

# DEQ in the Classroom:

## Earth Cleaning: “Dusting” the Air\*



IDAHO  
DEPARTMENT OF  
ENVIRONMENTAL  
QUALITY

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Boise, ID 83706  
208/373-0502

[www.deq.idaho.gov](http://www.deq.idaho.gov)

### Grade Level:

Grades 4 - 8

### Time Required:

One 50-minute class period and one 30-minute class period, one week apart. (Times will vary, depending on level of discussion, level of assistance needed in building dust catchers, and use [or not] of optional portions of the activity.)

### Objective:

To learn that particulate matter (PM) is a type of air pollution, what causes PM, and what students can do to reduce PM.

### Meets Idaho State Standards:

Grade 4: 4.M.2.1.1\*, 4.M.5.2.2\*, 4.S.1.2.1, 4.S.1.3.2\*, 4.S.1.6.2, 4.S.1.6.3\*, 4.S.1.6.4, 4.H.1.1.10

Grade 5: 5.M.2.1.1\*, 5.M.5.2.1\*, 5.S.1.2.1, 5.S.1.3.2\*, 5.S.1.6.2, 5.S.1.6.3\*, 5.S.1.6.4, 5.2.1.6.6, 5.S.1.8.1, 5.S.5.1.1, 5.H.1.1.8

Grade 6: 6.M.2.1.1\*, 6.M.5.2.1\*, 6.S.1.2.2, 6.S.1.3.2\*, 6.S.1.6.3\*, 6.S.1.6.4, 6.S.5.1.1, 6.H.1.1.10

Grade 7: 7.M.2.1.1\*, 7.M.5.2.1\*, 7.S.1.2.2, 7.S.1.6.1, 7.S.1.6.2\*, 7.S.1.6.3, 7.S.1.6.5, 7-8.H.1.1.9

Grade 8: 8.M.2.2.1\*, 8.M.5.2.1\*, 8-9.PS.1.1.1, 8-9.PS.1.2.3, 8-9.PS.1.6.2, 8-9.PS.1.6.4, 8-9.ES.1.2.1, 8-9.ES.1.2.3, 8-9.ES.1.6.1, 8-9.ES.1.6.4, 8-9.ES.5.1.1, 7-8.H.1.1.9

### Focus:

Air quality, particulate matter. Students collect and observe PM that is deposited near their schools to learn what causes PM in the air and what students can do to reduce PM.

### Materials:

One 10-inch x 2-inch piece of cardboard per student (one 2 ft x 2 ft square of cardboard will yield enough for a class of 25)

Compasses (to draw circles) or quarters (to trace circles) (one per student)

Scissors (one per student)

Hole punchers (one per student is best, but can share)

Clear tape (1 role) (2-inch-wide, packing-type tape works best)

String (25 ft, cut into 1-ft lengths)

Magnifying glasses (one per student is best, but can share)

Permanent markers (narrow point) (one per student)

Balance(s) (optional) (5 or more work best) (records in milligrams or smaller units)

Instruction sheet (Page 8; make one copy per student)

“Do not touch” signs (Pages 9-10; 2 per page; make one, double-sided copy per catcher)

Paper towels or rags

\*Adapted from “Air Strips,” Air & Waste Management Association, *Environmental Resource Guide, Air Quality*, Grades 6 - 8.

\*\*Meets these standards if “optional” Steps 7, 12, and 13 are completed.

## Background:

Particulate matter, or PM, is a type of air pollution. PM is the term for small particles found in the air including dust, dirt, soot, smoke, and liquid droplets. Particles can be suspended in the air for long periods of time.

Some particulates in the air are large enough to be seen, but many are not. In fact, the types of particulates that are of concern for air pollution and human health are much smaller than the diameter of a human hair (human hair = 70 micrometers in diameter): PM<sub>10</sub> (“coarse” particulate matter) is less than or equal to 10 micrometers in diameter and cannot be seen with the naked eye; PM<sub>2.5</sub> (“fine” particulate matter) is even smaller—less than 2.5 micrometers in diameter—and can only be seen with an electron microscope.

