Center for Materials for Information Technology (MINT)
University of Alabama
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Fun with oil, water and detergent: Student Activity

Activity 0.

Mix 15 mL of red colored vegetable oil and 15 mL of blue colored water in a container. Shake vigorously and then hold steady for about a minute. To a second container add 15 mL of red colored vegetable oil, 15 mL of blue colored water and a teaspoon of Dawn. Again shake vigorously, and then let stand of about a minute. How do the two solutions differ? What is happening?

Pick one of the following activities (or more if time allows).

Experiment #1: "Consumer Report Says…"

Directions:

Label each of your 5 cylinders with the name of one of the detergents you will be testing. In each cylinder add approximately 23 mL of dyed vegetable oil and 8 mL of colored water. Add 1 ¼ tsp (~5 mL) of the appropriate detergent, close lid tightly, and shake. Cylinders should be shaken simultaneously and then allowed to sit upright for 5 minutes. At the end of 5 minutes, observe the differences and measure the height of the water phase (bottom layer) in millimeters. Graph your results.

Sample Number	H_2O	Oil	Detergent	Results
1	8 mL	23 mL	5 mL of Dawn	
2	8 mL	23 mL	5 mL of Sunlight	
3	8 mL	23 mL	5 mL of Fab	
4	8 mL	23 mL	5 mL of Suave	
5	8 mL	23 mL	5 mL of Softsoap	

Experiment #2: "To Lube or Not to Lube"

Directions:

Label each of your 5 cylinders to differentiate the amounts of oil and water. In each cylinder add the appropriate amounts of dyed vegetable oil and colored water (as listed in the table below). Add 1 ½ teaspoon (~6 mL) of Dawn dishwashing liquid to each of the 5 cylinders, close lid tightly, and shake. Cylinders should be shaken simultaneously and then allowed to

sit upright for 5 minutes. At the end of 5 minutes, observe the differences and measure the height of the water phase (bottom layer) in millimeters. Graph your results.

Optional: View emulsion phase under microscope and draw results.

Sample Number	H_2O	Oil	Dawn	Results
1	25 mL	5 mL	6 mL	
2	20 mL	10 mL	6 mL	
3	15 mL	15 mL	6 mL	
4	10 mL	20 mL	6 mL	
5	5 mL	25 mL	6 mL	

Experiment #3: "How to Clean Oily Birds"

Directions:
Label each of your 5 cylinders to differentiate the diluted ratio of surfactant added to the sample. In each cylinder add the appropriate amounts of dyed vegetable oil and colored water (as listed in the table below). Add the appropriate amount of Dawn Ultra (as listed in the table below), close lid tightly, and shake. Cylinders should be shaken simultaneously and then allowed to sit upright for 5 minutes. At the end of 5 minutes, observe the differences and measure the height of the water phase (bottom layer) in millimeters. Graph your results.

Optional: View emulsion phase under microscope and draw results.

Sample Number	H_2O	Oil	*Diluted Dawn	Results
1	8 mL	23 mL	1 mL of 1:100	
2	8 mL	23 mL	1 mL of 1:50	
3	8 mL	23 mL	1 mL of 1:20	
4	8 mL	23 mL	1 mL of 1:10	
5	8 mL	23 mL	1 mL of 1:5	

Experiment #4: "Is this How I Clean Dishes?"

Label each of your 4 cylinders to differentiate the amount of surfactant added to the sample. In each cylinder add the appropriate amounts of dyed vegetable oil, colored water, and Dawn Ultra (as listed in the table below). Close lid tightly, and shake. Cylinders should be shaken simultaneously and then allowed to sit upright for 5 minutes. At the end of 5 minutes, observe the differences and measure the height of the water phase (bottom layer) in millimeters. Graph your results.

Optional: View emulsion phase under microscope and draw results.

Sample Number	H_2O	Oil	Dawn	Results
1	23 mL	8 mL	½ mL	
2	23 mL	8 mL	1.5 mL	

3	23 mL	8 mL	6 mL	
4	23 mL	8 mL	12 mL	

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Fun with oil, water and detergent: Teacher Instructions

The following four experiments were designed by Dr. Martin Bakker, Ms. Brenda O'Neil, Ms. Leigh McKenzie and Ms. Peggy Wallace to illustrate the interactions of oil, water and detergent.

