



# Cosmetics Teaching Unit

## Worksheets

These materials are based on a one-week vacation course for third or fourth grade elementary school students, which is part of the Forscherwelt or Researchers' World education initiative.

The teaching concept and program were developed under the guidance of Prof. Dr. Katrin Sommer, Chair of Chemistry Didactics at Ruhr University Bochum, Germany, with the support of Henkel.

## Symbols used



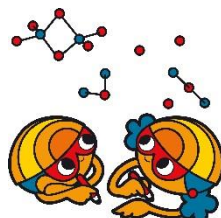
**Question to be investigated**



**Assumption**



**Experiment instructions**



**Record your observations**



**Results**

Name: \_\_\_\_\_

# Detecting the presence of acids

## Worksheet 1

Healthy teeth are attractive 😊

Bad teeth don't just look bad; they can also cause other diseases.

Taking good care of your teeth protects your health – and gives you a dazzling smile!



### What causes bad teeth? Sugar?

No – not the sugar itself. Small organisms in our mouth, bacteria, turn sugar into acid. The acid attacks our teeth and leads to tooth decay, also called caries, if we don't clean our teeth well with toothpaste.

## Detecting the presence of acids



1. Write the names of the liquids to be tested on the test tubes.
2. Guess which liquid is the most acidic, second most acidic, etc. and write down the order here:

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

4. \_\_\_\_\_

5. \_\_\_\_\_

Name: \_\_\_\_\_



3. Put about a three-finger width of each liquid into a test tube.
4. Insert the names of the liquids in the table below.
5. Using tweezers, hold an indicator paper in each sample and make a note of the color that becomes visible.
6. Tick the boxes in the table accordingly.

Very acidic -----neutral

liquid	1	2	3	4	5	6	7

Results:

Order the liquids according their acidity:



1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

4. \_\_\_\_\_

5. \_\_\_\_\_

Name: \_\_\_\_\_

# Effect of acid

## Worksheet 2

We will be using eggshells as our model substance for teeth. Just like eggshells, teeth contain calcium compounds. These calcium compounds are attacked by acids.



**What effect does acid have on the eggshell?**



Work with your partner.

1. Weigh your eggshell and make a note of its weight. (A) \_\_\_\_\_ g (oz.).
2. Put the eggshell into a small beaker and add enough household vinegar to cover the eggshell completely. Wait for 15 minutes.
3. Carefully dry the eggshell off before drying it with a hairdryer and then weigh it again: (B) \_\_\_\_\_ g (oz.)
4. Calculate the difference between the first and second times that you weighed the eggshell. TIP: To find the difference, you need to subtract one number from another.
5. (A) \_\_\_\_\_ g (oz.) – (B) \_\_\_\_\_ g (oz.) = \_\_\_\_\_ g (oz.)

Write down what the acid does to the eggshell:

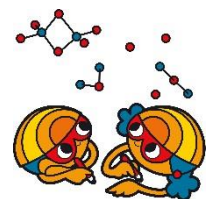
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Name: \_\_\_\_\_

# Protecting our teeth with toothpaste

## Worksheet 3



**How can you show that toothpaste protects your teeth from acid?**

Work with your partner to devise an experiment using the model substance that you have been introduced to. You can use toothpaste, vinegar and beakers for your experiment. Write down the procedure for your experiment here:

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To help you, here is a model solution:



1. Divide your eggshell into two halves by drawing a line in the center.
2. Rub toothpaste into one side and wait for three minutes.
3. Carefully remove the toothpaste with a piece of paper towel.
4. Put the egg carefully into the beaker and add enough vinegar to completely cover the eggshell.

Name: \_\_\_\_\_

# Cleaning agents in toothpaste

## Worksheet 4

Toothpastes contain a substance known as fluoride. Fluoride protects the surface of your teeth from acid. Toothpaste also contains other substances that help to clean your teeth when you brush them.



**Which substances in toothpaste help to remove food and plaque from your teeth?**



Investigate whether you can use toothpaste, table salt, lime (calcium carbonate) or detergent to clean a coin.

