



## Environmental Science Merit Badge Guide

### Requirements

[https://filestore.scouting.org/filestore/Merit\\_Badge\\_RegandRes/Environmental\\_Science.pdf](https://filestore.scouting.org/filestore/Merit_Badge_RegandRes/Environmental_Science.pdf)

2021 01 27

1. Make a timeline of the history of environmental science in America. Identify the contribution made by the Boy Scouts of America to environmental science. Include dates, names of people or organizations, and important events.
2. Define the following terms: population, community, ecosystem, biosphere, symbiosis, niche, habitat, conservation, threatened species, endangered species, extinction, pollution prevention, brownfield, ozone, watershed, airshed, nonpoint source, hybrid vehicle, fuel cell.
3. Do ONE activity from seven of the following categories (using the activities in this pamphlet as the basis for planning and projects):
  - (a) Ecology
    - (1) Conduct an experiment to find out how living things respond to changes in their environments. Discuss your observations with your counselor.
    - (2) Conduct an experiment illustrating the greenhouse effect. Keep a journal of your data and observations. Discuss your conclusions with your counselor.
    - (3) Discuss what is an ecosystem. Tell how it is maintained in nature and how it survives.
  - (b) Air Pollution
    - (1) Perform an experiment to test for particulates that contribute to air pollution. Discuss your findings with your counselor.
    - (2) Record the trips taken, mileage, and fuel consumption of a family car for seven days, and calculate how many miles per gallon the car gets. Determine whether any trips could have been combined (“chained”) rather than taken out and back. Using the idea of

trip chaining, determine how many miles and gallons of gas could have been saved in those seven days.

(3) Explain what is acid rain. In your explanation, tell how it affects plants and the environment and the steps society can take to help reduce its effects.

(c) Water Pollution

(1) Conduct an experiment to show how living things react to thermal pollution. Discuss your observations with your counselor.

(2) Conduct an experiment to identify the methods that could be used to mediate (reduce) the effects of an oil spill on waterfowl. Discuss your results with your counselor.

(3) Describe the impact of a waterborne pollutant on an aquatic community. Write a 100-word report on how that pollutant affected aquatic life, what the effect was, and whether the effect is linked to biomagnification.

(d) Land Pollution

(1) Conduct an experiment to illustrate soil erosion by water. Take photographs or make a drawing of the soil before and after your experiment, and make a poster showing your results. Present your poster to your counselor.

(2) Perform an experiment to determine the effect of an oil spill on land. Discuss your conclusions with your counselor.

(3) Photograph an area affected by erosion. Share your photographs with your counselor and discuss why the area has eroded and what might be done to help alleviate the erosion.

(e) Endangered Species

(1) Do research on one endangered species found in your state. Find out what its natural habitat is, why it is endangered, what is being done to preserve it, and how many individual organisms are left in the wild. Prepare a 100-word report about the organism, including a drawing. Present your report to your patrol or troop.

(2) Do research on one species that was endangered or threatened but that has now recovered. Find out how the organism recovered, and what its new status is. Write a 100-word report on the species and discuss it with your counselor.

(3) With your parent's and counselor's approval, work with a natural resource professional to identify two projects that have been approved to improve the habitat for a threatened or endangered species in your area. Visit the site of one of these projects and report on what you saw.

(f) Pollution Prevention, Resource Recovery, and Conservation

(1) Look around your home and determine 10 ways your family can help reduce pollution. Practice at least two of these methods for seven days and discuss with your counselor what you have learned.

(2) Determine 10 ways to conserve resources or use resources more efficiently in your home, at school, or at camp. Practice at least two of these methods for seven days and discuss with your counselor what you have learned.

(3) Perform an experiment on packaging materials to find out which ones are biodegradable. Discuss your conclusion with your counselor.

(g) Pollination

(1) Using photographs or illustrations, point out the differences between a drone and a worker bee. Discuss the stages of bee development (eggs, larvae, pupae). Explain the pollination process, and what propolis is and how it is used by honey bees. Tell how bees make honey and beeswax, and how both are harvested. Explain the part played in the life of the hive by the queen, the drones, and the workers.

(2) Present to your counselor a one-page report on how and why honey bees are used in pollinating food crops. In your report, discuss the problems faced by the bee population today, and the impact to humanity if there were no pollinators. Share your report with your troop or patrol, your class at school, or another group approved by your counselor.

Before you choose requirement 3g(3), you will need to first find out whether you are allergic to bee stings. Visit an allergist or your family physician to find out. If you are allergic to bee stings, you should choose another option within requirement 3. In completing requirement 3g(3), your counselor can help you find an established beekeeper to meet with you and your buddy. Ask whether you can help hive a swarm or divide a colony of honey bees. Before your visit, be sure your buddy is not allergic to bee stings. For help with locating a beekeeper in your state, visit [www.beekeeping.com](http://www.beekeeping.com) and click on "Resources," then select "Find Help" and "Find a Local Beekeeper."

