Environmental Quality Investigation
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In the Environmental Quality Investigation you will:

✔ Investigate the environmental quality at your school by collecting information and data on:

1. transportation choices and affects on the environment and indoor air quality,

2. additional factors, such as humidity and carbon dioxide levels, that affect indoor air,

3. the types of cleaning products used in the school,

4. off-gases from cleaning products, paints, and new building materials, and

5. hazardous materials on the school site.

✔ Analyze the data collected and brainstorm ways to make improvements.

✔ Develop an understanding of how individual and collective student actions can affect the environmental quality of the school.

✔ Learn about sustainable approaches to transportation and cleaning, and why it is important to adopt sustainable practices.

✔ Discover the connection between environmental quality and student health.

✔ Generate a plan to improve your school’s environmental quality and overall sustainability.

✔ Implement one or more of your improvement strategies.
Gather Documents and Supplies.

If possible, gather the following documents and supplies before the team begins the Investigation:

- Written plans and policies concerning environmental quality issues for the school. These items may include an indoor air quality plan, a mercury safety and disposal plan, a list of cleaning supplies and schedules for rooms being evaluated, or chemical handling and safety policies regarding disposal, recycling, and spills.
- Information on heating, ventilation, and air conditioning (HVAC) operations and maintenance, including any policies related to temperature, humidity, or thermostat controls
- Material Safety Data Sheets (MSDS) for all chemicals used at the school
- Indoor air quality monitoring equipment to assess carbon dioxide levels and relative humidity
- Standard or infrared thermometer

NOTE: For tips on how to use the monitoring equipment suggested in this Investigation, watch PLT’s videos How to Use an Infrared Thermometer and How to Use a Temperature/Relative Humidity Probe available on PLT’s YouTube channel at https://www.youtube.com/user/ProjectLearningTree. You may also want to review the following fact sheets before you conduct the Investigation: Fact Sheet: Tools and Instruments; Fact Sheet: Idling Reduction; Fact Sheet: Indoor Air Quality; Fact Sheet: Green Cleaning; and Fact Sheet: VOCs. These fact sheets can be found on pages 8-12 of this Investigation.

Review and Conduct the Investigation.

Review the Environmental Quality Investigation to determine if the questions are appropriate for your school. Also determine if there are additional questions that you’d like to add.

Provide a printed copy of the entire Environmental Quality Investigation to the Green Team members to use as they conduct the Investigation. They should answer the questions to the best of their ability according to the time allotted and materials available.

Develop and Implement an Action Plan.

Using the data collected from the Investigation, prioritize your ideas for action projects and implement one or more of these plans. You can apply for a PLT GreenWorks! grant to help fund your action projects. Find out more at www.plt.org/greenschools.

Celebrate Success.

Communicate your findings and achievements with other students, school administrators, and the community. For suggestions on how to share your achievements, see the Celebrate Success tip sheet available on page 11 of the Adult Leader Guide.

Apply for GreenSchools Certification.

Once you have completed all five PLT GreenSchools Investigations and taken action in at least one area, you can be recognized for your hard work and achievements through this national certification program. Certified schools are eligible for great recognition items, such as buffs and wristbands for students, weatherproof signs and banners for the school grounds, and more! You can view the certification requirements at https://www.plt.org/green-schools/certification-requirements.

Definitions for the words in bold text can be found in the Glossary on page 7.
Why Investigate
Environmental Quality?

Most people know that outdoor air pollution can damage their health, but many do not know that indoor air pollution can also have harmful effects. It may surprise you to learn that many schools harbor pollutants that can affect the health of students and those working in the school. For example, some pollutants found inside buildings, such as carbon monoxide, molds, or excessive fumes from cleaning products, can trigger asthma or chronic headaches. According to the Centers for Disease Control and Prevention, asthma is one of the leading causes of school absenteeism. Many studies have shown that absenteeism and illness affect a student’s overall ability to perform. In addition, children are more vulnerable to indoor air pollution than adults are because of their smaller body size and developing lung capacity. (Source: [www.epa.gov/iaq/schools/pdfs/student_performance_findings.pdf](http://www.epa.gov/iaq/schools/pdfs/student_performance_findings.pdf).)

The background information that follows may be useful as you complete the Investigation. It might also give you ideas for action projects to improve the environmental quality of your school.

Types of Indoor Air Pollutants

Indoor air quality refers to the quality of air inside buildings and includes such factors as temperature, relative humidity, amount of fresh air, mold, and chemicals. The quality of indoor air can affect a person’s health, comfort, and ability to do work. Indoor air pollutants come from a variety of sources. They can originate in the school or be drawn inside through air intake vents, doors, and windows. Fortunately, most indoor air pollution issues can be resolved with simple, inexpensive measures. The following chart lists some common indoor air pollutants, their sources, and their possible health effects.

