SOLUTIONS

COARSE SUSPENSION | COLLIODAL DISPERSION | TRUE SOLUTION | STRAINED PLUMS

TASK CARD SERIES

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TOPS LEARNING SYSTEMS

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ISBN 978-0-941008-82-2

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INTRODUCTION

TEACHING NOTES

REPRODUCIBLE STUDENT TASK CARDS

Gathering Materials

Listed below is everything you'll need to teach this module. You already have many of these items. The rest are available from your supermarket, drugstore and hardware store. Laboratory supplies may be ordered through a science supply catalog. Hobby stores also carry basic science equipment.

Keep this classification key in mind as you review what's needed:

special in-a-box materials:	general on-the-shelf materials:
Italic type suggests that these materials are unusual. Keep these specialty items in a separate box. After you finish teaching this module, label the box for storage and put it away, ready to use again the next time you teach this module.	Normal type suggests that these materials are common. Keep these basics on shelves or in drawers that are readily accessible to your students. The next TOPS module you teach will likely utilize many of these same materials.
(substituted materials):	*optional materials:
A parentheses following any item suggests a ready substitute. These alternatives may work just as well as the original, perhaps better. Don't be afraid to improvise, to make do with what you have.	An asterisk sets these items apart. They are nice to have, but you can easily live without them. They are probably not worth the extra trip, unless you are gathering other materials as well.

Everything is listed in order of first use. Start gathering at the top of this list and work down. Ask students to bring recycled items from home. The teaching notes may occasionally suggest additional student activity under the heading "Extensions." Materials for these optional experiments are listed neither here nor in the teaching notes. Read the extension itself to find out what new materials, if any, are required.

Needed quantities depend on how many students you have, how you organize them into activity groups, and how you teach. Decide which of these 3 estimates best applies to you, then adjust quantities up or down as necessary:

Q_1 / Q_2 / Q_3

- **Single Student:** Enough for 1 student to do all the experiments.
- **Individualized Approach:** Enough for 30 students informally working in 10 lab groups, all self-paced.
- **Traditional Approach:** Enough for 30 students, organized into 10 lab groups, all doing the same lesson.

KEY: *special in-a-box materials* (substituted materials) general on-the-shelf materials *optional materials

1/1/1	roll commercial-grade, soft paper towels	1/1/1	package rice
1/10/10	scissors	1/1/1	*envelope of powdered milk*
1/1/1	roll school-grade "hard" paper towels (laboratory-quality filters)	1/1/1	*small container flour, bleached or unbleached*
1/1/1	packages: corn starch, granulated sugar, *alum*, fine-grained table salt, baking soda, *copper sulfate*, *rock salt*, *Epsom salt;* include a dispensing spoon with each package	1/5/10	rolls clear tape
		1/10/10	graduated cylinders, 10 mL capacity
		1/1/1	box seltzer tablets, Alka-Seltzer or equivalent
		1/1/1	box sugar cubes
		1/6/10	microscope slides
3/30/30	baby food jars, most with lids (small beakers)	1/1/1	box facial tissues (roll toilet paper)
1/1/1	water source; use distilled water if source is hard	1/4/10	*microscopes
1/6/10	dropper bottles: *iodine*, rubbing alcohol	1/1/1	package rubber bands
1/3/6	dropper bottles: *chlorine bleach*, mineral oil, liquid detergent, *India ink*, vinegar, *distilled water*	1/1/1	**can scouring cleanser*
		1/10/10	index cards
		1/2/4	paper punches
1/1/1	hot plate with teapot (Bunsen burner or alcohol lamps and matches)	1/1/1	box plastic straws
		1/1/1	wall clock with second hand (stop watch)
2/10/20	eyedroppers	1/6/10	mass balances — instruments constructed in TOPS module, *Weighing 05,* are suitable
1/1/2	*packets non-dairy creamer*		
1 /1/1	*shaker of pepper*	1/10/10	*calculators
3/30/30	test tubes, 12 mL capacity or more	1/5/10	small Pyrex beakers
1/5/10	magnifying glasses	1/6/10	clothespins
1/10/10	small paper drinking cups	1/4/10	permanent markers
1/4/10	*metric rulers	1/1/1	*bottle calcium acetate* — activity 27 only
1/1/1	roll aluminum foil	1/1/1	*bottle sodium thiosulfate* — activity 28 only

