



Lesson Plan

<i>Title</i>	Air quality and you
<i>Subject</i>	Air quality
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<i>Grade level and Curriculum Links</i>	<p>5</p> <p>Grade 5 Science 5-9 Investigate relationships between weather phenomena and human activity. Recognize human actions can affect climate and identify human actions linked to the greenhouse effect.</p> <p>Grade 5 Science 5-4 Demonstrate positive attitudes for the study of science and for the application of science in responsible ways.</p> <p>Grade 5 Science 4-3 Problem solving through technology. Design and carry out an investigation of a practical problem.</p> <p>Grade 5 Math – Statistics and Probability (Data Analysis). Collect, display and analyze data to solve problems. Develop number sense.</p>
<i>Time duration</i>	The initial discussion for this lesson will take about 30 minutes, however the actual experiment will take about two weeks.
<i>Overview</i>	This lesson involves students conducting an air quality experiment, graphing their results and creating their own invention to clean the air. Some background information is provided at the back of this lesson and some resource links are provided in the Activities and Procedures section.
<i>Objective</i>	Students will understand how air quality can be impacted and how air quality impacts their health. They will also learn how air pollution relates to climate change and identify actions they can take to reduce air pollution.
<i>Materials</i>	Index cards, petroleum jelly, string and/or paperclips, popsicle sticks (to smear the petroleum jelly onto the index cards), pencils, rulers, magnifying glasses and/or microscopes, newspaper (or other material to protect student's desks when smearing on the petroleum jelly). CRAZ supply kit will include: 25 Index cards, petroleum jelly, 25 paperclips, 25 popsicle sticks, and 5 magnifying glasses.
<i>Activities and procedures</i>	<p>Before you begin this lesson with your students here are some links you may want to review:</p> <p>http://www.ec.gc.ca/air/default.asp?lang=En&n=04104DB7-1</p>

Class Discussion

<https://www.ec.gc.ca/cas-aqhi/default.asp?Lang=En>

<http://aep.alberta.ca/air/air-quality-health-index/default.aspx>

<http://craz.ca/monitoring/aqhi/>

Begin the lesson with a discussion on air quality. Ask the students what air quality means. Discuss what air quality does not mean (i.e. air quality is not climate change, but it is related to climate change because some air pollutants like vehicle emissions absorb energy from the sun which causes global warming). Explain to students what air quality is after discussing their thoughts.

Next discuss with the class what things can positively or negatively affect air quality. You can record this discussion on the board using the following chart:

Positive	Negative
Ex. trees	Ex. cars idling
	Ex. forest fires

Now begin discussing how we monitor air quality. Ask them how they can tell when the quality of the air is poor or good. Are there areas where they notice air quality is worse? Then introduce the petroleum jelly experiment. Explain that they'll be posting index cards with petroleum jelly on them in locations around the school to study air quality. Particles impacting air quality will stick to the petroleum jelly.

*Air Quality
Experiment*

Split the class into small groups.

Have them choose 4-6 locations that they want to place the index cards. They can choose all outdoor locations or some indoor and some outdoor. You will need to make one control card which will be placed in a Ziplock bag in the class.

Once they've chosen their locations hand out the index cards and have them draw the grid on each card as shown in the picture to the left. It is important that they use a pencil to draw the grid because the pencil will not smudge in poor weather or with application of the petroleum jelly. The grid will be the test area.

To the right of the test area will be the written area where students will record their names, location for the index card to be placed, and their classroom number. You may also want them to record the date and state "Please do not disturb. Experiment in progress."

Have them hole punch each card and tie the string in a loop in order to hang the card.



Have them use the popsicle stick to evenly spread the petroleum jelly over each square in the test area as seen in the picture to the left. It is important to spread a generous amount of petroleum jelly in the test area as some will be absorbed into the index card.

Have them hang their index cards in the chosen locations using the string, and/or paperclips.

Have them record their hypothesis in their science journals. Which cards do they think will have the most particles on them at the end of the experiment and why?