Background:

Experiment #1: "Consumer Report Says…"

Objective:
To observe which type of detergent will best emulsify oil and H_2O for the longest period of time.

Materials:
120 mL pure vegetable oil dyed with candle dye (oil soluble dye that can be purchased at craft stores)
50 mL H_2O colored with food coloring
2 tsp (~8 mL) Dawn Ultra
2 tsp (~8 mL) Sunlight dishwashing liquid
2 tsp (~8 mL) Fab laundry detergent
2 tsp (~8 mL) Suave shampoo
2 tsp (~8 mL) Softsoap antibacterial handsoap
5 cylinder shaped containers with lids (approximately 50 mL)
measuring spoons/graduated pipettes
metric ruler
graph paper

Teacher Hints:

- Prepare dyed oil and colored water prior to beginning of lab.
- Dye and food coloring should be different colors.
- Cylinder lids should be water tight.

Directions:
Label each of your 5 cylinders with the name of one of the detergents you will be testing. In each cylinder add approximately 23 mL of dyed vegetable oil and 8 mL of colored water. Add 1 ¼ tsp (~5 mL) of the appropriate detergent, close lid tightly, and shake. Cylinders should be shaken simultaneously and then allowed to sit upright for 5 minutes. At the end of 5 minutes, observe the differences and measure the height of the water phase (bottom layer) in millimeters. Graph your results.

Sample Number	H_2O	Oil	Detergent	Results
1	**8 mL**	**23 mL**	**5 mL of Dawn**	
2	**8 mL**	**23 mL**	**5 mL of Sunlight**	
3	**8 mL**	**23 mL**	**5 mL of Fab**	
4	**8 mL**	**23 mL**	**5 mL of Suave**	
5	**8 mL**	**23 mL**	**5 mL of Softsoap**	

Possible Discussion Questions:

- Which detergent stabilized the emulsion of the oil for the longest period of time?
- Looking at the cost of these products per milliliter, which detergent appears to be the best buy when looking at its emulsification ability?
- Is the most expensive product always the best?
- Why do you think the different types of detergents stabilized the emulsions for different lengths of time?

Experiment #2: "To Lube or Not to Lube"

Objective:
To create emulsions using a mixture of oil, H_2O, and a surfactant to determine which ratio of oil to H_2O will create a single phase for the longest period of time.

Materials:
85 mL pure vegetable oil dyed with candle dye (oil soluble dye that can be purchased at craft stores)
85 mL H_2O colored with food coloring
40 mL Dawn Ultra
5 cylinder shaped containers with lids (~ 50 mL)
measuring spoons/graduated pipettes
metric ruler
graph paper
microscope, microscope slides, and cover slips (optional)

Teacher Hints:
- Prepare dyed oil and colored water prior to beginning of lab.
- Dye and food coloring should be different colors.
- Cylinder lids should be water tight.

Directions:
Label each of your 5 cylinders to differentiate the amounts of oil and water. In each cylinder add the appropriate amounts of dyed vegetable oil and colored water (as listed in the table below). Add 1 ½ teaspoon (~6 mL) of Dawn dishwashing liquid to each of the 5 cylinders, close lid tightly, and shake. Cylinders should be shaken simultaneously and then allowed to sit upright for 5 minutes. At the end of 5 minutes, observe the differences and measure the height of the water phase (bottom layer) in millimeters. Graph your results.

Optional: View emulsion phase under microscope and draw results.

Sample Number	H_2O	Oil	Dawn	Results
1	**25 mL**	**5 mL**	**6 mL**	
2	**20 mL**	**10 mL**	**6 mL**	
3	**15 mL**	**15 mL**	**6 mL**	
4	**10 mL**	**20 mL**	**6 mL**	
5	**5 mL**	**25 mL**	**6 mL**	

Possible Discussion Question:
- What effect does altering the ratio of water to oil have on the stability of the emulsion?

Experiment #3: “

Objective:
To determine how much surfactant it takes to form a stable emulsion after 5 minutes if the ratio of oil to H_2O remains constant at ~3:1.