<table>
<thead>
<tr>
<th>COMMON IndoOR air Pollutants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollutant</td>
</tr>
<tr>
<td>Carbon monoxide</td>
</tr>
<tr>
<td>Volatile organic compounds (VOCs)</td>
</tr>
<tr>
<td>Biological contaminants, such as molds, mildews, mites, bacteria, and viruses</td>
</tr>
<tr>
<td>Radon</td>
</tr>
<tr>
<td>Mercury vapor</td>
</tr>
</tbody>
</table>

Sources: [www.epa.gov/iaq/voc.html](http://www.epa.gov/iaq/voc.html); [www.epa.gov/hg/about.htm](http://www.epa.gov/hg/about.htm); [www.epa.gov/iaq/ia-intro.html](http://www.epa.gov/iaq/ia-intro.html).
Volatile Organic Compounds (VOCs)
VOCs are chemicals that evaporate at room temperature. VOCs are emitted by a wide array of products used in buildings, including cleaning supplies, paints, lacquers, varnishes, air fresheners, pesticides, building materials, and furnishings. VOCs are released from products into the air both during use and during storage. VOCs can cause eye, nose, and throat irritation; headaches; nausea; respiratory issues; and additional health problems after high levels of exposure.

When you purchase products such as paints and cleaners for use in schools, check labels for no VOCs or low VOCs. Several green label certifications are now available to help consumers purchase such products.

Radon Gas
Radon is a cancer-causing, radioactive gas that is found all over the United States. It is both colorless and odorless. When you breathe in air containing radon, you can develop lung cancer. Radon comes from the natural breakdown of (radioactive) uranium in soil, rock, and water and enters the air you breathe. It can get into any type of building, typically seeping into holes and cracks in a building’s foundation, and result in a high indoor radon level. Testing is the only way to know whether radon is present in a building. The EPA recommends testing all homes and schools below the third floor for radon. Testing is simple and inexpensive. If radon is found in a building, radon reduction measures can be taken.

Room Temperature, Relative Humidity, and Carbon Dioxide (CO₂) Levels
How comfortable a room feels is a function of the room’s air temperature, relative humidity, and CO₂ level. A person’s alertness and ability to think are also affected by these factors.

CO₂ is released every time we exhale. It is also released by the combustion of fuels. To keep the level of CO₂ in a building within an acceptable range, outside air must be mixed with air that is recirculated through the heating, ventilation, and air conditioning (HVAC) system, and the HVAC system must be properly maintained.

CO₂ levels are used as an indicator of proper ventilation. High levels of CO₂ in a room may indicate blocked or clogged fresh air return vents and filters. People in a room with high levels of CO₂ often report feeling drowsy and lethargic.
Why Investigate Environmental Quality?

Plants as Air Fresheners
Long-term exposure to some chemicals in room air fresheners may be harmful to health, and young people may be particularly vulnerable (Source: http://www.nrdc.org/media/2007/070919.asp). An easy way to freshen the air in rooms without using air fresheners is to increase ventilation by opening windows when the weather permits or by increasing the amount of fresh air circulating through the heating and cooling system.

Another natural way to purify the air in rooms is to add plants. The leaves of plants not only take up CO₂ and give off oxygen, they can also capture toxic gases from cleaning supplies, furnishings, and building materials. NASA researchers found that one potted plant per 100 square feet of space was needed to create a healthier environment.

Some plants are more effective at cleaning the air than others. Here are a few plants that have been shown to purify the air:
1. Boston fern
2. Lady palm
3. Bamboo palm
4. Rubber plant
5. Areca palm
6. Gerbera daisy

Students Making a Difference
You can do your part to improve the environmental quality of your school. This will create a cleaner, greener, and healthier environment for students and all who work there.

In addition, you can take what you’ve learned at school to your home to help improve indoor air quality. For useful tips, see Green Your Home: Improving Environmental Quality found at the end of this Investigation. You can also download it at www.plt.org/activities-for-families/around-your-home/.

PLT GreenSchool Videos
To learn more about improving the environmental quality at your school and to see how other GreenSchools across the country are taking action, watch PLT’s short videos Investigating Environmental Quality and GreenSchools in Action: Environmental Quality. These videos are available on PLT’s YouTube channel: https://www.youtube.com/user/ProjectLearningTree.
There are many careers related to maintaining the environmental quality of a school. Here are a few of the fields that you may discover as you conduct the Investigation:

- Air quality specialist
- Environmental health and safety analyst
- Environmental health and safety technician
- Environmental law and policy specialist
- Environmental scientist
- Hazardous materials removal worker
- HVAC technician
- Indoor environmental quality specialist
- Manufacturer of indoor environmental quality equipment
- Microbiologist
- Pollution control designer or engineer
- Pollution control inspector or technician
**Glossary**

**Air quality** — a gauge of the concentration of one or more chemicals in the atmosphere, that could potentially be harmful to humans, other animals, vegetation, or materials.

**Carbon monoxide (CO)** — a colorless, odorless, poisonous gas. It is formed when carbon is not completely burned, for example in a car engine, lawn mower, or portable generator.

**Combustion** — the process of burning; a chemical process that produces heat and usually light.

**Humidity** — the amount of moisture (water vapor) in the air.

**HVAC** — abbreviation for Heating, Ventilation, and Air Conditioning.

**Idle** — to allow a vehicle engine to run when the vehicle is not moving.

**Indoor Air Quality** — the quality of air inside buildings, including such factors as temperature, relative humidity, amount of fresh air, mold, and chemicals.

**Pollutant** — a substance that pollutes something; a substance that makes air, water, or soil impure or unsafe.

**Pollution** — the contamination of air, water, or soil by substances that are harmful to living organisms.

**Radon** — an odorless, colorless gas produced naturally from the radioactive decay of radium.

**Relative humidity** — a ratio, expressed as a percentage, of the amount of atmospheric moisture present at a specific temperature relative to the amount that would be present if the air were saturated.