Keep the cards up for 2 weeks. Have the students check on their cards the day after they set them up to ensure that they spread enough petroleum jelly on. Then have students check on the cards frequently throughout the next two weeks.

After 2 weeks have each group collect all of their cards and begin to make notes on their findings. For example, they can record general observations such as a color change (i.e. the card may no longer be white). If they notice any large debris such as leaves or sticks they can carefully pick these off the index card and discard them.

Have the students count the number of squares that have particles on them and record the value. They will need to do this for each index card.

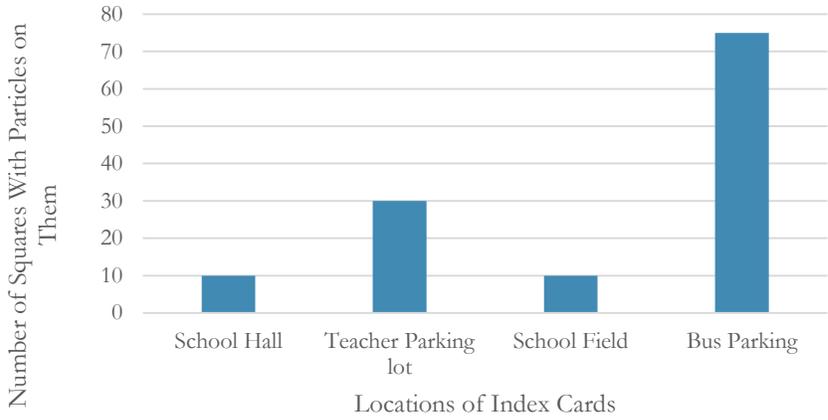
Have the students graph the results on a bar graph for all locations using the following scale or a scale that they have created (the scale will depend on the number of squares they have in the test area):

- Not dirty = 0
- Slightly dirty = 1-27
- Dirty = 28-55
- Very dirty = 55-82
- Extremely dirty = 93-110

Here is an example of the graph:

Graphing Results

Air Quality Experiment



Throughout the time of the experiment you can show the students the AQHI for Calgary and get them to record that on their observations as well. You can also compare the AQHI in Calgary to other cities such as Edmonton, London, England and Beijing, China.

Air Quality Health Index

Conclusions

Once the students have graphed their data have them analyze their data, revisit their hypothesis and record their conclusions. Did some locations have more particulates than others? If so, what might have caused the difference? You can have each group share their results with the class.

Additional Activities

Have the students design a way to clean the air. You can have them draw a picture or build their invention and share it with the class.

Air Quality and You Background Information

Key Definitions:

- **Air Quality** – is the degree to which ambient air is pollution free, as assessed by measuring a number of recognized indicators (Air Quality. (n.d.) in Oxford English Dictionary. Retrieved September. 19, 2016 from <http://www.oed.com/view/Entry/4366?redirectedFrom=air+quality#eid7956104>)
- **Air Pollution** – is the introduction of particulates, biological molecules, or other harmful materials into earth's atmosphere, causing diseases, allergies, death to humans, damage to other living organisms such as animals and food scraps or the natural or built environment (Air Pollution. (n.d.) in Wikipedia. Retrieved September 20, 2016 from https://en.wikipedia.org/wiki/Air_pollution).
- **Air Quality Health Index** – is a scale used indicating air quality in an area. The index number is determined by a calculation that includes levels of ground level ozone, fine particulate matter and nitrogen dioxide in the air. (AQHI FAQs: Frequently Asked Questions about the Air Quality Index (AQHI). (n.d.). Retrieved September. 19, 2016 from <http://aep.alberta.ca/air/air-quality-health-index/AQHI-FAQs.aspx>).
- **Ground Level Ozone (O₃)** - is created by chemical reactions between oxides of nitrogen and volatile organic compounds in sunlight. (Environment and Climate Change Canada. Frequently asked questions about the Air Quality Health Index (AQHI). How is the AQHI calculated? (n.d.) Retrieved September 20, 2016 from <http://www.ec.gc.ca/cas-aqhi/default.asp?lang=En&n=3E3FDF68-1#ws8051A96B>).
- **Fine Particulate Matter (PM_{2.5})** - is tiny airborne particles that contribute to air pollution. (Environment and Climate Change Canada. Frequently asked questions about the Air Quality Health Index (AQHI). How is the AQHI calculated? (n.d.) Retrieved September 20, 2016 from <http://www.ec.gc.ca/cas-aqhi/default.asp?lang=En&n=3E3FDF68-1#ws8051A96B>).
- **Nitrogen Dioxide (NO₂)** - is a chemical compound made up of one nitrogen molecule and two oxygen molecules. (Wikipedia. Nitrogen Dioxide. (n.d.). Retrieved September 22, 2016 from https://en.wikipedia.org/wiki/Nitrogen_dioxide).