Materials:
125 mL pure vegetable oil dyed with candle dye (oil soluble dye that can be purchased at craft stores)
50 mL H_2O colored with food coloring
*47 mL Dawn Ultra diluted with H_2O into ratios of 1:100, 1:50, 1:25, 1:10, and 1:5
5 cylinder shaped containers with lids (~ 50 mL)
measuring spoons/graduated pipettes
metric ruler
graph paper
microscope, microscope slides, and cover slips (optional)

Teacher Hints:

- Prepare dyed oil and colored water prior to beginning of lab.
- Dye and food coloring should be different colors.
- The diluted ratios of Dawn Ultra should be prepared prior to beginning of lab.
- Directions for preparing Dawn Ultra dilutions
  1:100 = 1 mL Dawn to 99 mL non-colored water
  1:50 = 2 mL Dawn to 98 mL non-colored water
  1:25 = 4 mL Dawn to 96 mL non-colored water
  1:10 = 10 mL Dawn to 90 mL non-colored water
  1:5 = 20 mL Dawn to 80 mL non colored water
- Each lab group should be given 2 mL of each diluted Dawn Ultra sample.
- Cylinder lids should be water tight.

Directions:
Label each of your 5 cylinders to differentiate the diluted ratio of surfactant added to the sample. In each cylinder add the appropriate amounts of dyed vegetable oil and colored water (as listed in the table below). Add the appropriate amount of Dawn Ultra (as listed in the table below), close lid tightly, and shake. Cylinders should be shaken simultaneously and then allowed to sit upright for 5 minutes. At the end of 5 minutes, observe the differences and measure the height of the water phase (bottom layer) in millimeters. Graph your results.

Optional: View emulsion phase under microscope and draw results.

Sample Number	H_2O	Oil	*Diluted Dawn	Results
1	**8 mL**	**23 mL**	**1 mL of 1:100**	
2	**8 mL**	**23 mL**	**1 mL of 1:50**	
3	**8 mL**	**23 mL**	**1 mL of 1:20**	
4	**8 mL**	**23 mL**	**1 mL of 1:10**	
5	**8 mL**	**23 mL**	**1 mL of 1:5**	

Possible Discussion Questions:

- How much surfactant does it take to form a stable emulsion after 5 minutes if the ratio of oil to H_2O remains constant at ~3:1?
- Who would need a more concentrated surfactant to clean his/her hands: an auto mechanic or a child that has playing in the mud?

Experiment #4: "Is this How I Clean Dishes?"

Objective:
To determine how much surfactant it takes to form a stable emulsion after 5 minutes if the ratio of H_2O to oil remains constant at ~3:1.

Materials:
50 mL pure vegetable oil dyed with candle dye (oil soluble dye that can be purchased at craft stores)
125 mL H_2O colored with food coloring
25 mL Dawn Ultra
4 cylinder shaped containers with lids (~ 50 mL)
measuring spoons/graduated pipettes
metric ruler
graph paper
microscope, microscope slides, and cover slips (optional)

Teacher Hints:
- Prepare dyed oil and colored water prior to beginning of lab.
- Dye and food coloring should be different colors.
- Cylinder lids should be water tight.

Directions:
Label each of your 4 cylinders to differentiate the amount of surfactant added to the sample. In each cylinder add the appropriate amounts of dyed vegetable oil, colored water, and Dawn Ultra (as listed in the table below). Close lid tightly, and shake. Cylinders should be shaken simultaneously and then allowed to sit upright for 5 minutes. At the end of 5 minutes, observe the differences and measure the height of the water phase (bottom layer) in millimeters. Graph your results.

Optional: View emulsion phase under microscope and draw results.

Sample Number	H_2O	Oil	Dawn	Results
1	**23 mL**	**8 mL**	**½ mL**	
2	**23 mL**	**8 mL**	**1.5 mL**	
3	**23 mL**	**8 mL**	**6 mL**	
4	**23 mL**	**8 mL**	**12 mL**	

Possible Discussion Questions:
- How much surfactant does it take to form a stable emulsion after 5 minutes if the ratio of H_2O to oil remains constant at ~3:1?
- Who would need a more concentrated surfactant to clean his/her hands: an auto mechanic or a child that has playing in the mud?