Sequencing Task Cards

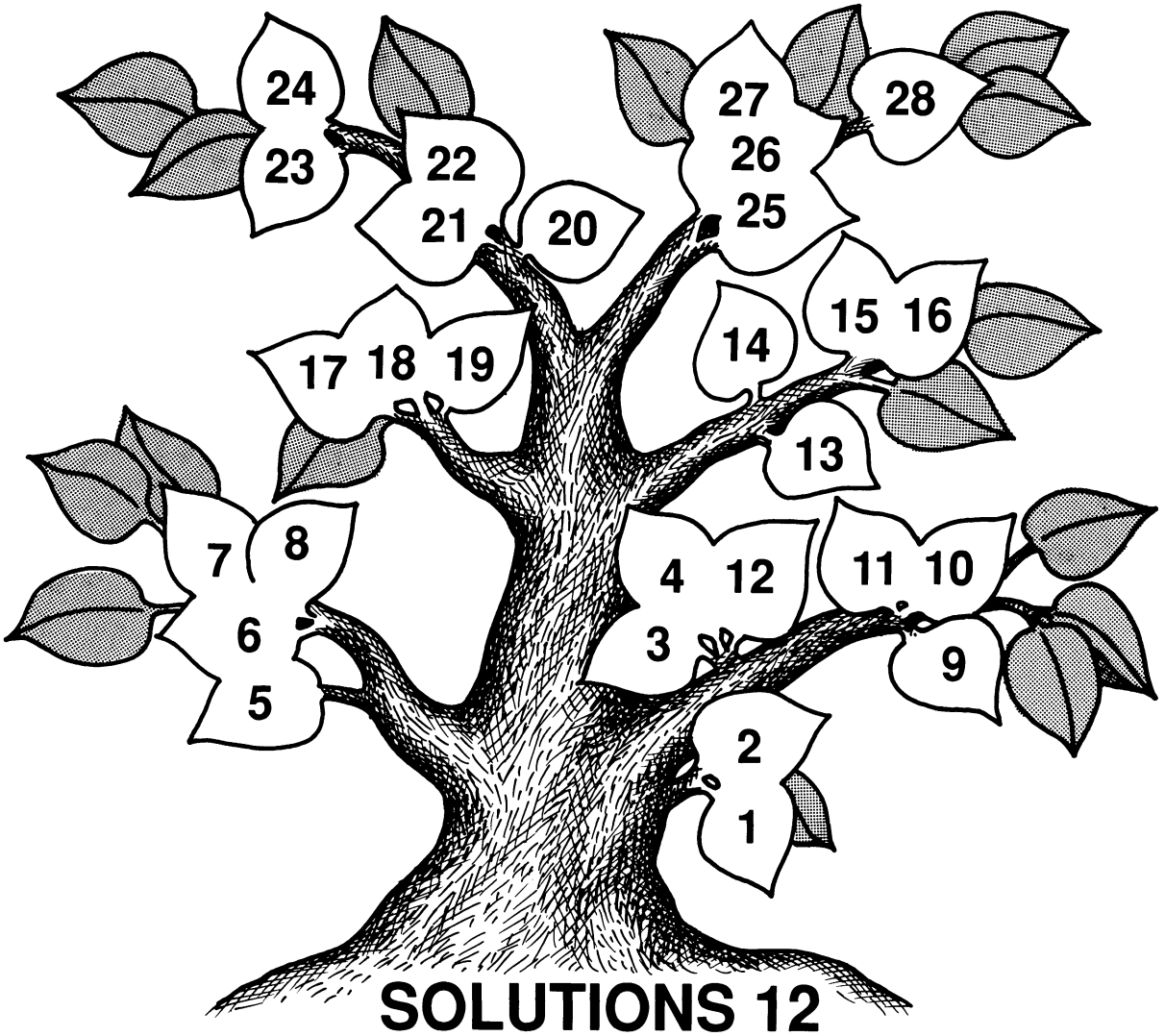
This logic tree shows how all the task cards in this module tie together. In general, students begin at the trunk of the tree and work up through the related branches. As the diagram suggests, the way to upper level activities leads up from lower level activities.