**Temperature** — a measure of the hotness or coldness of something.

**Thermometer** — an instrument for measuring how hot or cold something is; a tool that measures temperature.

**Volatile Organic Compounds (VOCs)** — chemicals that evaporate at room temperature. VOCs are emitted by a wide array of products used in schools, including cleaning supplies, paints, lacquers, varnishes, air fresheners, pesticides, building materials, and furnishings. VOCs are released from products into the air both during use and while stored. VOCs can cause eye, nose, and throat irritation; headaches; nausea; and additional health problems with high levels of exposure.
Why is it bad to idle vehicles?
Idling school buses and other vehicles with gas or diesel-powered engines can pollute the air around the vehicles. Exhaust from these vehicles can also enter school buildings through air intakes, doors, and open windows. In addition, if ventilation inside a school bus is poor, accumulated diesel exhaust from the bus may be retained during the ride.

Idling vehicles with gas or diesel-powered engines produce the same pollutants as when they are moving, including nitrogen oxide, particulate matter, carbon monoxide, and volatile organic compounds. These pollutants are linked to causing a variety of human illnesses including asthma, chronic bronchitis, heart disease, and even cancer.

Benefits of idling reduction
Limiting a vehicle’s idling time can dramatically reduce air pollutants and students’ exposure to them. Idling reduction has many benefits, including the following:

- Making the air cleaner both outside and inside the school
- Saving money by not wasting fuel
- Reducing wear-and-tear on engines
- Helping everyone breathe easier
- Reducing pollutants that contribute to global warming

What can you do?
Start a “no idling” campaign at your school. Encourage drivers to turn off their engines as soon as possible after arriving at school. They should only restart when they are ready to depart.

Sources:
U.S. EPA: http://www2.epa.gov/region8/idle-free-schools
Environmental Defense Fund: https://www.edf.org/climate/reports/idling
Indoor Air Quality
Indoor air quality (IAQ) refers to the quality of air inside buildings and includes such factors as temperature, relative humidity, carbon dioxide (CO₂) level, and the concentration of pollutants in the air. The quality of indoor air can affect a person’s health, comfort, and ability to do work.

Temperature, Relative Humidity, and Carbon Dioxide (CO₂)
The comfort of a classroom or school building can have a direct effect on student achievement, attitude, and overall ability to concentrate. The following ranges for temperature, relative humidity, and CO₂ levels are recommended by U.S. EPA Indoor Air Quality Tools for Schools program and the American Society of Heating, Refrigeration, and Air Conditioning Engineers.

Temperature
Summer (AC): 74–79°F (23–23°C) if building is occupied; can be raised to 80°F if unoccupied.
Winter (heat): 68–75°F (20–24°C) if building is occupied; can be lowered to 66°F if unoccupied.

Relative Humidity
How the temperature feels to people in the building is influenced by relative humidity levels. Relative humidity should be in the range of 30%–60%. Humidity levels above 60% encourage microbial buildup and are thus a health concern.

Carbon Dioxide
Carbon dioxide (CO₂) is a natural component of the atmosphere and is produced when people breathe. The concentration of CO₂ in a room can become elevated if the heating, ventilation, and cooling system is not adding enough outside air to the indoor recirculated air. When CO₂ levels become elevated, it may cause people to feel drowsy and lethargic. The CO₂ concentration in an occupied indoor space indicates if the building’s air exchange balance is appropriate – that is, if the optimal amount of outside air is being mixed with air that has been circulating in the building.

Current technology makes it easy to measure CO₂ levels. The amount of CO₂ in an air sample is expressed as parts per million (ppm) – the number of CO₂ molecules per million molecules of air. The CO₂ level in outside air is usually between 300-500 ppm. It is generally recommended that indoor CO₂ levels should not exceed 1,000 ppm.

**Air Quality Monitor**
Indoor air quality monitoring equipment may be available from a U.S. EPA regional office or from the state agency that is responsible for environmental quality. You may be able to borrow this equipment, or the agency may send a professional to your school to assist with air quality assessments.

Indoor air quality monitors are also available for purchase online. Some monitors have multiple functions. Look for monitors that will measure carbon dioxide ($\text{CO}_2$) levels, relative humidity, and air temperature.

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**Thermometer or Infrared Temperature Gauge**
A regular thermometer or an infrared temperature gauge can be used to take measurements in the classroom. The advantage of the infrared temperature gauge is that you can point it at an object and get a quick readout of the surface temperature. Infrared temperature gauges typically cost $25 and up. To find these instruments online, use the keywords “thermometer” and “infrared temperature gauge.”
Green Cleaning—What Is It?
Green cleaning products have nontoxic ingredients that help protect the health of students, teachers, and custodial staff. A green cleaning program can prevent harmful exposure to toxic chemicals found in some cleaning products. Following are easy tips that schools can follow to start greening their cleaning products and practices.

Green Cleaning Products
Green cleaning products have the following features:
- Nontoxic/No known carcinogens
- Low or no Volatile Organic Compounds (VOCs)
- Neutral pH levels
- Biodegradability
- Less packaging.

Cleaning products may be “green certified.” Green certification means that the product meets the environmental and human health standards set forth by the certifying organization. For example, the US EPA has a “Safer Choice” certification for cleaning products that meet their stringent human health and environmental standards. Check labels on cleaning products for green certification.