Work in a group of four. Each student receives a different “cleaning agent.”

1. Put a small amount of your cleaning agent onto a damp cloth and rub it onto the coin for 10 minutes.
2. Compare your coin with the coins cleaned by the others in your group.
3. What cleaned the coins best and what wasn't as good?
4. Make a note of the order:

1) \_\_\_\_\_

2) \_\_\_\_\_

3) \_\_\_\_\_

4) \_\_\_\_\_



Name: \_\_\_\_\_

# Determining the surface area of the skin

## Worksheet 5



The skin is a very large organ of the human body. But exactly how large is the surface area of the skin?



To determine the surface area of our skin, a test subject is wrapped in toilet paper.

1. The test subject first puts their left foot on the start of the toilet paper. Carefully wrap the toilet paper around their left leg up to their hips and then back down their right leg. Tear off the toilet paper and put the end under their right foot.
2. Fasten the new start of the toilet paper to the test subject's pants using masking tape and wrap the toilet paper up to their chest. At one shoulder, wrap the toilet paper down one arm until you reach the hand. Then tear off the toilet paper again. The test subject holds the end of the toilet paper with their hand.
3. Put the new start of the toilet paper in the test subject's other hand. Wrap it up their other arm and around their shoulders and neck until you reach their head. Be very careful when you are wrapping the shoulders and head as the toilet paper tears easily here.
4. Now carefully remove the toilet paper.
5. Lay out the toilet paper on the prepared squares.



One square is as large as one square meter (12 square feet). How many square meters (or square feet) of skin does your test subject have?

m<sup>2</sup> (sq. ft.)



# The effect of cream

## Worksheet 6

Have your parents ever applied cream to your face even though you didn't want them to? And have you ever wondered why?



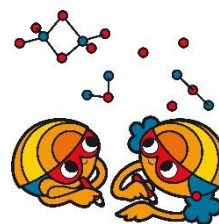
**What effect does cream have on your skin?**

Work with your partner.



1. The test subject washes both hands thoroughly with soap.
2. Pull a rubber hair band over the test subject's right and left wrists (one on each wrist).
3. Apply some petroleum jelly (e.g. Vaseline) to the test subject's right hand. Do not apply anything to their left hand.
4. Put both hands into freezer bags and seal the bags with the hair bands so that no air can get in. Make sure that as little cream as possible gets onto the freezer bag.
5. Observe the test subject's hands for five minutes and compare them. What happens to the freezer bags?

What do you see?




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Name: \_\_\_\_\_

# Investigating the properties of water and oil

## Worksheet 7

A cream contains water and oil. These substances make our skin smooth and elastic, and protect it from drying out. But what happens when we mix oil and water?



**Which of the following liquids can be mixed together: sunflower oil, isopropyl myristate (IPM)\*, olive oil and water?**

\*Note: isopropyl myristate is a colorless and odorless thin oil that is used to produce creams. It helps the cream to be better absorbed and reduces oily shine.

Work with your partner.



1. Label six test tubes with the numbers 1 through 6.
2. Conduct experiment 1 as in the table below:
  - a. Pour about 1 cm (½ inch) of liquid 1 into the test tube.
  - b. Add exactly the same amount of liquid 2 and carefully seal the test tube with a stopper.
  - c. Shake the liquids well and wait for about 3 minutes.
  - d. Check the boxes in the table to show whether or not the liquids can be mixed together.
3. Conduct experiments 2 through 6 in exactly the same way.

Experiment #	Liquid 1	Liquid 2	Can be mixed	Cannot be mixed
1	Water	Sunflower oil		
2	Water	Olive oil		
3	Water	IPM		
4	Sunflower oil	Olive oil		
5	Sunflower oil	IPM		
6	Olive oil	IPM		

Name: \_\_\_\_\_

# Conductivity

## Worksheet 8



Which of the liquids to be investigated can conduct electricity?

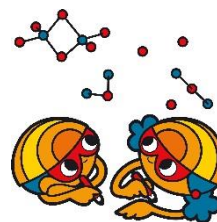


Work with your partner.