Some particulates are directly emitted into the air while others are formed in the air through chemical reactions. Sources of PM<sub>2.5</sub> include all types of combustion (motor vehicles, power plants, wood burning, etc.) and some industrial processes. Sources of PM<sub>10</sub> include industry, crushing or grinding operations, and dust from paved or unpaved roads.

Both PM<sub>2.5</sub> and PM<sub>10</sub> can accumulate in the respiratory system and are associated with numerous health effects. Adverse health effects have been associated with exposures to PM over both short periods (such as a day) and longer periods (a year or more). It can impair the development of children’s lungs; aggravate asthma, emphysema, and bronchitis; and exacerbate allergies. Particulates in the air (or light reflecting off of them) are often what people see when the air looks “dirty.” They are one of the main causes of visibility impairment (haze) in the United States.

In Idaho, many areas have the right combination of pollution sources, weather conditions, and terrain that lead to high levels of particulate pollution. Areas of special concern in Idaho are the Sandpoint area (Bonner County), the Silver Valley (Pinehurst), the Portneuf Valley (Pocatello area), the Cache Valley (Franklin County/Preston area), and Treasure Valley (Boise area).

## Vocabulary:

<b>Alternative Fuel</b>	A fuel that takes the place of traditional petroleum gasoline or diesel fuels.
<b>Biodiesel (B20)</b>	A mixture of diesel fuel with soybean or vegetable oil-based products. B20 (20% biodiesel and 80% petrodiesel) is the most common blend.
<b>Clean Air Zone Idaho</b>	A statewide program aimed at reducing children’s exposure to school bus diesel exhaust and other vehicle exhaust by discouraging the idling of vehicles and encouraging the use of alternative fuels in school buses.
<b>Combustion</b>	The process of burning.
<b>Compressed Natural Gas (CNG)</b>	Natural gas used to fuel vehicles. CNG vehicles may run exclusively on natural gas or on both natural gas and gasoline.
<b>Diesel Retrofit Technology</b>	Equipment that can be added to diesel engines to reduce emissions.
<b>Emission</b>	The act or instance of discharging (emitting) something into the air, such as by an internal combustion engine (e.g., a vehicle).
<b>Emit</b>	To give off or discharge.

<b>Ethanol (E10 and E85)</b>	Alcohol, commonly derived from corn, that can be blended with traditional petroleum fuel. Common blends include E10 (10% ethanol and 90% petroleum) and E85 (85% ethanol and 15% petroleum).
<b>Exhaust</b>	The fumes or gases released from an engine.
<b>Particulate Matter (PM)</b>	Small particles in the air including dust, dirt, soot, smoke, and liquid droplets.
<b>PM<sub>2.5</sub></b>	Particulate matter (PM or particles) in the air less than 2.5 micrometers in diameter. Often referred to as “fine” particulate matter. Not visible to the naked eye; can only be seen with an electron microscope.
<b>PM<sub>10</sub></b>	Particulate matter (PM or particles) in the air between 2.5 and 10 micrometers in diameter. Often referred to as “coarse” particulate matter. Not visible to the naked eye.
<b>Pollutant</b>	Any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.
<b>Pollution</b>	The act or process of polluting or the state of being polluted, especially the contamination of soil, water, or air by the discharge of harmful substances.
<b>Rate</b>	A quantity measured with respect to another measured quantity (e.g., grams per hour).

## Procedure:

**Ahead of time:** Make a dust catcher for yourself to show to students so they can see what the final product should look like (wait to add the tape to yours until the students do theirs so that you do not “collect” any PM in the interim). Also use yours as a “control” to compare theirs to after they have collected PM. If possible, schedule the activity when there is little or no chance of rain during the week since the catchers will be outdoors.

**Step 1.** Ask the students if they know what the term “pollution” means. Using their answers, reach a consensus that it means something that hurts the environment or makes it dirty. It is caused by humans.

**Step 2.** Ask the students what types of things can become polluted. Look for answers such as air, water, land, etc.

**Step 3.** Ask the students if they have heard of “particulate matter,” “particulates,” or “PM” in the air. Discuss that PM is one type of air pollution and can have human health effects. See “Background.”