Benefits
The chemicals used in some cleaning products can be harmful to human health, as well as to the environment. The chemicals found in some cleaning products can cause eye, nose, and throat irritation and headaches. If the cleaning products contain VOCs, adverse health effects can include asthma, upper respiratory irritation, fatigue, nasal congestion, nausea, and dizziness.

Following are some of the many benefits of using green cleaning products and practices:
1. Protecting the health of students, who may be more vulnerable to chemical exposure than adults
2. Protecting the health of custodial staff members who frequently use cleaning products
3. Preventing student and faculty absences by reducing exposure to asthma triggers
4. Increasing cost savings by using fewer products
5. Improving the environmental quality of the school environment.
What are VOCs?
Volatile Organic Compounds (VOCs) are a large group of carbon-based chemicals that easily evaporate at room temperature. They can be found in a wide array of products used in schools, including paints and lacquers, paint strippers, varnishes, cleaning supplies, air fresheners, pesticides, building materials, and furnishings. VOCs are released from products during both use and storage.

Health Risks
The risk of health effects from inhaling any chemical depends on how much is in the air, as well as how long and how often a person breathes it in. VOCs can cause a variety of health problems. Short-term exposure can cause headaches, nausea, and eye, nose, and throat irritation. Long-term exposure to high levels of VOCs can damage the liver, kidney, and central nervous system, and possibly cause cancer.

Green Certification
Various testing laboratories have developed product emissions testing protocols and standards to certify products as “low VOC” or “no VOC.” Green certification means that the product meets the environmental and human health standards set forth by the certifying organization. For example, the US EPA has a “Safer Choice” certification for products that meet their stringent human health and environmental standards.

How to Reduce Exposure to VOCs
1. Remove or reduce the number of products that give off VOCs.
2. Look for “green” product alternatives that do not contain VOCs.
3. If products containing VOCs must be used, buy limited quantities to reduce the release of vapors during long-term storage.
4. Make sure there is plenty of fresh air and ventilation (e.g., open windows and use extra fans)
5. Adults using the products should carefully follow directions and warnings on product labels for use and storage.

Sources:
U.S. EPA: http://www2.epa.gov/indoor-air-quality-iaq/volatile-organic-compounds-impact-indoor-air-quality#Health_Effects
Minnesota Department of Health: http://www.health.state.mn.us/divs/eh/indoorair/voc/
Overview
Through this investigation, you will assess several aspects of the environmental quality of your school. Specifically, you will look at transportation choices and how that affects air quality; hazardous materials used and stored in the school; and how the cleaning products used in the school may affect student and staff health. The results will help you see where your school could make improvements.

School Name: ___________________________________________ Date: ________________

GREEN TEAM:
(Please include administrators, teachers, school staff, students, community members, parents, and others involved in this investigation.)

<table>
<thead>
<tr>
<th>NAME</th>
<th>TITLE/ROLE</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

SCHOOL POPULATION
Students: ________ Staff: ________
Emissions from vehicles cause both air pollution and health problems. The survey that follows will reveal the transportation choices that students and staff members make. These choices affect the environment and health of those attending the school.

**HOMEROOM TRANSPORTATION SURVEY**

Survey students and staff members in each of the school’s homerooms to find out how they most often get to and from school. Coordinate with teachers to schedule a time to conduct this survey. Indicate the number of responses for each category. The results from this Homeroom Transportation Survey will be compiled on the Schoolwide Transportation Tally Chart.

Date: __________________ Room # or Location: __________________

Teacher or Supervisor: ___________________________________________ Grade or Use: __________________

<table>
<thead>
<tr>
<th>Transportation Mode</th>
<th>Number of People Who Most Often Travel to School by...</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mode of Travel</td>
</tr>
<tr>
<td></td>
<td>Students</td>
</tr>
<tr>
<td>Personal vehicle</td>
<td>Car/regular van</td>
</tr>
<tr>
<td></td>
<td>Truck/SUV</td>
</tr>
<tr>
<td></td>
<td>Large passenger van**</td>
</tr>
<tr>
<td></td>
<td>Hybrid/Alternative fuel vehicle***</td>
</tr>
<tr>
<td>School vehicle</td>
<td>Bus</td>
</tr>
<tr>
<td></td>
<td>Large passenger van**</td>
</tr>
<tr>
<td></td>
<td>Car</td>
</tr>
<tr>
<td>Public transportation</td>
<td>Bus</td>
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<tr>
<td></td>
<td>Train/transit</td>
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<tr>
<td></td>
<td>Ferry</td>
</tr>
<tr>
<td>Own power</td>
<td>Walk</td>
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<tr>
<td></td>
<td>Bike</td>
</tr>
<tr>
<td></td>
<td>Other</td>
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<tr>
<td>Other transportation mode</td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td></td>
</tr>
</tbody>
</table>

* A carpool is considered at least 2 students or 2 staff members per car. Carpools only applies to traveling to school by a personal motor vehicle.
** A large passenger van is one that can accommodate 11 or more passengers.
*** A Hybrid/Alternative fuel vehicle runs on a fuel that is not made from petroleum. Examples of alternative fuels include ethanol, methanol, compressed natural gas (CNG), and electricity stored in batteries.
### SCHOOLWIDE TRANSPORTATION TALLY CHART

Compile the results from each of the Homeroom Transportation Surveys on this chart. Then answer the School Transportation Questions that follow on page 16.

