

Explore the Air Around You Check-Out Kit Activity Guide

For 3rd-8th grade students

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Supplies Included

- Five petri dishes
- One container of hypoallergenic petroleum jelly
- Wooden applicators
- One permanent marker
- String
- Tape dispenser
- Explore the Air Around You - Particle Photo Guide
- Explore the Air Around You - Activity Worksheet

Activity

This activity will help you explore some of the different **particles** that exist in the air but are too small to be seen with just your eye. Much of what we find in the air are small bits of larger things that are floating on air currents, like bits of dried plant material, dust, sand, and animal hair. However, some particles that can be found in the air are there because they use air to travel from one location to another, like plant **pollen**, spores of **fungi**, and certain **viruses** and **bacteria**. Most living things in the air are **microbes**.

It is difficult to see many of these particles with just your eyes because they are so small. Some of the particles may be big enough to see with a magnifying glass, but the best way to view extremely small objects is by using a **microscope**. Microscopes use lenses and focused light to help increase the images of tiny objects so you can see the details that were invisible before. Most microscopes will be able to show you what something looks like up to one thousand times larger than it is. You can find particles like dust, sand, pollen, spores, plant matter, and other larger particles using a regular microscope.

Even though regular microscopes can show you many things that you would not be able to see with your eyes, some things are so small you would need special (and expensive) microscopes to see them such as electron microscopes. They allow you to see particles that are one to five million times larger than they occur; this means you

can look at particles the size of **molecules**. With an electron microscope, you would be able to see really, tiny objects, like smoke particles, water molecules, and even microbes like bacteria and viruses.

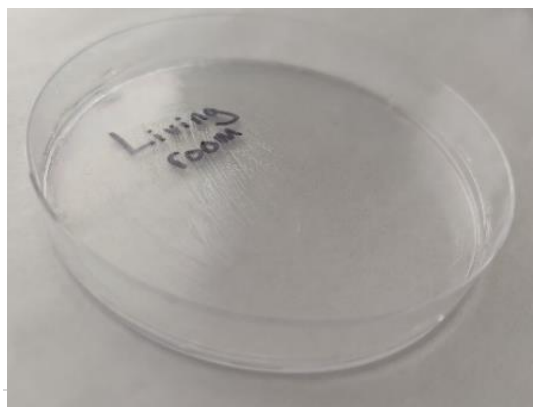
For this activity, you will be using a simplified method that scientists use by spreading petroleum jelly on petri dishes and hanging them in different areas to trap particles moving through the air. By yourself or with someone, start thinking about where there might be different types of particles. For example, do you think you would find the same kind of particles inside your home as you would outside? What about different places outside, like near lots of cars or plants?

The best way to do science is to learn a little bit about something (just like you've learned a little bit about the different things that are in the air), and then make a prediction about what you think will happen if the things you've learned are true. Once you have decided which five locations you are going to use, fill out the location of where you are placing the plates in the **Predictions** part of the **Activity Worksheet**. The locations and the predictions should be filled out on the worksheet before you collect any samples.

For this activity, use the permanent marker to write one location name on each of the five dishes. Remove the lid and label the name on the inside of the bottom (taller) dish as shown in Figure 1.

Figure 1

Labeled petri dish: Living Room



Once the ink is dry, use the wooden applicator to scoop a bit of the petroleum jelly (about the size of a pea). See Figure 2.

Figure 2

Petroleum jelly on wooden applicator



Place the scoop of the petroleum jelly in the center of the petri dish. Use your finger to spread a thin layer of petroleum jelly across the inside surface of the petri dish. Make sure the layer covers the entire bottom of the dish like in Figure 3.

Figure 3

Thin layer of petroleum jelly looks like



Note: If the jelly is too thick, there will be a higher chance of producing air bubbles.

Once the jelly has been applied, put the lid back on the petri dish to stop anything from settling on the layer of jelly. There will be left over petroleum jelly on your finger, use this to add the thin layer of jelly to the remaining four dishes. One pea size scoop of petroleum jelly should be enough for all five petri dishes. Replace the lids of the other four dishes.

