B3.2 Air pollution

It has recently snowed. The balcony and yard are covered by a white layer of snow. It looks beautiful. However, as you walk along the street to catch the bus, you see that the snow near the curb looks totally black.

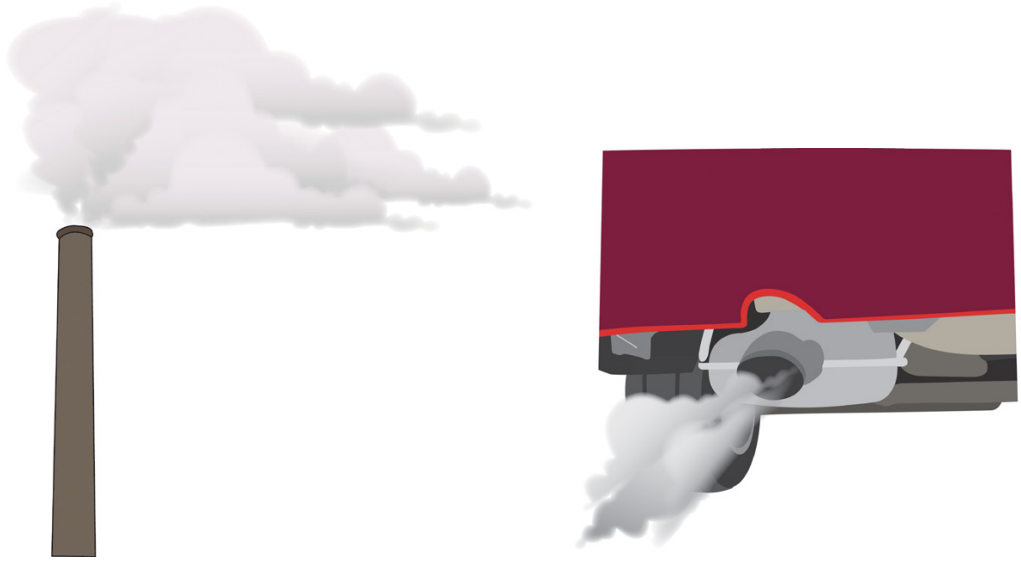

Figure 1: Pollution of the environment from exhaust gases.

Why is the snow near the curb black and not white?

Write down your ideas and guesses:

You need the following for the experiment:

- ☐ 1 piece of adhesive tape
- ☐ 1 cotton swab
- ☐ 1 fireproof base
- ☐ 1 magnifying glass
- ☐ Matches
- ☐ 1 pair of scissors
- ☐ 1 tea light
- ☐ 1 test tube
- ☐ 1 test tube clamp
- ☐ 1 towel
- ☐ Water

Figure 2: Required materials.

How to set up the experiment:

Lay out all the materials as shown in the photo.

How to conduct the experiment:

1. Place a tea light on the fireproof base and light it.
2. Wait until the flame burns evenly, and then use the test tube clamp to hold the test tube above the tea light so that the closed end of the test tube touches the tip of the flame.
3. Check the test tube after three seconds. If you do not observe anything, move the test tube a little more into the flame and hold it a bit longer over the tea light.
   Attention! The test tube is now hot.
4. Use the cotton swab to wipe the test tube. What is the nature of the substance? What color is it? Write down your observations.

Now you will go outside and be an environmental detective: Find the dirt in the air we breathe.

5. Find a test object with a smooth surface: a windowsill, a patio table, or something similar.
6. Use a moist towel to wipe the surface clean and then wait for one day.
7. Cut a piece of adhesive tape approximately 7 cm long. Hold the adhesive tape only at the ends, because the middle section must remain clean.
8. Press the sticky side of the adhesive tape on your test object and immediately pull it up.
9. Observe the adhesive tape with the magnifying glass and write down what you can see.

Write down your observations:

On the bottom of the test tube, I recognize: _____

_____

_____

On the sticky side of the adhesive tape, I recognize: _____

_____

_____

Evaluate your observations:

1. Guess what substance you discovered on the test tube.

_____

_____

2. The substance on the test tube is produced in many other processes. Write down where else you know this substance from.

3. Guess what you picked up on the adhesive tape.

Doing further research:

Many European cities have low-emission zones. Only cars with low exhaust emissions may be driven there.

1. What could be the reasons for these regulations?
2. Find out what conditions must be met before someone is permitted to drive in a low-emission zone.

Figure 3: The sign indicates that the low-emission zone rules apply here.

Tracking down technology

Perhaps you have helped vacuum at home. The vacuum removes dirt and dust from the floor and from objects. Here you will learn how a vacuum cleaner works and discover other ways of removing dirt.