1. You are provided with a battery with an LED. Check whether the LED lights up red when you briefly hold the two ends of the battery wires together.
2. Use a pipette to add 2 ml ( $\frac{1}{2}$  teaspoon) to a watch glass.
3. Hold the wire ends of the battery in the water. The ends of the wires must not touch each other. If the small light illuminates, the liquid conducts electricity. Make a note of the result in the table.
4. Wipe the wire ends well with a tissue or paper towel after they have been used.
5. Repeat steps 2 through 4 with sunflower oil, olive oil and IPM.

Write down what you observe:

	Does it conduct electricity?
Water	
Sunflower oil	
Olive oil	
IPM	



Name: \_\_\_\_\_

**Now compile all your results in a table:**

	Can it be mixed with water?	Can it be mixed with oil?	Does it conduct electricity?
Water			
Sunflower oil			
Olive oil			
IPM			

**You can now answer the following questions:**



1) Can water be mixed with oil?

\_\_\_\_\_

2) What floats on top, water or oil?

\_\_\_\_\_

3) Can the different oils be mixed together?

\_\_\_\_\_

4) Does water conduct electricity?

\_\_\_\_\_

5) Does oil conduct electricity?

\_\_\_\_\_

Name: \_\_\_\_\_

# Making your own cream

## Worksheet 9

To be able to mix water and oil together, you need another substance – an emulsifier. We now want to make a cream from water, oil and emulsifier.

Work with your partner and check off every step before you move on to the next one.



1. Put two metal balls into a plastic container with a screw top.

2. Put into the plastic container:

a) 4 ml (1 teaspoon) paraffin oil

b) 3 ml ( $\frac{3}{4}$  teaspoon) IPM

c) 1 ml ( $\frac{1}{4}$  teaspoon) emulsifier


3. Add 2 ml ( $\frac{1}{2}$  teaspoon) of water, screw the top back onto the container and shake for approx. 30 seconds.

4. Repeat step 3 another six times until you have added 14 ml ( $3\frac{1}{2}$  teaspoons) of water to your cream.

Do not forget to shake the container (for 30 seconds) every time you add water.

To help you keep track, you can put a check in one of the boxes below each time you add water:

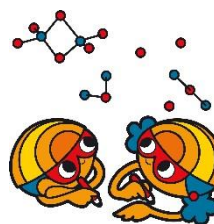
1	2	3	4	5	6



Find out whether your cream has “water properties” or “oil properties.”

(Tip: think about the investigations into conductivity.)

Write down here what you observe:




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Name: \_\_\_\_\_

# Effect of shampoo

## Worksheet 10



Why do we use shampoo to wash our hair?

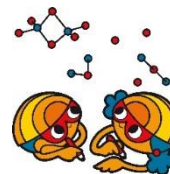
### Preliminary test: the grease spot test

1. Use a pencil to draw two circles on a single sheet of filter paper and label them "water" and "oil."
2. Add a drop of water to one circle and a drop of sunflower oil to the other circle.
3. Dry the filter paper using a hairdryer.

What do you notice after you have dried the paper?

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Name: \_\_\_\_\_

Work with your partner. Check off the steps as you do them. In this experiment, you will work on strands of hair that have been washed in different ways. You should test which “detergent” cleans the strands of hair best.

1. The four strands of hair must be marked so that you can tell the difference between them. To do so, use cable ties in the following colors:



Hair strand	Color of the cable tie
1	Blue (will be washed <u>later</u> with water – see below )
2	Yellow (will be washed <u>later</u> with soapsuds – see below)
3	Red (will be washed <u>later</u> with shampoo – see below)
4	White (will not be washed at all)

2. Rub sunflower oil into the four strands of hair: to do so, put each hair strand onto a separate watch glass. Add 10 drops of sunflower oil to each strand and massage it into the hair.
3. Carefully dab off excess sunflower oil from the strands of hair.
4. Wash hair strand 1 (blue) under running water for one minute.
5. Dry hair strand 1 with a hairdryer and put it to one side.
6. Use the disposable pipette to put 5 ml (1 teaspoon) of soapsuds onto a watch glass and rub it into hair strand 2 (yellow) for one minute.
7. Rinse hair strand 2 under running water for one minute and dry it with a hairdryer.
8. Put 5 ml (1 teaspoon) of shampoo onto a watch glass and treat hair strand 3 (red) like hair strand 2.
9. Do the grease spot test on all the strands of hair. To do so, rub the hair strands onto a piece of filter paper and then dry it with a hairdryer.