**Step 4.** Discuss where PM pollution comes from (in general and specifically in your location). Automobiles are a common source, as are wood fires, industry, dusty roads or construction sites, etc.

**Step 5.** Explain to students that they will make “dust catchers” to trap PM in the air. After they have made their dust catchers, they will hang them for one week to see what PM they can catch. Based on your discussion in Step 4 (sources of PM), ask them to be thinking of good locations to hang their dust catchers. It is best to have the dust catchers spread out across a variety of locations for comparison at the end. Good locations may include near/far from a road, near/far from car/bus loading areas, near/far from building intake/output vents, the edge of school grounds, near the school building, in the middle of the playground, etc.

**Step 6.** Provide students with the instruction sheet and materials and have each make a dust catcher. Remind them not to touch the sticky side of the tape. Label all catchers with the student’s name, class, and date.

**Step 7.** *Optional.* Have students weigh their dust catchers and record the weight. Do the same for the “control” catcher that you made. Be careful not to touch the sticky side of the tape.

**NOTE:** *Weighing the catchers is a good way to show quantifiable results and provides students with the chance to use their math skills. However, the differences in weight are subtle. A high-quality balance that records weight in milligrams (or smaller units) is necessary to complete Steps 7, 12, and 13. Otherwise, students will not see a difference in weight between the “before” and “after” samples.*

**Step 8.** Have students hang or place their catchers at different places on the school grounds (mostly outside, but a few inside) (see Step 5). Tie the string to hang the strip (e.g., from a tree) or tape the strip to a surface, such as a fence or side of a building. Be sure catchers are well-attached so they do not blow away (e.g., do not simply drape the loop of string over a tree branch; tie it to the tree). Be sure all catchers are in places where they will not be disturbed and that the sticky side is exposed to the air without obstruction. Label each catcher with the location where it is placed. Be careful not to touch the sticky side of the tape. Do not place/hang the teacher’s “control” catcher; store it someplace where it will not collect dust (e.g., in a sealed plastic box).

Inform other school personnel (including grounds and maintenance staff) about the project and ask that the catchers not be disturbed. You may also want to place small signs (see pages 9/10; 2 per page; print double sided for two-sided signs) near the catchers (laminates them to protect them from rain) to let others know about the activity and to help ensure the catchers will not be disturbed.

### **Wait One Week**

**Step 9.** After one week, have students retrieve their catchers. Do not touch the sticky side of the tape.

**Step 10.** Bring catchers back into the classroom. Be careful not to touch the sticky side of the tape.

**Step 11.** Have the students compare catchers, then line the catchers up on a table, from the “cleanest” (should be the teacher’s control catcher) to the “dirtiest” catcher. Take a photo or make a drawing to record the range of “dirtiness” and indicate where each catcher was placed for the study. If skipping Steps 12 and 13, leave the catchers on the table through Step 15. Otherwise, return catchers to the table after weighing or refer to the photo or drawing during Step 14.

**Step 12.** *Optional; do if also completed Step 7.* Re-weigh each catcher, including the control. If the control shows a weight gain, this is likely due to humidity. If this is the case, subtract the weight gain of the control from the weight gain of the others to see the actual weight gain due to PM.

**Step 13.** *Optional; if completed Step 12.* Provide students with the weight data from Step 12 and have students create bar or line graphs depicting the results. (May want to assign this as homework and skip directly to Step 14 now.)

**Step 14.** Discuss the results of Steps 11 and 12 (optional) and 13 (optional, if completed at this point). Where were the dirtiest catchers placed? The cleanest ones? Do you see differences in colors or consistency of PM on catchers from different spots as well as differences in amount? Were there major differences among catchers, or were the differences minor? What conclusions can be made from the results? Were there any results that surprised you (e.g., you thought a catcher placed in a specific location would be extremely dirty or clean, and it was not).

**Step 15.** *Optional.* Using magnifying glasses, have students study the PM on their dust catchers in more detail. Discuss what they see.