At the teacher's discretion, certain activities can be omitted or sequences changed to meet specific class needs. The only activities that must be completed in sequence are indicated by leaves that open *vertically* into the ones above them. In these cases the lower activity is a prerequisite to the upper.

When possible, students should complete the task cards in the same sequence as numbered. If time is short, however, or certain students need to catch up, you can use the logic tree to identify concept-related *horizontal* activities. Some of these might be omitted since they serve only to reinforce learned concepts rather than introduce new ones.

On the other hand, if students complete all the activities at a certain horizontal concept level, then experience difficulty at the next higher level, you might go back down the logic tree to have students repeat specific key activities for greater reinforcement.

For whatever reason, when you wish to make sequence changes, you'll find this logic tree a valuable reference. Parentheses in the upper right corner of each task card allow you total flexibility. They are left blank so you can pencil in sequence numbers of your own choosing.



SOLUTIONS 12

Review / Test Questions

Photocopy the questions below. On a separate sheet of blank paper, cut and paste those boxes you want to use as test questions. Include questions of your own design, as well. Crowd all these questions onto a single page for students to answer on another paper, or leave space for student responses after each question, as you wish. Duplicate a class set and your custom-made test is ready to use. Use leftover questions as a review in preparation for the final exam.

task 1

You filter a bucket of gravel through a wire screen that has squares measuring 2 cm on a side. Rocks that pass though are then filtered through a smaller screen with squares measuring 1 cm on a side. What size gravel is trapped in between? Explain.

task 2

a. Explain how a coffee filter separates fresh brewed coffee from the grounds.
b. Suppose you ran out of coffee filters. Describe another method, other than filtering, to separate the liquid from the grounds.

task 3

When clay is mixed in water the solution turns cloudy, but when sugar is mixed in water the solution remains clear. What does this tell you about the size of the particles in each solution?

task 2-3

How would you use a filter and iodine to prove that starch particles in water are reduced in size when heated to boiling?

task 4,12

Classify each mixture as a coarse suspension, colloidal dispersion or true solution. Give a reason for each answer.
a. Milk
b. Sea water.
c. A seasoning sauce that says "shake before using.

task 5

A mixture of sand, silt and clay is called loam. How would you determine if the soil in your area qualifies as loam?

task 6

Describe how you would clear each colloidal dispersion in water:
a. Clay.
b. India ink.
c. Milk.

task 7

Is the water in a swimming pool purified by adding chlorine tablets? Explain.

task 8

You are lost in the desert with only a shovel, a large clear plastic tarp and a bucket. You discover moisture in the soil at a depth of 1 meter, but no liquid water. Design a solar still to help you survive.

task 5, 8

A pinch of sand, clay and salt are mixed in a glass of water. How would you...
a. remove only the sand?
b. remove both the sand and clay?
c. remove all impurities at once?

task 9

Soap film is extremely thin and transparent. Nevertheless, a soap bubble is easy to see as it floats through the air. How can this be?

task 9

Detergents are often used to clean up oil tanker spills at sea. Do these detergent really "clean" the water?

task 10-11

A lump of sugar is dropped into a clear glass of water.
a. Account for the wavy turbulence surrounding the dissolving cube.
b. Why does the lump eventually disappear?

task 10-11

Corn oil, alcohol and water are combined in graduates with these results:
10.0 mL corn oil + 10.0 mL water = 20.0 mL mixture
10.0 mL alcohol + 10.0 mL water = 19.8 mL solution
Account for the difference in volume.

task 4,12

Identify each of the following as a coarse suspension, colloidal dispersion or true solution:
a. _____The cloudy solution will not settle.
b. _____The solute dissolves in the solvent.
c. _____The cloudy solution clears when filtered, but you must first add a coagulant.
d. _____The cloudy solution clears if allowed to settle.
e. _____The clear, colorless solution leaves a residue behind as it evaporates.
f. _____The cloudy solution clears when filtered.

task 13

A teaspoon of blue, grape-flavored powder is added to a glass of water. It is then stirred until the powder completely dissolves. Explain when the solution is homogeneous and when it is heterogeneous.

task 13-14

You can increase the rate that a solute dissolves in a solvent by stirring the solution. Name 2 additional ways to increase this dissolving rate.