(3) Hive a swarm OR divide at least one colony of honey bees. Explain how a hive is constructed.

(h) Invasive Species

(1) Learn to identify the major invasive plant species in your community or camp and explain to your counselor what can be done to either eradicate or control their spread.

(2) Do research on two invasive plant or animal species in your community or camp. Find out where the species originated, how they were transported to the United States, their life history, how they are spread, and the recommended means to eradicate or control their spread. Report your research orally or in writing to your counselor.

(3) Take part in a project of at least one hour to eradicate or control the spread of an invasive plant species in your community or camp.

4. Choose two outdoor study areas that are very different from one another (e.g., hilltop vs. bottom of a hill; field vs. forest; swamp vs. dry land). For BOTH study areas, do ONE of the following:

(a) Mark off a plot of 4 square yards in each study area, and count the number of species found there. Estimate how much space is occupied by each plant species and the type and number of non-plant species you find. Report to your counselor orally or in writing the biodiversity and population density of these study areas.

(b) Make at least three visits to each of the two study areas (for a total of six visits), staying for at least 20 minutes each time, to observe the living and nonliving parts of the ecosystem. Space each visit far enough apart that there are readily apparent differences in the observations. Keep a journal that includes the differences you observe. Discuss your observations with your counselor.

5. Using the construction project provided or a plan you create on your own, identify the items that would need to be included in an environmental impact statement for the project planned.

6. Find out about three career opportunities in environmental science. Pick one and find out the education, training, and experience required for this profession. Discuss this with your counselor, and explain why this profession might interest you.

### **Homework for All Merit Badges before class:**

1. Scouts must read the BSA merit badge book or pamphlet **before** class. A Scout might borrow a copy from their troop library or from another Scout. The latest print editions are stocked and are for sale at the Mecklenburg County Council Scout Shop at 1410 East 7th Street Charlotte, NC 28204  
704 333 5471

[www.mccscouting.org](http://www.mccscouting.org)

Scouts may order printed or digital copies from [www.scoutshop.org](http://www.scoutshop.org).

2. Scouts can print current merit badge requirements from <https://www.scouting.org/programs/scouts-bsa/advancement-and-awards/merit-badges/>  
Unofficial merit badge workbooks with all requirements and spaces to write in answers are posted at <http://usscouts.org/meritbadges.asp>  
Printing a workbook is optional and not mandatory, but Scouts will find that a workbook from the <http://usscouts.org/meritbadges.asp> will be very helpful in organizing their work and in sending in merit badge homework assignments to their merit badge counselors.

Workbooks printed from <http://usscouts.org/meritbadges.asp> may contain extra resources Scouts may use to complete merit badge requirements. One example is a Home Safety Checklist applicable to all three of Emergency Preparedness, Fire Safety, and Safety Merit Badges. (The same checklist applies to all 3 MB's and the same checklist is included in all 3 of these MB workbooks. Scouts working on one of these merit badges could consider working on all 3 because requirements are similar.)

Scouts should bring these pages and blank paper and pen to each virtual and/or in-person course session to present their notes and research and to facilitate

discussions with the counselor and other Scouts during class. Paper and pens will not be supplied by the course instructors.

3. Each Scout must show their pre-course homework to the counselor during their class sessions. If a Scout is not prepared, they may not be able to complete all merit badge requirements before the end of their merit badge class. The Scout can work with their merit badge counselor, or with a home troop counselor identified by their Patrol Leader or Senior Patrol Leader and approved by their Scoutmaster, after merit badge class to complete their blue card. Scouts may also work with their home troop Advancement Chair or Scoutmaster to identify merit badge counselors through Scoutbook.

### **Homework for Environmental Science Merit Badge before class:**

For **requirement # 1**, please review information

<https://www.sutori.com/story/a-timeline-of-the-history-of-environmental-science-in-america--4T7voVGxQE7MWEXTqm5yk69c>

Choose dates and events and people that interest you and write out your timeline

Please bring your written timeline to class to show the Merit Badge Counselor.

Scouts may wish to create a timeline with information about

Native Americans as conservationists:

<https://www.perc.org/1996/07/01/conservation-native-american-style/>

History of greenhouse effect:

<https://www.bbvaopenmind.com/en/science/environment/eunice-newton-foote-pioneer-greenhouse-effect/>

Baden-Powell as a catch-and-release fisherman:

<https://troopleader.scouting.org/program-feature-fishing/>

Henry David Thoreau

Yellowstone National Park

Ernest Thompson Seton

Theodore Roosevelt

Rachel Carson

Stewart Udall

Greta Thunberg

[https://en.wikipedia.org/wiki/Greta\\_Thunberg](https://en.wikipedia.org/wiki/Greta_Thunberg)

For **requirements # 2, # 3a3, and # 3b3**, information is included at the end of this Guide.

For **requirement # 2**, please write out your definitions before class. Please bring your written definitions to class to show the Merit Badge Counselor. These written definitions are required for sign off of this requirement.