## Questions for Discussion:

### 1. Why should we care about air pollution?

*Hurts the environment, is unhealthy, blocks views, stinks, can cause economic issues if air quality doesn't meet national standards (see [http://www.deq.idaho.gov/air/data\\_reports/monitoring/overview.cfm](http://www.deq.idaho.gov/air/data_reports/monitoring/overview.cfm)), etc. Point out that many of these issues exist even in places with relatively clean air.*

### 2. What causes particulate air pollution?

*Vehicle exhaust (especially from diesel engines), industry, fires (wildfires, agricultural burning, fireplaces/wood stoves), blowing dust, volcanoes, gas-powered lawn tools (e.g., lawn mowers), etc.*

### 3. How can we reduce (limit) particulate air pollution?

- *Limit vehicle emissions*
  - *Limit driving: carpool, walk, combine errands, take the bus, ride a bike*
  - *Turn off engines while waiting (e.g., don't idle in drive though or while waiting to pick up kids)*
  - *Retrofit existing diesel engines (e.g., school buses, trucks, tractors) with emissions reduction technology*
  - *Keep vehicles well-maintained (get better gas mileage, so produce fewer emissions pre mile driven)*
  - *Purchase and use low emission vehicles (e.g., hybrids)*
  - *Use alternative fuels (e.g., biodiesel [B20], ethanol [E85], and compressed natural gas [CNG]).*
- *Take care with fires*
  - *Comply with burn bans*
  - *Don't burn garbage*
  - *Convert your wood-burning fireplace to a gas fireplace or certified wood stove*
- *Cover dirt when carrying it in a truck (to keep it from blowing out)*
- *Use an electric or non-motorized lawn mower and trimmer instead of gasoline-powered lawn equipment*

## Expansion and Follow-Up Ideas:

- Have students develop a map showing locations of dust catchers, relative “dirtiness of catchers,” and summarizing geographic trends of PM on the school grounds.
- Have students place tape across the front of their used catchers to preserve the particulates, then make a poster or display using the catchers to teach others about particulates. (Consider combining with graphs [optional from the activity], maps [see idea above], and/or a larger education campaign [see idea below]).
- Have students conduct an educational campaign at their school or in their city to encourage activities that reduce particulate air pollution. Write letters to the editor, make posters, etc.
- Track the levels of pollutants in your area on DEQ’s Web site (<http://www.deq.idaho.gov/air/aqindex.cfm>); create graphs, charts, etc. of the data.
- Visit an auto dealership that sells low emission vehicles and/or vehicles that use alternative fuels or visit a gas station that sells alternative fuels to learn more about these technologies.
- Contact DEQ to learn about diesel retrofit technologies, which are available to reduce emissions from school buses (and other vehicles). Your school district may be able to apply for a grant for retrofit technologies for its buses<sup>1</sup>.
- Encourage your school or school district to join the Clean Air Zone Idaho program (if it hasn’t already). See [http://www.deq.idaho.gov/air/educ\\_tools/clean\\_air\\_zone\\_idaho/index.cfm](http://www.deq.idaho.gov/air/educ_tools/clean_air_zone_idaho/index.cfm) for more information.
- Have students pick one source of particulate emissions and research and prepare a report on it. What types of PM does it emit (soot? chemicals? dust? PM<sub>10</sub>? PM<sub>2.5</sub>)? How can emissions be curtailed? How does this source affect the community?
- Have students compile a notebook of air quality and related issues in the news. (The highest number of news items are likely to appear in winter and summer. The Treasure Valley, Portneuf Valley, Cache Valley, Silver Valley, and Bonner County are some areas likely to have a lot of air quality issues in the news.)
- Have students research air quality issues in your area and compile an oral or written report.
- Do the activity again, but place the catchers at different places around the community. Discuss results and “why?”
- Do the activity again, but compare strips daily to see if the day of the week makes a difference. Discuss results and “why.” Be sure to record weather conditions, driving schedules, etc. to help answer the “why” questions.

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<sup>1</sup> For information on retrofit grants, call DEQ at (208) 373-0502.