Use tape to attach lengths of string to each dish. Make sure you have enough string to hang the dishes in different locations. Now, hang the petri dishes in the five locations you chose. Figure 4 shows how the string is attached to the petri dishes and hung in the desired location.

Figure 4

Hanging the petri dish



Avoid placing the petri dish in a hot space or in direct sunlight. Otherwise, the petroleum jelly might melt, and the particles might slide out of the petri dish.

Once the petri dishes have been hung, remove the top of the five lids and leave your petri dishes uncovered for at least five days. Remember to keep the (top) dish lids in a safe place to use after the experiment is over. After five days you will be ready to see what your petri dishes have trapped.

Put the lids that you had put in a safe place, back on the top of the petri dishes and tape the lids so they don't fall off. It doesn't matter if the lids go back onto the same dish they came from. Place all five, sealed petri dishes in a bag.

To see what particles you've collected, you will need to return to the library where you borrowed this kit. Ask the front desk how to borrow their microscope for this kit. You will use the microscope to discover the particles you have collected in the petri dishes. The **Particle Photo Guide** included in this kit will help you determine what kind of particles

you have collected. Now, fill out the **Observations** section found in the **Activity Worksheet** and compare it to the **Predictions** section that you filled out previously.

After you have identified the particles you have collected find someone to have a discussion with about what you found. Great questions to start with are:

- *Did you find the particles you predicted you would find? Were there particles in locations you didn't predict?*
- *What particles did you find that you did not expect to find? Where do you think these particles came from?*
- *What particles did you not find that you expected? What do you think stopped them from getting there?*
- *Which particles do you think are the coolest to look at?*

Science in Action

Scientists use a method like this to collect air particles from different places around the world. Once they have collected their samples, they will use **DNA** testing to see what living **organisms** they have found. Particles such as dust, sand, and fibers do not have DNA. Therefore, they do not show up on DNA tests. However, pollen, fungal spores, bacteria, and viruses do. As such, scientists can use the sampled DNA to identify different types of organisms that are found in a forest (see Figure 5).

Figure 5

Rotating sample collectors made and used by scientists at Colorado State University



Just like you added petroleum jelly to a dish, scientists will spread a thin layer of petroleum jelly or rubber cement onto a glass plate. These plates are then attached to a bar that rotates with a small motor. A plastic cup and a skirt made of aluminum protect the motor from rain and snow. These samplers are cheap to make and are used to measure **pathogens** in hard-to-reach places like the forests in Rocky Mountain National Park. Figure 6 shows another method that involves using a pump to pull air, and the particles in the air, through a filter.

Figure 6

Air pump filter collecting samples from the air



After particles have become trapped in the filter, scientists use them to run **DNA** tests, which lets them identify different types of bacteria and fungal spores that were collected in the filter. To do this, scientists collect samples from the filters as shown in Figure 7.

Figure 7

Samples in three petri dishes collected from filters



Once the samples are collected in petri dishes, scientists will help the organisms in the dish reproduce by feeding them and keeping them at the right temperature. This will give them more organisms to work with. Once there are enough organisms growing on a dish, scientists will remove the organisms and extract their DNA, like in Figure 8.

Figure 8

Dr. Pankaj Trivedi prepares samples taken from filters to use in a DNA test



Once they identify the organism's DNA, they will compare what they find to the DNA of other species by using computers. DNA tests allow scientists to determine exactly what species of plant pollen, bacteria, or fungi are floating in the air, and how things like weather and temperature change the species they find. This is very important because it allows scientists to know when pathogens appear that can harm the plants and animals living in that area.

Glossary

Bacteria: Organisms that are made up of only one cell. Like fungi, they are alive but are not animals or plants. There are trillions of different kinds of bacteria on Earth.