Review / Test Questions (continued)

task 14

Which dissolves faster in water, a gram of granulated sugar or a gram of powdered sugar? Explain.

task 15

Describe how to prepare a saturated solution of copper sulfate in water.

task 15

Water from the Dead Sea has a much higher concentration of salt than ocean water. How would you experiment with Dead Sea water to determine if it was saturated or unsaturated?

task 16

Would you expect a seltzer table to dissolve faster in distilled water, sea water or saturated salt water? Justify your answer.

task 17

Do ice crystals form for the same reason that salt crystals form? Explain.

task 18

Crystals grow by repeating a unit pattern. Does this mean that all crystal formations of the same salt also have the same shape? Explain.

task 17-18

You find an unlabeled bottle of clear colorless salt solution in your laboratory. What could you do to identify this salt?

task 19

The president of Acme Water Systems asks you to do a television commercial to scientifically demonstrate that Acme distilled water is the purest form of water that you can buy. Design a commercial.

task 20

A crystal of rock salt is added to a test tube of fully saturated salt water, then sealed with a cork.

a. Will the salt crystal gradually disappear? Explain.

b. Will the salt crystal retain its original surface atoms? Explain.

task 21-22

It is determined by experiment that 20 grams of salt will dissolve in 100 mL of water when stirred moderately for 1 minute. Can you use this data to predict how many grams of salt will dissolve in the same amount of water if it is stirred moderately for 2 minutes?

task 21-22

Exactly 40 grams of a red salt is added to 100 grams of water. The water is stirred slowly and constantly while its increasing salt concentration is recorded every 5 minutes by a light-absorption device. Here are the results for the first half hour:

time (min)	concentration (g salt/100 g H_2O)
0	0
5	16
10	22
15	26
20	28
25	29
30	29

a. Make a graph of time vs. concentration.

b. What is the concentration of this salt solution at saturation?

c. How many grams of salt remain undissolved at the bottom of the beaker?

task 23

You are given two salt samples in test tubes. One is hydrated, the other is anhydrous. How can you tell which is which?

task 24

Exactly 20.0 grams of a certain salt is thoroughly heated and then reweighed. Its new mass is found to be 13.8 grams.

a. How much water of hydration was driven off?

b. Express this water of hydration as a percentage of the total mass.

task 25-26

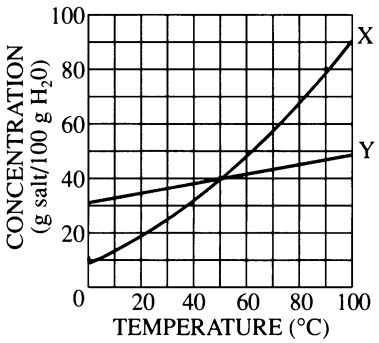
Just 5.0 g of alum dissolves in 100 g of cold water at 10° C to form a saturated solution. But twice that amount dissolves if the water is warmed to 27° C. Describe the solubility of this salt...

a. in words.

b. in numbered units of concentration.

task 25-26

The solubility of salts X and Y change with temperature as shown.



a. Qualitatively compare (in words) the solubility of each salt.

b. Quantitatively compare (in numbers) the solubility of each salt at room temperature (20° C).

c. Under what condition do both salts have equal solubilities? What is that solubility?

task 27

Air bubbles form on the inside of a pan as it is heated on the stove. Explain.

task 28

Your are given a supersaturated solution of sodium thiosulfate (hypo) in a test tube.

a. How would you recrystallize this solution?

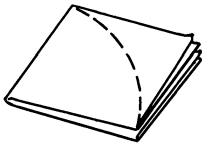
b. Would you expect the temperature to change? Why?

Task Objective (TO) compare the filtering capacity of soft and hard paper towels. To relate the porosity of filter paper to the size of particles in suspension.

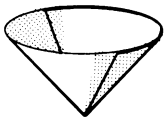
TWO KINDS OF FILTERS

Solutions ( )

1. Fold a soft absorbent paper towel into quarters. Trim the 4 loose edges into a quarter circle to make a cone-shaped filter.
2. Make a second filter like the first, from a "hard," unbleached, school-grade paper towel.