<table>
<thead>
<tr>
<th>Transportation Mode</th>
<th>Number of People Who Most Often Travel to School by...</th>
<th>Mode of Travel</th>
<th>Carpool?*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Students</td>
<td>Staff</td>
</tr>
<tr>
<td><strong>Personal vehicle</strong></td>
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<td></td>
</tr>
<tr>
<td>Car/regular van</td>
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<td><strong>Own power</strong></td>
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<td>Walk</td>
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<td><strong>Other transportation mode</strong></td>
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<td>Totals</td>
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* A carpool is considered at least 2 students or 2 staff members per car. Carpooling only applies to traveling to school by a personal motor vehicle.

** A large passenger van is one that can accommodate 11 or more passengers.

*** A Hybrid/Alternative fuel vehicle runs on a fuel that is not made from petroleum. Examples of alternative fuels include ethanol, methanol, compressed natural gas (CNG), and electricity stored in batteries.
PART II: Transportation (cont.)

SCHOOLWIDE SUMMARY OF TRANSPORTATION USED TO GET TO AND FROM SCHOOL

Using the results of the Schoolwide Transportation Tally Chart, determine the percentages of students and staff using each of the following modes of transportation.

<table>
<thead>
<tr>
<th>Percentage Using...</th>
<th>Students</th>
<th>Staff</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal vehicle</td>
<td></td>
<td></td>
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<tr>
<td>School vehicle</td>
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<td></td>
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<td></td>
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<tr>
<td>Own power</td>
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</tr>
</tbody>
</table>

School Transportation Questions

1. For students who travel by a personal vehicle, what percentage carpool? ________

2. For staff who travel by a personal vehicle, what percentage carpool? ________

3. What other observations and conclusions can you make from the data collected?
___________________________________________________________________________________________________________

4. Do school buses idle their engines for longer than 3 minutes while parked outside?  
   See Fact Sheet: Idling Reduction for more information. (This Fact Sheet can be found on page 8 of this Investigation.)  
   □ Yes □ No

5. Do other vehicles (e.g., personal motor vehicles, afterschool activity buses or vans, carpool vehicles) idle for longer than 3 minutes?  
   □ Yes □ No

6. If your school has a driver’s education program, does it use fuel-efficient or alternative fuel vehicles for instruction?  
   □ Yes □ No

7. Does your school participate in any activities or programs that promote safety when walking or biking to school?  
   □ Yes □ No

8. Does your school hold bike- or walk-to-school days?  
   □ Yes □ No

9. Brainstorm and record a list of ways that your school could encourage transportation choices that improve air quality, increase safety and accessibility for walking and biking to school, and reduce traffic and air pollution in the vicinity of the school.
PART III. INDOOR AIR QUALITY (IAQ): TEMPERATURE, RELATIVE HUMIDITY, AND CO₂

Indoor air quality refers to the quality of air inside buildings and includes such factors as temperature, relative humidity, amount of fresh air, mold, and chemicals. The quality of indoor air can affect a person’s health, comfort, and ability to do work.

In this section, you will use scientific equipment to measure the temperature, relative humidity, and CO₂ levels in various rooms throughout the school. You will also look for factors that contribute to the buildup of dust, molds, and mildew, all of which affect indoor air quality. After you tally the results, the data will help you determine whether there are ways to improve IAQ at your school.

To avoid interrupting instruction, coordinate with teachers to schedule a time to take measurements in classrooms. Schedule a time with the school office staff to take measurements in other rooms, such as the cafeteria, gym, and locker rooms.

Individual Room IAQ Measurements

Make a copy of the Individual Room IAQ Survey (page 18) for each room that you will assess. Record the data collected for each room on the charts provided. Try to involve as many rooms in the school as possible. All of the data from the individual rooms will be compiled and analyzed by using the Schoolwide IAQ Survey (pages 19-22).

Obtain an air quality instrument that can measure CO₂, relative humidity, and temperature. Check that the instrument is charged and calibrated. See the Fact Sheet: Tools and Instruments for more information. (This fact sheet can be found on page 10 of this Investigation.)

If possible, take room readings at three different times of the day. Record the time of each reading.

To find the temperature range, take three readings at different points around the room using a standard or infrared thermometer. Note whether the temperature is in degrees Fahrenheit or Celsius.

Relative humidity is measured as a percentage of 100; and CO₂ units are parts per million, or ppm.

Circle any measurements that are outside the acceptable occupied ranges.

See the Fact Sheet: Indoor Air Quality for more information. (This fact sheet can be found on page 9 of this Investigation.)
Complete the following chart to record information on the Indoor Air Quality in the room.

### INDIVIDUAL ROOM IAQ MEASUREMENTS

<table>
<thead>
<tr>
<th>Time</th>
<th>Time of Day</th>
<th>Temperature* Range (°F/°C)</th>
<th>Relative Humidity*</th>
<th>CO₂ Level (ppm)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading 1 (morning)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading 2 (midday)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading 3 (afternoon)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Acceptable Occupied Ranges

Temperature:
- Summer (AC): 74–79°F (23–26°C) if building is occupied
- Winter (heat) 68–75°F (20–24°C) if building is occupied

Relative Humidity:
- Relative humidity should be in the range of 30%–60%.

Carbon Dioxide (CO₂):
- Indoor CO₂ levels should not exceed 1,000 parts per million (ppm).