## Additional Resources:

Air Quality Brochures, Fact Sheets, and More for Citizens and Communities

[http://www.deq.idaho.gov/air/assist\\_citizen\\_comm/publications.cfm](http://www.deq.idaho.gov/air/assist_citizen_comm/publications.cfm)

Air Quality Educational Tools (includes information for students and teachers, activities, and more)

[http://www.deq.idaho.gov/air/educ\\_tools.cfm](http://www.deq.idaho.gov/air/educ_tools.cfm)

Air Quality: How it is Measured [http://www.deq.idaho.gov/air/data\\_reports/monitoring/overview.cfm](http://www.deq.idaho.gov/air/data_reports/monitoring/overview.cfm)

Air Quality Index (check your air quality) <http://www.deq.idaho.gov/air/aqindex.cfm>

Air Quality in the Treasure Valley [http://www.deq.idaho.gov/air/data\\_reports/monitoring/bro.cfm](http://www.deq.idaho.gov/air/data_reports/monitoring/bro.cfm)

Air Quality Reports, Portneuf Valley

[http://www.deq.idaho.gov/air/data\\_reports/reports/portneuf\\_valley/index.cfm](http://www.deq.idaho.gov/air/data_reports/reports/portneuf_valley/index.cfm)

Clean Air Zone Idaho [http://www.deq.idaho.gov/air/educ\\_tools/clean\\_air\\_zone\\_idaho/index.cfm](http://www.deq.idaho.gov/air/educ_tools/clean_air_zone_idaho/index.cfm)

Dust and Air Quality [http://www.deq.idaho.gov/air/prog\\_issues/pollutants/dust.cfm](http://www.deq.idaho.gov/air/prog_issues/pollutants/dust.cfm)

Health and Environmental Effects of Particulate Matter <http://www.epa.gov/ttn/oarpg/naaqsfm/pmhealth.html>

Local Environmental Information [http://www.deq.idaho.gov/about/office\\_locations.cfm](http://www.deq.idaho.gov/about/office_locations.cfm)

Particulate Matter [http://www.deq.idaho.gov/air/prog\\_issues/pollutants/health.cfm#pm](http://www.deq.idaho.gov/air/prog_issues/pollutants/health.cfm#pm)

Smoke, Burning, and Air Quality [http://www.deq.idaho.gov/air/prog\\_issues.cfm#burn](http://www.deq.idaho.gov/air/prog_issues.cfm#burn)

Vehicle Emissions [http://www.deq.idaho.gov/air/prog\\_issues/pollutants/vehicles.cfm](http://www.deq.idaho.gov/air/prog_issues/pollutants/vehicles.cfm)

Visibility and Haze [http://www.deq.idaho.gov/air/prog\\_issues/pollutants/haze\\_overview.cfm](http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_overview.cfm)

What Can Citizens Do to Prevent (Air) Pollution

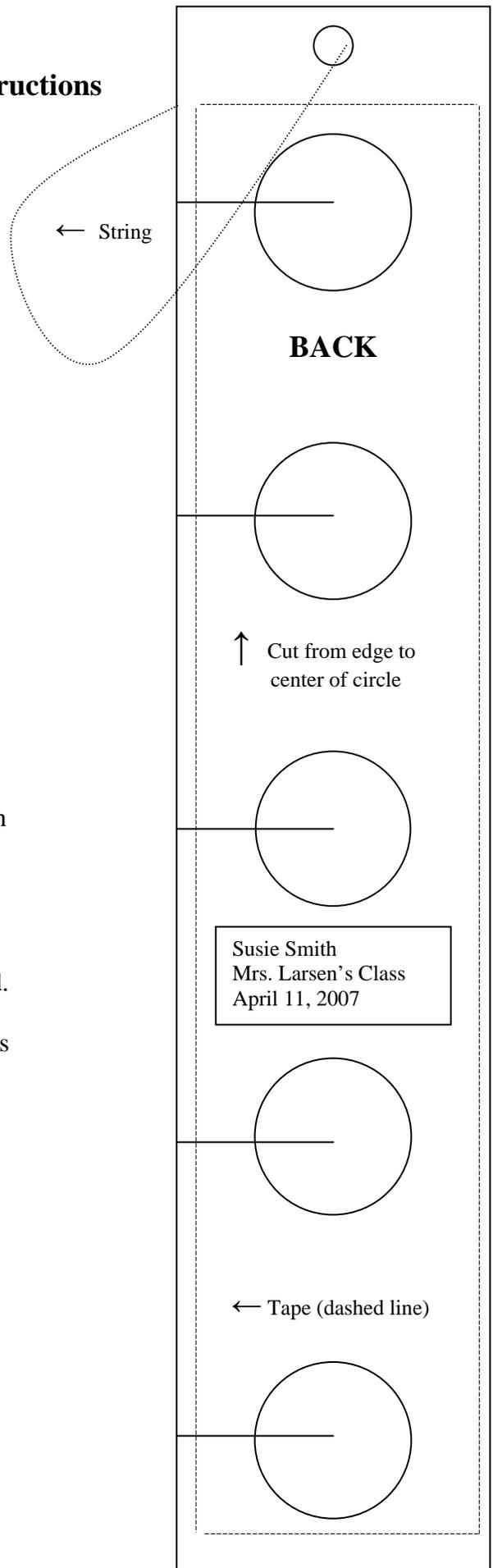
[http://www.deq.idaho.gov/multimedia\\_assistance/p2/citizens\\_overview.cfm#air](http://www.deq.idaho.gov/multimedia_assistance/p2/citizens_overview.cfm#air)

