Environmental Science Lab

ANALYSIS OF PARTICULATES IN THE AIR

OVERVIEW

Particulates are solid or liquid particles that remain suspended in air for a long period of time. Most are less than 500 μm in diameter. Particulates are a common component of the air around us. It is a mixture of dust particles and tiny water droplets that form the clouds in the sky. The source of these particulates is varied. They can be soil particles blown by the winds or dust from volcanic eruptions. They can have an anthropogenic source such as smoke from a factory or the exhaust of a diesel truck. Regardless of their origin, they can have a detrimental impact on the health of living organisms. They are easily inhaled by humans and can irritate or scar the lungs. In cases of extreme exposure, they can cause serious lung problems such as the "black lung" disease suffered by coal miners. In this lab activity you will collect and analyze particulates from your local area.

1. You will first use the cardboard and the glass slide to make an apparatus that can capture the particulate matter from the air. The particulate matter will stick to the petroleum jelly on the glass slide.

2. Next, you will leave your particulate collectors in two separate locations for about 24 hours. Ideally one location will be inside and the other will be outside.

3. Using a microscope, you will analyze the glass slides to determine the type of particulate matter found in the two locations.

4. Finally you will determine the source of this particulate matter and clean up the lab.

TIME REQUIREMENTS

Part 1: This requires a 30-minute class period for preparation and set-up of the laboratory procedure.

Part 2: This requires a 50-minute class period to collect and analyze the data.

LAB EQUIPMENT AND MATERIALS

A list of equipment and materials you will need to perform for each part of the lab is given below.

Part 1:

Equipment	**Amount Needed**
Microscope slide (glass)	2
Razor blade or sharp knife	1
Materials	**Amount Needed**
Cardboard piece (thick, 120 mm x 50 mm)	2
Index card (3" x 5")	2
Petroleum jelly	2 teaspoons
String (30 cm)	2
Tape (2-3 cm piece)	1

Part 2:

Equipment	**Amount Needed**
Microscope (with measuring eyepiece)	1

LAB PROCEDURE

Hints for a successful lab:

⇒ Cut the cardboard so that the glass slide is sitting flush with the top of the thick cardboard. That way the slide will not be shielded from the wind by the top of the cardboard. If this is not possible, you can simply tape the slide to the cardboard, but be careful not to disturb the slide during data collection.

⇒ Be careful when using the razor blade or knife!

⇒ Be aware of your local area. It may be more likely to find a higher concentration of particulates in one location than another.

⇒ Leave your particulate collectors in areas where they can be exposed to moving air. This will maximize the amounts of particulates that strike the collector in a given amount of time. Try to not shelter the collector in a bush or behind a wall.

⇒ Become familiar with the measuring scale within the eyepiece of your microscope. It is important to accurately measure the particulate sizes.

Part One:

Make the collectors

1. Cut an opening in the top portion of the thick cardboard about the size of the glass slide using the razor blade or knife. Try to cut the hole a little wider but a little shorter than the slide. The shorter length will provide the pressure to hold the glass in place. The hole should be deep enough that the glass slide lies flush with the top of the cardboard. See Fig. 1.

2. Cut a small hole in one end of the cardboard. This will be the top of the collector.

3. Insert the glass slide into the cardboard and secure it into place using the pressure from cardboard near the ends of the slide to. If the slide will not properly wedge into the cardboard, use double sided tape to secure the slide.

4. Smear the petroleum jelly on the center portion of the slide. The jelly should be evenly applied with a clean finger. Do not use paper products as they contain particulate matter and can skew the data. The smear should be about 2 cm x 2 cm.

5. Insert the string into the hole and make a loop. You will hang the collector from this string.

6. Make a second collector following steps 1-5.

Place the collectors

1. Place the collectors in two separate locations. One location should be inside and one should be outside. The particulates in the air will collect on the petroleum jelly. Select locations with some air movement, as this will maximize the amounts of particulates collected. Avoid rainy or wet areas.

2. Fill out data worksheet with the location information.

Part Two:

Retrieve the collectors

1. After 24 hours, retrieve the collectors.

2. Cover the front of the collector (the side with the exposed petroleum jelly) using an index card. This will protect the jelly during transportation. Tape can be used to secure the index card to the front of the cardboard.

3. Return to the classroom.

Analyze the particulates

1. Remove the slide from the cardboard. Be careful to not disrupt the petroleum jelly containing the embedded particulates.

2. Place the slide on the microscope stage. A cover slip is not necessary.

3. Focus your microscope so you can see the surface of the petroleum jelly. It will appear thick and wavy under the microscope. Use the fine focus knob to focus through the jelly until you can view the particulates embedded within the jelly.

4. Describe the types and numbers of particulates and measure their sizes using the measuring scale within the eyepiece of your microscope. If you are uncertain about any description, then do the best you can. See Table 1.

5. Record the information on the data worksheet.

LAB REPORT / ANALYSIS QUESTIONS

Answer the following questions in complete sentences.

1. What are the differences between natural and anthropogenic particulates?

2. Which industries or industrial activities generate the greatest amount of anthropogenic particulates?

3. Briefly describe the two particulate collection sites.

4. Which was the most frequently found type of particulate on the indoor collector? How frequent was it?

5. Which was the most frequently found type of particulate on the outdoor collector? How frequent was it?

6. What was the most unusual particulate found on either of your collectors.

7. Name three natural and three anthropogenic sources of particulates. Which of these are common in your geographic region?