### INDIVIDUAL ROOM IAQ OBSERVATIONS

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Comments and Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are air supply vents covered with papers or other items?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are air supply vents dusty?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there any signs of ongoing water damage in the room?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there signs of mold or mildew in the room?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are items that are infrequently used stored in cabinets or containers?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If there are live animals in the room, are the cages regularly cleaned?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there live plants in the room?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is food, including food for pets, stored in airtight containers?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there air fresheners of any type in the room?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there an odor from cleaning products used in the room?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If paint has recently been applied, is there an odor?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there new furnishings in the room that are causing an odor? (carpet,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>furniture, computers)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there an odor from recently installed ceiling tiles?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do people in the room regularly suffer from eye, nose, or throat irritation?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Use the data collected on the **Individual Room IAQ Survey** sheets to fill out this **Schoolwide IAQ Survey**.

### SCHOOLWIDE IAQ MEASUREMENTS

<table>
<thead>
<tr>
<th>Time</th>
<th>Time of day range</th>
<th>Temperature* range (°F/°C)</th>
<th>Relative humidity (%) range*</th>
<th>CO₂ level (ppm) range*</th>
<th>Number of rooms outside acceptable ranges**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading 1 (morning)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading 2 (midday)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading 3 (afternoon)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
* Indicate the range of values measured for all rooms surveyed at each of the three times.
** Indicate the number of rooms in which measurements were not within the acceptable occupied ranges for temperature, relative humidity, or CO₂.

**Acceptable Occupied Ranges**

**Temperature:**
- Summer (AC): 74–79°F (23–26°C) if building is occupied; can be raised to 80°F (27°C) if unoccupied.
- Winter (heat) 68–75°F (20–24°C) if building is occupied; can be lowered to 66°F (19°C) if unoccupied.

**Relative Humidity:**
Relative humidity should be in the range of 30%–60%. Humidity levels above 60% can encourage the growth of molds and mildew and are a health concern.

**Carbon Dioxide (CO₂):**
Indoor CO₂ levels should not exceed 1,000 parts per million (ppm).

See the Fact Sheet: Indoor Air Quality for additional information. (This fact sheet can be found on page 9 of this Investigation.)
Schoolwide Questions on IAQ Measurements

1. Did the time of day make a difference in temperature, humidity, or CO₂ levels? □ Yes □ No
   If yes, which varied the most and why do you think this happened?

2. Did the location of the room make a difference in temperature, humidity, or CO₂ levels? □ Yes □ No
   If yes, note any observations:

3. Are room temperatures within acceptable occupied ranges for the season? □ Yes □ No
   Note any areas with temperatures that were not within acceptable ranges:

4. Is the relative humidity in the school within acceptable ranges (30%–60%)? □ Yes □ No
   Note any areas with relative humidity ranges that were not within acceptable ranges:

5. Are CO₂ levels below 1,000 ppm throughout the building? □ Yes □ No
   Note any areas with CO₂ levels that were not within acceptable ranges:

6. Brainstorm and record a list of ways that the IAQ of the school could be improved on the basis of temperature, relative humidity, and CO₂ levels.
Tally the results from the Individual Room IAQ Observations here.

Date:______________________  Total Number of Rooms Surveyed:____________________

<table>
<thead>
<tr>
<th>Question</th>
<th># of Yes responses</th>
<th># of No responses</th>
<th>Comments and Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are air supply vents covered with papers or other items?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are air supply vents dusty?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there any signs of ongoing water damage in the room?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there signs of mold or mildew in the room?</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Are items that are infrequently used stored in cabinets or containers?</td>
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<td></td>
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<tr>
<td>If there are live animals in the room, are the cages regularly cleaned?</td>
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<td></td>
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</tr>
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<td>Are there live plants in the room?</td>
<td></td>
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<td>Is food, including food for pets, stored in airtight containers?</td>
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<td>Are there air fresheners of any type in the room?</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Is there an odor from cleaning products used in the room?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If paint has recently been applied, is there an odor?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there new furnishings in the room that are causing an odor?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(carpet, furniture, computers)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there an odor from recently installed ceiling tiles?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do people in the room regularly suffer from eye, nose, or throat irritation?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Brainstorm and record a list of ways that the indoor air quality of the school could be improved using the data on the chart above.
General Schoolwide Questions on Indoor Air Quality

1. Does your school have an indoor air quality plan? ........................................... □ Yes □ No

2. Have regularly occupied (at least 45 minutes/day) spaces at or below ground level been tested for radon? .................................................. □ Yes □ No
   If yes, was any remediation needed to bring the level of radon into an acceptable range? ........ □ Yes □ No

3. Are furnace and ventilation filters cleaned or replaced on a routine maintenance schedule? ........ □ Yes □ No

Locate and examine the outside air intake vents. Then answer the following questions:

4. Are ventilation units on? .................................................. □ Yes □ No
   If yes, is air flowing into the outdoor intake? .................................................. □ Yes □ No

5. Are outdoor air intakes free from blockage or obstruction? .................................. □ Yes □ No

6. Are bird or animal droppings near air intakes? .................................................. □ Yes □ No

7. Are sources of vehicle exhaust accumulation (parking lots, loading docks, bus loading, and so on) located near air intakes? .................................................. □ Yes □ No

8. Are garbage dumpsters located near air intakes or windows and doors that are frequently open? ........ □ Yes □ No

9. Brainstorm and record ideas for ways that your school could improve indoor air quality.
In this section, you will assess the cleaning practices and the presence of volatile organic compounds (VOCs) at your school. VOCs are substances that contain carbon and vaporize at room temperature. They can be found in a wide array of products used in schools, including cleaning products, paints, and air fresheners. VOCs can cause a variety of health problems. A “green” cleaning program can reduce exposure to these harmful chemicals.