## Dust Catcher Instructions

### Materials:

- ✓ One strip of cardboard 2 inches wide and 10 inches long
- ✓ Compass or quarter
- ✓ Pencil or pen
- ✓ Scissors
- ✓ Hole puncher
- ✓ Paper towel or rag
- ✓ Pen
- ✓ Tape (about 2 inches wide and 9 ½ inches long)
- ✓ String (one foot)

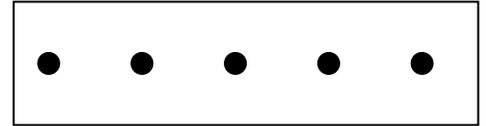
1. Using a hole puncher, punch a hole at the top of the strip.
2. Using a compass, draw five circles on the strip, each 1-inch in diameter. (Or draw the five circles by tracing around a quarter.) Space the circles evenly along the strip.
3. Cut out the circles. Make one cut from the side of the catcher to each circle to make it easier to cut out the circles.
4. Label one side of the catcher “front” and one side “back.”
5. Wipe all dust and dirt from the top of your desk or table.
6. Carefully lay your dust catcher front-side down on the clean area. Write your name, your class, and the date on the back of the catcher.
7. Cut a piece of tape long enough to cover the five big holes and lay it, sticky side down, on the back of your dust catcher, so that the holes (except for the hole for the string) are covered. Be careful not to touch the sticky side of the tape. The side where the sticky side of the tape is exposed through the holes is the front of the catcher.
8. When your teacher tells you to, carefully carry your dust catcher to the place where you will hang or set it. Write the location where you are placing the strip on the front of the catcher (your teacher may need to help so that you don’t touch the sticky part of the tape).
9. Hang your strip by placing a string through the small hole at the top, or tape the catcher, front side up, to a flat surface. Be careful not to touch the sticky part of the tape!
10. Leave your dust catcher alone for a week, then take it down (with your teacher’s help) and bring it back to class to compare to others.



# Please Do Not Touch - Learning Happening Here

The long, narrow piece(s) of cardboard you see (like the drawing, below) are part of an activity where we are learning about air quality. Please do not touch or remove the cardboard. We will be back to retrieve it on

\_\_\_\_\_  
(date)



Thank you,

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(Name of class or group)

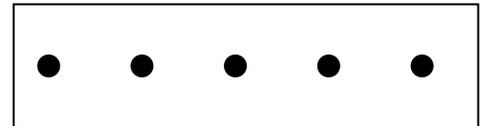
For more information about the project, contact

\_\_\_\_\_ at \_\_\_\_\_.

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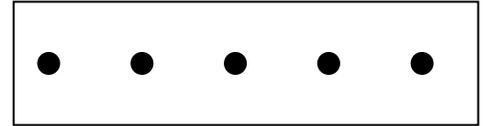
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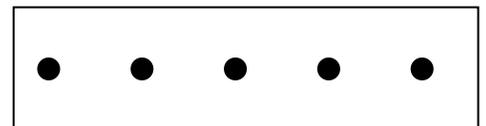
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