinegar

Explanation:

Same as above.

**Teachable Moment:** Use this opportunity to discuss with students that many of the substances they chose are actually already dissolved in water and solutions themselves.

- c. Find one solid that will not dissolve in water. You may not use dirt.

Solid:     butter, coffee grounds, flour

Explanation:

The substance can still be seen after lots of stirring.

**Teachable Moment:** Use this opportunity to discuss with students how some of their choices are mixtures themselves and parts of these mixtures could dissolve in water. For example, a marshmallow will not seem to dissolve, but the sugar on the marshmallow will dissolve, the gelatin does not. Some part of the coffee ground does obviously dissolve or else it could not make coffee.

- d. Find one liquid that will not dissolve in water. Explain.

Liquid:     motor oil, some salad dressings, cooking oil

Explanation:

Same as c above.

**Teachable moment:** Use this opportunity to discuss with students how some of their choices actually contain similar substances to oil in the mixture. For example, salad dressing often contains oil which will not dissolve.

**Questions:**

1. Describe one other time in a science class when you learned or could have used one of the ideas above.

Any answer that relates to an activity, lesson, or idea about solutions or mixtures. The rationale behind this question is that students can relate the importance of mixtures to other areas they have studied in their classes.

## Teacher's Notes

2. In part 2 above name two items that made a solution. Explain how you know it is a solution.

Students must choose only the items that dissolved in water. These made the solutions because a solution is formed when the phases can no longer be seen.

### Optional follow up activity:

At this point you may want students to design their own card for the powers of 10 poster. They could draw a picture of the solution and/or suspension they found at home and place it to the poster. This activity could be used when students are waiting for the completion of the mini lab activity.

## **Activity 7:** **Making a Solar Still**

### Time:

Student creation of model (done day before)

Student observations of model

~ 10 minutes

Answer questions about model

~30 minutes

**Total Estimated Time**

**~ 35 minutes**

### Materials:

Per student group:

1 large bowl or container of some kind

1 coffee mug or glass – make sure the mug or glass is shorter than the bowl when placed inside it. You may have success using a plastic cup with a piece of clay to secure it.

1 stopper, stone or other small object to be used as a weight

Plastic wrap to cover the bowl

Masking Tape

Sharpie Marker

Lamp (optional)

Per student:

Paper cup

For the class:

Salt water solution – enough to fill  $\frac{1}{4}$  of each groups bowls. The concentration of salt water does not matter.

### Activities:

Creation of model:

See picture:





## Teacher's Notes

1. Make sure to create the model at least one day before you intend to use it in a lesson. It takes a few hours to a day to fully run the experiment.
2. In order to better understand the set up go to the following website and watch a short video about it: <http://www.teachersdomain.org> use the login: **elitgroup** and password: **elit**. Click on "My Folders" and scroll down to Solar Still. You should be able to view the video. NOTE: Teacher's domain is a free website to all teachers, you can set up your own login and password. There are thousands of useful videos, websites, and other media you may want to use in your classroom.
3. **Make sure whatever equipment you intend to use that it is clean** – not lab ware – students will be asked to drink the fresh water they have made at the end of the experiment.
4. It is important that the coffee mug or glass that you decide to use fits inside the bowl so that the rim of the bowl is above the rim of the mug or glass. The still collects water into the cup by gravity, so water needs to be able to drain into the mug or glass from the plastic wrap where it will condense.
5. You may choose to have students in larger groups from this activity depending on the number of supplies and space available in your classroom.
6. You may choose to make the salt water solution in front of your students as a demonstration. In this way they will believe that there was salt in the water to begin with.
7. Students are supposed to set their models aside near a window that will receive sun. If you do not have a window or do not have enough space you may set a lamp above the bowls to simulate sunlight.

### Student observations:

1. Students are asked to dry the bottom of their mug or glass so that salt water does not mistakenly dribble into their paper cups. Below are observations students should make.

### Data:

Observations of the bowl after it sat for one day. How has it changed from the original set up?

The plastic wrap will have droplets of a clear, colorless liquid on the inside of the plastic wrap. The bowl will feel warm.

Observations of the substance inside the mug or glass: visual and taste.

There is liquid inside of the mug or glass and it is clear and colorless. It has no salty taste.

### Student Questions:

1. Explain or draw a picture of what happened to the water molecules in the solar still as it sat for a day.

The liquid molecules gained energy from the sun or lamp and turned into a gas.

When they hit the plastic wrap which was cooler they condensed back into a liquid.

The liquid ran down the plastic wrap into the mug or glass.

## Teacher's Notes

2. Did the water in the mug or glass taste salty? NO Explain why or why not.

The water did not taste salty because the salt does not evaporate with the water; it is left behind in the bowl.

3. Do you think the salt water left in the bowl would taste the same, more, or less salty than at the beginning of the experiment? Why?

It would taste more salty because there is less water to dilute it.

4. What can this experiment tell you about how water evaporates in the ocean?

Since water in the ocean is salty when it evaporates the salt would stay behind. This is why rain water is fresh.

5. Do you think the still could make fresh water from orange juice or other liquids?

Yes, orange juice is a mixture or solution like salt water. The water would evaporate and leave the other parts behind.

6. This experiment is also an analogy of the water cycle. Explain how this could be.

When water evaporates from the ocean, lakes, rivers, etc. it cools in the upper atmosphere and condenses. Any dissolved or mixed in substances in the water do not evaporate with the water, hence rain is fresh water.

### **Zooming In and Out Transparency**

What You See When You Zoom In	Starting Point: What You See	What You See When You Zoom Out
	City Park	
	Chicago	
	United States	
	Solar System	
	Galaxy	
	Hand	
	Skin	
	Capillaries	
	DNA	
	Carbon Atom	

### Properties of Solutions, Suspensions, and Colloids Activity 4

	<b>Solutions</b>	<b>Suspensions</b>
<b>Particle size</b>	smaller than $10^{-7}$ cm	larger than $10^{-4}$ cm
<b>Appearance</b>	transparent, uniform throughout	at least two substances visible, not uniform throughout
<b>Separation method</b>	distillation	filtration
<b>Effect on light beam</b>	light goes straight through	Either could happen