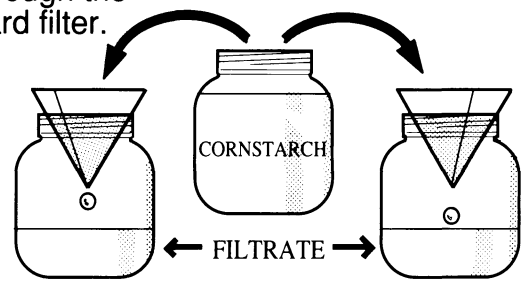


FOLD AND TRIM



OPEN CONE

3. Mix a pinch of cornstarch in a small jar full of water. Filter part of this solution into 2 more jars, some through the soft filter and some through the hard filter.



SOFT TOWEL HARD TOWEL

4. Examine each *filtrate*. Are the cornstarch particles larger or smaller than the pores in each filter paper? Explain.
5. Add a drop of iodine to each filtrate. If cornstarch is present it will turn blue-black. What can you conclude?
6. Pour all 3 solutions into 1 jar. Close with a lid that is labeled with your name.

Answers / Notes

4. The filtrate under the *soft* paper towel is cloudy, indicating that the cornstarch particles were small enough to pass through its pores. The filtrate under the *hard* paper towel is clear, indicating that the cornstarch particles were larger than the pores in the filter paper and therefore trapped by the paper.

5. The cloudy filtrate (from the soft paper towel) turned a dingy grey, confirming the presence of starch. The clear filtrate (from the hard paper towel) was tinged yellow by the iodine, but indicated no starch.

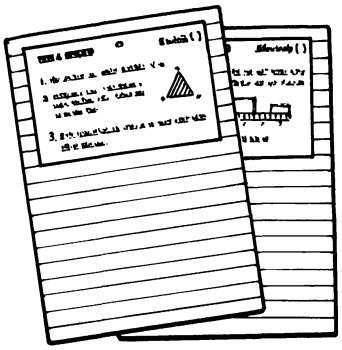
6. *This coarse suspension of blue-black starch requires from 5 to 15 minutes to settle to the bottom of the jar, depending on the amount of starch added in the original pinch. Students may begin the next activity after it settles, or wait until tomorrow.*

Materials

☐ Soft, absorbent, paper towel. Any commercial brand name sold in grocery stores will do.
☐ Scissors.
☐ "Hard," unbleached, industrial-grade paper towel. Find this dispensed in rolls (not individual sheets) in the school lavatory. You may also substitute laboratory grade paper filters or coffee filters if the paper has a close weave that is dense enough to filter out cornstarch particles.
☐ Cornstarch from the grocery store. This and most dry goods used later may be conveniently dispensed directly from the box. Keep a spoon in the box so that students can easily manage the powder and "pinch" small amounts without waste or spilling.
☐ Three baby food jars with at least 1 lid. One additional lid will be needed later. These jars are widely used throughout this module. Small beakers may often be substituted, but lack the advantage of being sealable.
☐ A water source. This is a requirement in nearly all activities, but will only be mentioned in this first activity. If you don't have an adequate distribution of sinks and faucets, substitute water-filled bottles or pitchers, plus plastic tubs to contain the excess. If your water is exceptionally hard, substitute distilled water where appropriate.
☐ Iodine dispensed in a dropper bottle. Use tincture of iodine (sold in drug stores) full strength, or dilute with water for economy. You can make your own by adding 2 g iodine crystals and 5 g potassium iodide to a liter of water. Iodine is poisonous and stains clothing. It should carry an appropriate warning label.
☐ Masking tape.

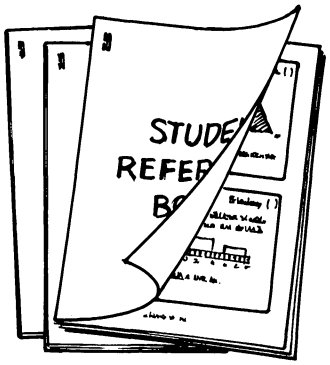
Task Cards Options

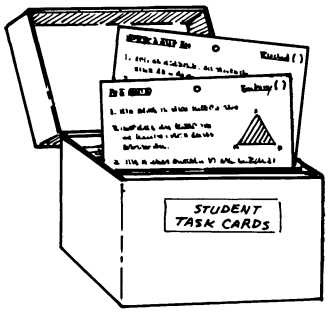
Here are 3 management options to consider before you photocopy:



1. Consumable Worksheets: Copy 1 complete set of task card pages. Cut out each card and fix it to a separate sheet of boldly lined paper. Duplicate a class set of each worksheet master you have made, 1 per student. Direct students to follow the task card instructions at the top of each page, then respond to questions in the lined space underneath.