Which cleaning agent worked best and leaves the least amount of grease on the filter paper? Make a note of the order:

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_



Name: \_\_\_\_\_

# Measuring viscosity

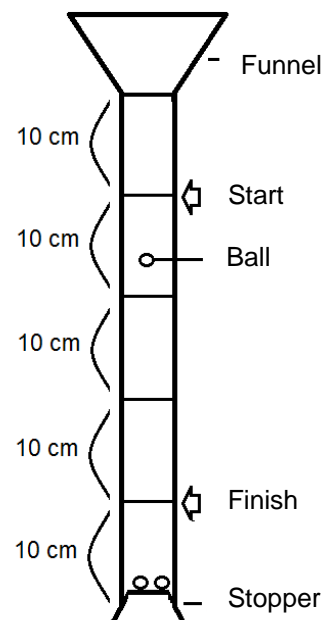
## Worksheet 11



How viscous are water, honey, syrup and shampoo?

### Experiment setup

1. Label the tube with lines 10 cm (4 inches) apart and clearly mark the start and finish. The distance between the start and finish should be 30 cm (12 inches).
2. Fix the tube to a support rod so that it hangs vertically.
3. Seal the bottom end of the tube with a stopper.



### Procedure

1. Fill the tube with the liquid assigned to your table (water, honey, syrup or shampoo).
2. Put a ball into the tube and measure the time it takes the ball to travel the distance between the start and finish. Record the time in the table on the next page (fall time 1).
3. Repeat the measurement three times and also record the figures in the table (fall times 2-4).
4. Now go to the next table and carry out the measurements there with the liquid that the students on that table put into their tube.
5. After you have been to all four stations, you will be back at "your" table. Calculate the average (mean value) of the four fall time measurements for "your" sample.

Name: \_\_\_\_\_



## Evaluation

This is how you calculate the average:

1. First add together the four fall times that you wrote down:

$$\text{Fall time 1} + \text{fall time 2} + \text{fall time 3} + \text{fall time 4} = \text{result}$$

2. Divide the result by 4:

$$\text{Result} \div 4 = \text{average}$$

Enter the averages for all the samples in your worksheet.



Sample	Water	Honey	Syrup	Shampoo
Fall time 1 (in seconds)				
Fall time 2 (in seconds)				
Fall time 3 (in seconds)				
Fall time 4 (in seconds)				
<b>Average</b> (in seconds)				

Name: \_\_\_\_\_

# Stability of hair

## Worksheet 11

Our hair is subjected to different types of damage every day. This means it is important not just to wash your hair but also to use additional hair care products. But exactly how strong is one very thin hair?



**Develop a method to test the stability of hair.**

**Materials you can use:**

- Strands of hair
- Quartz sand
- Scales
- Plastic cup
- Stand
- Adhesive tape
- Freezer bags
- Wire

**Draw a sketch of your apparatus here:**

Name: \_\_\_\_\_

Now use your apparatus to measure how many grams (or ounces) one hair can bear before it tears. To do so, take several measurements:

Measurement 1	Measurement 2	Measurement 3

Now find the average (mean value) for these measurements. You do so as follows:

1. First add together the figures for the 3 measurements

$$\text{Measurement 1} + \text{measurement 2} + \text{measurement 3} = \text{result}$$

2. Since you carried out 3 measurements, you must now divide your result by 3

$$\text{Result} \div 3 = \text{average}$$

How much weight does one hair bear?

g (oz.)



Name: \_\_\_\_\_