1. The following text describes the principle of a vacuum cleaner.
   Read the text and then in your own words explain to your classmate next to you how a vacuum cleaner works.

a.	A vacuum cleaner has a motor that drives a cooling fan. (Think of this fan as similar to a room fan.)
b.	The cooling fan generates a negative pressure.
c.	Air, dust, and dirt are drawn into the vacuum cleaner by the negative pressure.
d.	This airflow passes through several filters in the vacuum cleaner and is cleaned.
e.	The clean air is expelled from the vacuum cleaner. The dust and dirt remain inside the vacuum cleaner.
f.	When the vacuum cleaner is full of dirt, it must be emptied.

2. A vacuum cleaner needs current to work. Look for the place in the text where current is needed and write down the letters: _____
3. Why is electricity needed?
4. Guess why the air that comes out of the vacuum cleaner is warm.

So, a vacuum cleaner has filters. You are already familiar with filters from the experiment on water purification.

5. In your own words, describe the properties of a filter.
6. Vacuum cleaners with a vacuum bag are common.
   Have an adult show you the inside of a vacuum cleaner and count the number of filters.
   Tip: The vacuum bag is one of the filters.
7. Find out what function the filters perform.
   Write down your results.

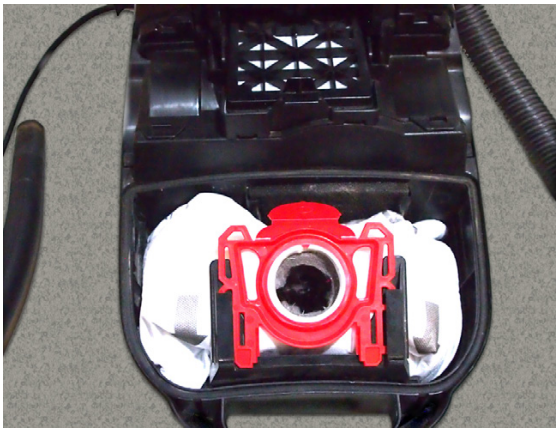

Figure 4: Vacuum cleaner with bag.

Other technologies can be used in place of the bag to filter the dirt out of the drawn-in air. Then you no longer need a vacuum bag. That's why these vacuum cleaners are called **bagless vacuum cleaners**.

The photo shows a bagless vacuum cleaner.

8. Where do you think the dirt is collected? Circle the place on the photo.
9. With your teacher's help, find out how dust particles are separated from the air without filters. If you search on the Web, the following keywords can help you: cyclone filter, cyclone principle. Take notes.

Figure 5: Vacuum cleaner without a bag.

Filters are also used in cars because engine combustion produces exhaust gases and pollutants that should not reach the environment.

10. Find out from someone who has a car or from a car repair shop where filters are installed in the car. Take notes.
11. What are these filters used for?

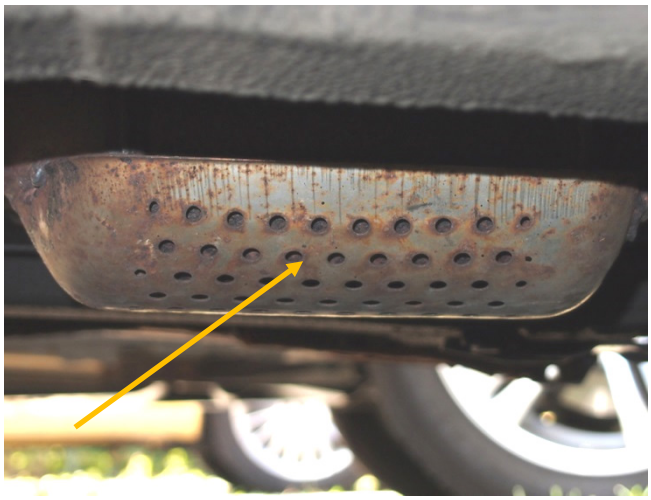

Figure 6: Catalytic converter and diesel particulate filter in the exhaust pipe of a diesel vehicle.

The filters are usually built into the car, and you almost can't recognize them. If you lie underneath a diesel vehicle, you can see the device shown in the adjacent photo. It contains the diesel particulate filter, which makes sure that black smoke doesn't pour out of the exhaust pipe.

What is your opinion?

It's your best friend's birthday and he lives just a few blocks away from you. You and your brother have been invited. You're running late. Your brother suggests, "Let's ask Mom if she can drive us over!"

Think about it: What would you do?