For more information, see the Fact Sheets: VOCs and Green Cleaning found on pages 11-12 of this Investigation.

### SCHOOLWIDE CLEANING AND VOCS

Directions: Interview the maintenance or custodial supervisor in order to complete this chart. Then answer the questions that follow on page 24.

<table>
<thead>
<tr>
<th>Item</th>
<th>Frequency of cleaning (e.g., daily, monthly)</th>
<th>Cleaning product used</th>
<th>* Is the product green certified?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floors (hard surface)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floors (carpeted)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desks and chairs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Windows</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air Vents</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cafeteria tables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bathroom fixtures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Green certification means that the product meets the environmental and human health standards set forth by the certifying organization. For example, the US EPA has a “Safer Choice” certification for cleaning products that meet their stringent human health and environmental standards.
General Questions on Schoolwide Cleaning and VOCs

1. Who is responsible for purchasing cleaning supplies?

_______________________________________________________________________

2. Are the majority of the cleaning products green certified? ........................................... □ Yes □ No

3. Are maintenance and custodial staff trained in green cleaning techniques?
   (For example, when possible, is the school cleaned when it is unoccupied or using
   cleaning products that are nontoxic and have low VOCs?) ........................................... □ Yes □ No

4. According to your observations, is the cleaning frequency for the various items adequate?
   (For example: Do windows appear clean? Are air vents dust free? Are cafeteria tables clean?) . . . . . . □ Yes □ No

   If no, list the areas where the cleaning is not adequate:

_______________________________________________________________________

5. Is indoor painting done when students and teachers are on break to prevent exposure
to paint fumes? ........................................... □ Yes □ No

6. Is the installation of new materials, such as carpets and ceiling tiles, done when students
   and teachers are on break to prevent exposure to fumes? ........................................... □ Yes □ No

7. Brainstorm and record ideas for improving the cleaning and maintenance practices at your school.
In this section, you will assess hazardous materials that may be found in your school. Although chemicals have many uses, they can be very dangerous to humans and the environment. Chemicals are found in many locations throughout a school, including custodial closets, under sinks, and in health clinics. The keys to using chemicals safely are proper handling, storage, and disposal.

### HAZARDOUS MATERIALS INVENTORY CHART

**Safety:** This chart should be completed with the assistance of teachers. Do not handle items containing hazardous chemicals or mercury. You may want to ask a maintenance staff member who is familiar with the location and storage of hazardous materials to accompany the team. If you find anything containing mercury, label it so it is properly handled in the future.

**Directions:** Visit each room or area where hazardous materials may be used or stored.

<table>
<thead>
<tr>
<th>Item</th>
<th>Number of items or amount</th>
<th>Is it labeled (Yes or No)</th>
<th>Is it in a locked cabinet or closet? (Yes or No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toxic cleaners</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paints and varnishes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pesticides/herbicides</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazardous chemicals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury thermometers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood pressure gauges containing mercury</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury-based thermostats</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury barometers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elemental mercury</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury-containing compounds or reagents</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluorescent light bulbs: CFLs or tubes*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Because fluorescent bulbs contain small amounts of mercury, indicate whether extra bulbs are labeled and securely stored.
Hazardous Materials Questions

1. Does your school keep an updated inventory list of all chemicals present in the building, as well as where they are stored? □ Yes □ No

   If yes, how often is an inventory of chemicals conducted?
   □ Once every 2–3 months (or more often)
   □ Once every year
   □ Once every 2 years
   □ Other: (explain)____________________________________________________________________

2. Are Material Safety Data Sheets (MSDS) available for all chemicals used in the school? □ Yes □ No

   If yes, where are sheets located?
   ____________________________________________________________________________________

3. Do staff consider less-hazardous or green chemical substitutions when they are purchasing products containing hazardous materials? □ Yes □ No

4. Are hazardous chemicals disposed of as outlined by their MSDS sheet? □ Yes □ No

5. If your school has any mercury in labs or mercury-containing devices, does the school have a written procedure for handling mercury spills? (Mercury-containing devices may include thermometers, barometers, thermostats, and fluorescent bulbs.) □ Yes □ No

   If yes, where is it kept?
   ____________________________________________________________________________________

6. How does your school handle “burned out” fluorescent bulbs?
   □ Recycled
   □ Disposed of as hazardous waste
   □ Thrown in the trash
   □ Other ____________________________________________________________________________

   (Visit the following website for information on the proper disposal or recycling of fluorescent bulbs, which contain small amounts of mercury: www.epa.gov/epawaste/hazard/wastetypes/universal/lamps/index.htm.)
1. Have at least two members of your staff participated in PLT professional development? □ Yes □ No

2. Are PLT professional development opportunities available to all teachers? □ Yes □ No

3. Do at least 10% of classes or courses embed environmental education, including PLT? □ Yes □ No

4. Does your school curriculum include the following:
   a. Transportation-related topics covering health, safety, and the environmental effects of transportation choices □ Yes □ No
      If yes, in which subject is it included and at which grade levels?

   b. Indoor air quality or information on asthma and allergies □ Yes □ No
      If yes, in which subject is it included and at which grade levels?

   c. Information on VOCs □ Yes □ No
      If yes, in which subject is it included and at which grade levels?

   d. Chemical safety and handling □ Yes □ No
      If yes, in which subject is it included and at which grade levels?

   e. Environmental and health effects of mercury pollution □ Yes □ No
      If yes, in which subject is it included and at which grade levels?