2. Nonconsumable Reference Booklets: Copy and collate the 2-up task card pages in sequence. Make perhaps half as many sets as the students who will use them. Staple each set in the upper left corner, both front and back to prevent the outside pages from working loose. Tell students that these task card booklets are for reference only. They should use them as they would any textbook, responding to questions on their own papers, returning them unmarked and in good shape at the end of the module.



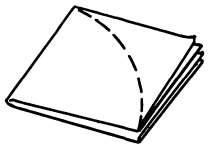


3. Nonconsumable Task Cards: Copy several sets of task card pages. Laminate them, if you wish, for extra durability, then cut out each card to display in your room. You might pin cards to bulletin boards; or punch out the holes and hang them from wall hooks (you can fashion hooks from paper clips and tape these to the wall); or fix cards to cereal boxes with paper fasteners, 4 to a box; or keep cards on designated reference tables. The important thing is to provide enough task card reference points about your classroom to avoid a jam of too many students at any one location. Two or 3 task card sets should accommodate everyone, since different students will use different cards at different times.

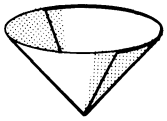
TWO KINDS OF FILTERS

Solutions ( )

1. Fold a soft absorbent paper towel into quarters. Trim the 4 loose edges into a quarter circle to make a cone-shaped filter.
2. Make a second filter like the first, from a "hard," unbleached, school-grade paper towel.

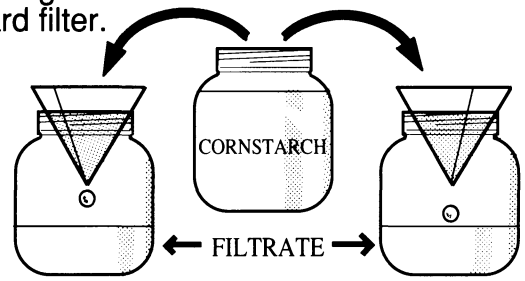


FOLD AND TRIM



OPEN CONE

3. Mix a pinch of cornstarch in a small jar full of water. Filter part of this solution into 2 more jars, some through the soft filter and some through the hard filter.

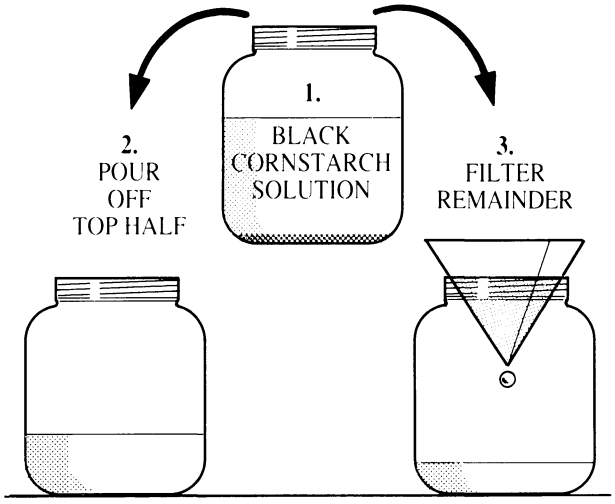


4. Examine each *filtrate*. Are the cornstarch particles larger or smaller than the pores in each filter paper? Explain.
5. Add a drop of iodine to each filtrate. If cornstarch is present it will turn blue-black. What can you conclude?
6. Pour all 3 solutions into 1 jar. Close with a lid that is labeled with your name.

TWO WAYS TO PURIFY

Solutions ( )

1. Get your black cornstarch solution from the previous activity. Be careful not to unsettle the solution inside.
2. Gently pour off the clear top *half* into a second jar. How has gravity helped purify this solution?
3. Filter the remaining bottom half into a third jar. Will just any kind of filter paper work? What special property must it have?



4. Cornstarch forms a *coarse suspension* in cold water.
   a. Name 2 ways to purify a coarse suspension.
   b. Explain how these 2 ways happen similarly in nature to clear up the water we drink.