DNA: Deoxyribonucleic acid (DNA) is material found in every cell of every organism. It provides unique information about how that organism was built and gives information about their ancestors. This means you can use DNA to tell what kind of organism it came from.

Fungi: A group of organisms that use spores to reproduce. Fungi are alive but are not animals or plants. They mostly feed on rotting organic matter. Mushrooms and yeast are a type of fungi.

Microbes: Really tiny things that are alive but aren't an animal or a plant. Some examples are things like bacteria, fungi, mold, and viruses. "Micro" means small in Greek.

Microscope: An instrument that humans use to look at very small particles. Microscopes can be very simple (a little more complicated than a magnifying glass) to incredibly complicated (a huge machine used to look at things so small they almost don't exist).

Molecules: The smallest piece that a particle can be before it no longer is that particle. If you cut a piece of cheese in half hundreds of times, eventually you would be left with the smallest piece of cheese (a molecule of cheese) that would be so small it couldn't be cut anymore and still be cheese.

Organisms: Organisms are living things on our planet, like plants, animals, bacteria, and fungi. Viruses have DNA but are not alive.

Particles: Smaller pieces of a larger item, like sawdust from a piece of wood.

Pathogen: An organism like bacteria, viruses, or fungi that causes disease in plants and animals. Did you know that plants can get sick, just like humans?

Pollen: A fine powder of small particles that come from plant flowers so they can reproduce. Each grain of pollen is an individual cell of a plant that fertilizes the eggs held within other flowers of the same type.

Spores: Tiny little pieces that fungi use to grow in new places, similar to pollen.

Viruses: Very small cells that only have enough DNA to infect healthy plant and animal cells to reproduce. Viruses usually make what they have infected sick. Examples of some sickness caused by viruses are Covid-19 and common colds. In plants, an infection from a virus causes poinsettias to become red!

Objectives

Students will be able to express an understanding that there are particles in the air that we cannot see with our unaided eyes.

Intended Outcomes

After completing this lesson plan and activity, students will be able to identify some particles that can be found in the air and explain how they got there. Additionally, they will display an understanding of how to use a microscope, and knowledge of how scientists use observations to make and confirm predictions.

Age/Grade Levels

This lesson plan is intended for third through eighth grade students. However, if you modify this lesson for a different grade level, please email

BROADN_Outreach@colostate.edu to show us that version. We want to see how others have effectively expanded this lesson.

Colorado Science Standards Met

Assures educators that the content addresses the concepts that students are learning at school.

Grade Level	Science Standards	Standards Met
3 rd	Life Science	Organisms have unique and diverse life cycles.
	Life Science	Different organisms vary in how they look and function because they have different inherited information; the environment also affects the traits that an organism develops.
	Earth and Space Science	A variety of weather hazards result from natural process; humans cannot eliminate weather-related hazards but can reduce their impacts.
4 th	Life Science	Organisms have both internal and external structures that serve various functions.

	Earth and Space Science	Earth's physical features occur in patterns.
	Earth and Space Science	Energy and fuels that humans use are derived from natural sources and their use affects the environment in multiple ways.
5 th	Physical Science	Matter exists as particles that are too small to be seen; measurements of a variety of observable properties can be used to identify particular materials.
	Life Science	Matter cycles between air and soil and among plants, animals and microbes as these organisms live and die.
	Earth and Space Science	Societal activities have had major effects on the land, ocean, atmosphere and even outer space.
Middle School	Life Science	Organisms...are dependent on their environmental interactions both with other living things and with nonliving factors.
	Life Science	Biodiversity is the wide range of existing life forms that have adapted to the variety of conditions on Earth, from terrestrial to marine ecosystems.
	Earth and Space Science	Humans depend on Earth's land, ocean, atmosphere, and biosphere for different resources...Resources are distributed unevenly around the planet as a result of past geologic processes.
	Earth and Space Science	Human activities have altered the biosphere, sometimes diagraming it, although changes to environments can have different impacts for different living things.

<https://www.cde.state.co.us/apps/standards/>