Most of us understand that air pollution can irritate our lungs and airways making it difficult to breathe especially for those who have chronic diseases such as asthma. However we often forget about air pollution as we go about our day to day lives unless it becomes visibly present to us. For example, in Calgary during the summer of 2015, many people were comparing our poor air quality to that of Beijing, China. This was due to all of the smoke the wind brought up from the forest fires occurring in Washington State (i.e. fine particulate matter). More recently during the Fort McMurray forest fires in the summer of 2016 we saw news coverage of health officials directing the public in the area to remain indoors. Again this was due to the high amount of fine particulate matter from the forest fires. However, air pollution is far less visible yet just as impactful to our health.

Ground level ozone is an air pollutant that tends to increase during the summer because it is created by chemical reactions between oxides of nitrogen and volatile organic compounds while in sunlight. It is unlikely that you would notice if ground level ozone was present if you simply walked outside your house, however

your lungs and respiratory tract could be impacted by just short term exposure to it. As well, nitrogen dioxide, while also not as noticeable in the air can impact our health by reducing our immunity to lung infections leading to illnesses such as bronchitis. Even carbon dioxide has been found to contribute adversely to our health, although we often just think of it as having a negative impact on the environment. A study at Stanford University found that increases in carbon dioxide emissions can lead to increased number of deaths in humans (Stanford News. Stanford Report: Study Links Carbon Dioxide Emissions to Increased Deaths. January 3, 2008. Retrieved September 20, 2016 from news.stanford.edu). With these types of air pollutants being far less visible, the Air Quality Health Index becomes much more valuable.

The purpose of the Air Quality Health Index is to inform people of the air quality in their area so that they can be better equipped to make decisions about doing outdoor activities. Currently there are AQHI apps for your phone that you can download to make it easier to view the air quality in your area every day.
<https://open.alberta.ca/interact/aqhi-canada>

Obviously reducing air pollution will have a positive impact on our health and our environment. Most of us are aware of many ways to reduce air pollution such as burning less fuel (ex. gasoline, diesel, wood), carpooling, using transit, using cold water for washing whenever possible, avoiding products in aerosol cans, etc. Yet, many of us forget how significant an impact idling has on air pollution. It is common to drive by a Tim Horton's and see a long line up of cars. We don't typically think how much pollution is going into the air when we see that line up; we tend to be more concerned with getting our coffee. Yet, if all Canadians stopped idling their vehicles for just five minutes a day we would prevent more than two million tonnes of carbon dioxide from being released into the atmosphere. This is why the Calgary Region Airshed Zone is working with communities to install idle free signs throughout Calgary. One way to encourage being Idle Free is to get students encourage their parents and other adults to sign a "Commitment to be Idle Free" certificate. The Calgary Region Airshed Zone would be happy to provide you with these certificates or they are downloadable off of the CRAZ website.

After completing this air quality experiment with your students you may identify areas around your school that you would like to install idle free signs. The Calgary Region Airshed Zone can supply you with idle free signs that you can use around your school. You can also engage your students with a citizen science project related to this topic. For example, how can they help to reduce air pollution? How can they encourage their parents to help reduce air pollution? You can also reach out to their parents and the community on this issue.

The Calgary Region Airshed Zone's website www.craz.ca is a great source for materials including real time data, anti idling resources, and an information video.

www.craz.ca