5. Does your school sponsor or participate in any programs that encourage environmentally friendly ways to get to and from school (for example, carpooling, walk- or bike-to-school days, bike safety classes, and so forth)? □ Yes □ No
   If yes, please describe the programs:

6. Does your community have a mercury collection program to encourage the proper disposal and handling of mercury-containing items? □ Yes □ No
7. Does your community have any regulations concerning the sale, disposal, or recycling of mercury-containing products? □ Yes □ No

8. Do all students and staff members wear appropriate personal protection equipment when handling chemicals or scientific apparatus? □ Yes □ No

9. Does your community have a chemical collection program to encourage the proper disposal of chemicals? □ Yes □ No

10. Brainstorm and then record ideas for ways the school could improve environmental quality education and training. Also consider ways the school could reach out to the community with environmental quality education and programs.
Review the list of ideas that you brainstormed for improving environmental quality at your school. Prioritize the ideas and decide on a few action projects that you could do to improve the health and safety of students and staff members at your school. See the next page for examples of action projects.

List your action project ideas for each section of the Environmental Quality Investigation:

**Transportation**

**Indoor Air Quality**

**Cleaning and Volatile Organic Compounds**

**Hazardous Materials**

**Education, Training, and Community Connections**
Environmental Quality Action Project Ideas

Here are just a few ideas to help get you started. You can check out what other PLT GreenSchools are doing by watching PLT’s short video GreenSchools in Action: Environmental Quality (available on PLT’s YouTube channel at https://www.youtube.com/user/ProjectLearningTree) and by reading stories posted at www.plt.org/teacher-stories.

A. Transportation
- Develop a “no idling” campaign for buses and cars near your school; hand out fact sheets or note cards to drivers explaining why idling is harmful.
- Have a poster contest that encourages carpooling.
- Sponsor a walk- or bike-to-school day.

B. Indoor Air Quality
- Work with school administrators to reduce possible allergen triggers in the classrooms.
- Investigate the consequences of high CO2 levels on student learning and overall health.
- Develop a policy to ensure that ventilation and humidity levels are appropriate to prevent the growth of molds and mildew.

C. Cleaning and VOCs
- Create a “no clutter” policy for your school or district.
- Investigate green cleaning techniques and procedures to limit exposure to toxic chemicals and fumes, which will often save money and time as well.
- Work with the janitorial staff to implement ideas.

D. Hazardous Materials
- Work with school administrators to phase out mercury in your school, including mercury in equipment such as thermometers and thermostats.
- If mercury containing equipment or devices must be kept, label them so they are properly handled.
- Become familiar with the school’s mercury use and storage practices. If mercury is located in your school, you can work to become a “mercury free school.” For further information on mercury in schools, visit www.epa.gov/hg/schools.htm.
- Petition the school to begin purchasing only TCLP (Toxicity Characteristic Leaching Procedure) certified fluorescent bulbs.
- Work with school administrators to encourage the use of green cleaning products that do not expose students and staff members to toxic chemicals.
- Work with school staff to adopt the use of Integrated Pest Management in order to reduce the use of pesticides and herbicides on school grounds.
- Write articles for the school newsletter or develop a school news show that explains the importance of safely handling chemicals at school and at home.
How healthy is your home? Indoor pollutants can cause headaches, dizziness, nausea, fatigue, dry or runny eyes, congestion, and sore throats. They can also increase the symptoms of asthma. There are many simple things that you can do to improve the health of your home. Use the following questions to help you identify various factors that affect indoor air quality.

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Has your home been tested for radon?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Do you regularly change the filters on your heating and air conditioning units to improve efficiency and reduce allergens?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Do you use household cleaners that are nontoxic and safe for use around children and pets?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Have you checked your home for molds and mildew?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Do you use fans in the kitchen and bathrooms to prevent moisture buildup that can lead to the growth of molds and mildew?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Do you turn off the car engine when the car is in the garage or near air intakes? (Idling produces dangerous gasses such as carbon monoxide.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Have you replaced old thermometers that contain mercury with newer mercury-free thermometers? (Thermometers containing mercury should be properly disposed of to prevent mercury contamination.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>If you have pesticides, are they safely stored outside and out of reach to protect children, pets, and the environment?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Do you have indoor plants, such as the Spider plant or Boston fern, that are non-toxic and help remove indoor air pollutants?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
To learn more about PLT GreenSchools:

- Watch tutorials and videos showing how GreenSchools across the country are taking action by viewing PLT’s videos on our YouTube channel (https://www.youtube.com/user/ProjectLearningTree).

- Read stories on GreenSchools posted online at PLT’s website (www.plt.org/teacher-stories).

- Subscribe to our e-newsletter for updates and information about new resources, grant opportunities, tips from educators, and stories of students making a difference at school and in their communities (www.plt.org/sign-up)