	Natural	Anthropogenic
1.		
2.		
3.		

8. Explain the human physiological effects of particulates and name one disease they can cause.

9. Name one effect of excessive particulates on plant life.

10. Particulate matter such as soot and fly ash are frequently found in industrial and incinerator effluents. The government has mandated that devices must be installed on smokestacks that reduce the amount of particulate matter released. Describe (in detail) one mechanism that can reduce and control the amount of particulates released.

11. Name one piece of federal legislation that governs air quality.

12. Name one local or federal agency that regulates air quality.

13. How could you reduce the amount of particulate matter at your two collection sites?

14. What is one natural way that the earth removes particulate matter from the air?

15. What are possible sources of error in this experiment?

16. Write a comprehensive summary and conclusion of your results.

END OF LAB

Fig. 1 Particulate Collector

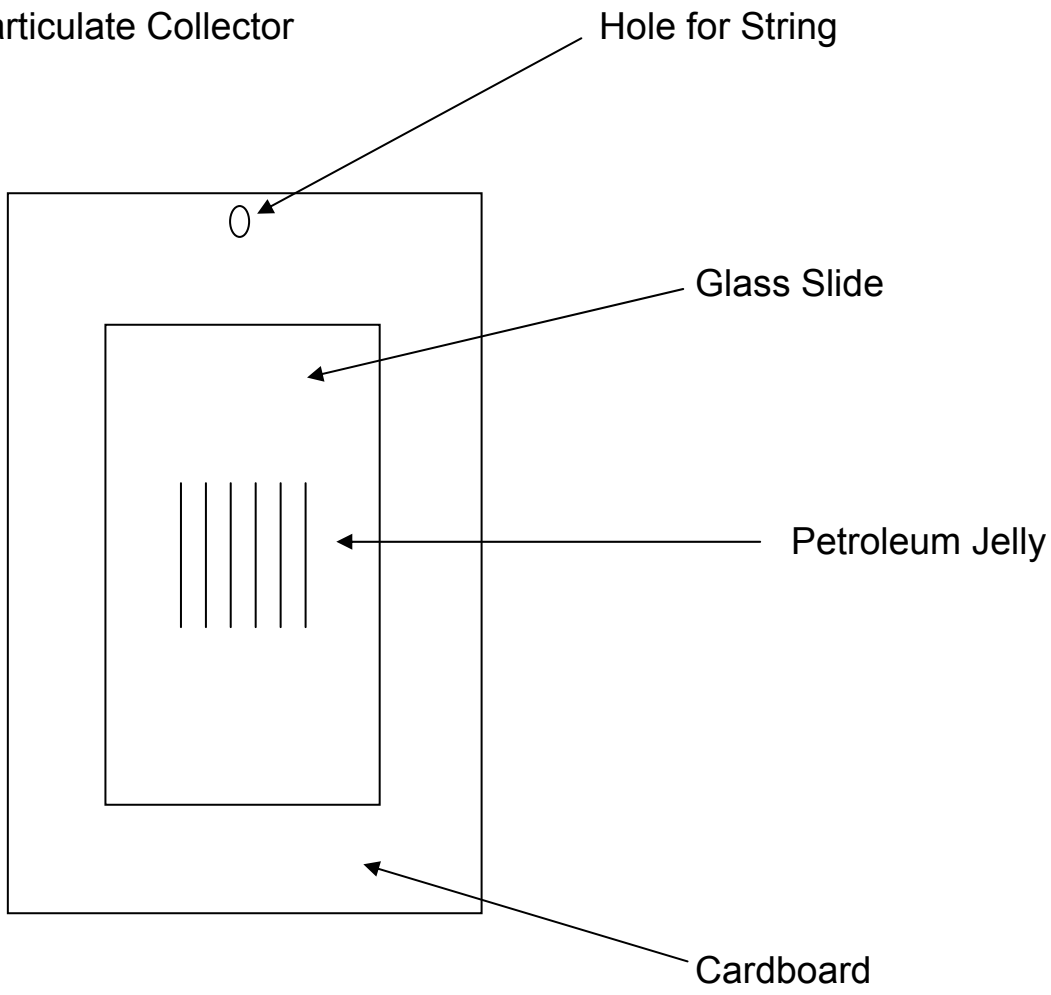

Table 1.

Types of Particulates		
Name of Particulate	**Radius Size (μm)**	**Description**
Raindrops	500-5000	Round, light *** Use as a size reference point ***
Sea salt droplets	1-40	Light, regular and round
Ground limestone	30-800	Light, granular
Fly ash	3-80	Dark, irregular edges with definite planes
Pollen	20-60	Light colored, round, with protrusions
Bacteria	1-15	Round and dense
Foundry sand	20-200	Light colored, granular shaped
Coal dust	10-400	Dark, irregular edges with definite planes
Cement dust	10-150	Light, irregular edges with definite planes
Fertilizer	30-800	Round and dense
Milled flour	10	Tan, round with flat edges

Particulates Data Worksheet

	Collection Site #1	Collection Site #2
Specific Site Location:		
Indoors or Outdoors:		
Collection Duration (h):		
Most Frequent Particulate		

Particulate Type Observed	General Description	Location (#1 or #2) (Indoor or Outdoor)	Radius Size (μm)	Possible Source	Anthropogenic or Natural
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					