For **requirement # 3a3**, please write out how an ecosystem is maintained in nature and how it survives.

For **requirement # 3b3**, please write out information on acid rain. A good source for information is <https://www.epa.gov/acidrain/what-acid-rain>

For **requirement # 3c3**, please consider a report of the

Deepwater Horizon oil spill of 2010

<https://www.britannica.com/event/Deepwater-Horizon-oil-spill>

or

Exxon Valdez oil spill of 1989

<https://www.history.com/topics/1980s/exxon-valdez-oil-spill>

or

Tampa Bay algae bloom of 2021

<https://www.abcactionnews.com/news/region-sarasota-manatee/scientists-believe-blue-green-algae-bloom-in-tampa-bay-likely-caused-by-piney-point-leak>

or other event of your choosing

For **requirement # 3d3**, if you have a camera, please take pictures before class. Scouts may have an opportunity to take pictures during class. Scouts may review parts of **requirement 3d1 or 3d2** during class.

For either **requirement # 3e1 or requirement # 3e2**, please complete your research and write a report before class.

If you choose to work on **requirement # 3e1**, please research one species and write your report before class.

Here is a link to list of endangered or threatened species in North Carolina:

[https://www.fws.gov/raleigh/es\\_tes.html](https://www.fws.gov/raleigh/es_tes.html)

Clicking on a species name brings up information that may be useful for your report.

Whooping cranes and red wolves could be other species to consider for **requirement # 3e1**.

If you choose to work on **# 3e2**, please research one species and write your report before class. As one example, here is link to information about Wild Turkey recovery from low populations from hunting with conservation efforts:

<https://www.ncwildlife.org/Learning/Species/Birds/Wild-Turkey>

Information on black bears can be found at

<https://www.ncwildlife.org/Learning/Species/Mammals/Black-Bear#2498420-overview-br>

Before class, please complete your research and write your report for either **requirement # 3f1 on reducing pollution at home for 1 week or for # 3f2 on using resources more efficiently at home, school, or camp for 1 week.**

Ideas for reducing air pollution at home:

Decreasing air pollution in home from chemicals and particles:

Avoid smoking indoors (but quitting smoking is the best answer for overall health).

Use craft supplies in well-ventilated areas.

Make sure your gas stove is well-ventilated.

Minimize clutter.

Remove carpeting if possible.

Use a dehumidifier and/or air conditioner to reduce moisture.

Keep trash covered to avoid attracting pests.

Remove shoes at the door.

Have car emissions tested regularly.

Minimize air freshener use.

Test your home for radon.

Use carbon monoxide detectors.

Fix water leaks.

Dust surfaces and vacuum frequently.

Wash bedding weekly in hot water.

Make sure exhaust fans are functioning in your bathrooms and kitchen.

Keep a lid on scented candles.

<https://health.clevelandclinic.org/17-simple-ways-prevent-air-pollution-home/>

Use home air filters and keep filters clean.

<https://www.epa.gov/indoor-air-quality-iaq/air-cleaners-and-air-filters-home>

Reducing home or camp waste

1. Reduce your food waste
2. Paper or plastic? Neither!
3. Say no to bottled water. Use a refillable water bottle. At camp, use powdered drink mix in large quantities, not individual drinks.
4. Use reusable rags and cloths for cleaning instead of paper towels.
5. Opt out of paper mailings, bills, ads, junk mail, and phone books
6. Buy foods with little or no packaging
7. Rethink food storage: Use reusable containers instead of plastic baggies, aluminum foil, and cling wrap.
8. Use reusable cutlery and cloth napkins and real dishes
9. Go straw-less
10. Avoid paper cups and plastic tops
11. Recycle right

<https://www.addisoncountyrecycles.org/recycling/reduce-reuse/plastics-reduction>

12. Use toilet paper manufactured from recycled paper or from bamboo to decrease deforestation and loss of boreal forests.

If every American household replaced just one toilet paper roll of virgin-fiber a year with a roll made from 100% recycled paper, approximately 425,000 trees would be saved annually.

<http://www.toiletpaperhistory.net/toilet-paper-made/recycled-toilet-paper/>

<https://reelpaper.com/blogs/reel-talk/eco-friendly-toilet-paper>

<https://www.nrcan.gc.ca/our-natural-resources/forests-forestry/sustainable-forest-management/boreal-forest/8-facts-about-canadas-boreal-forest/17394>

In Mecklenburg County, Recycle Right means

Glass bottles and jars

Plastic containers (with necks only)

Aluminum cans

Tin or steel cans

Empty aerosol cans

Cardboard boxes (flattened)

Milk cartons and juice boxes

Cereal and pizza boxes

Paper (brown bags, high grade paper)

Junk mail

Magazines

Newspaper

DO NOT bag recyclables in plastic bags.

Recycle Wrong means

Food

Plastic bags and trash

Plastic grocery bags

Plastic food containers

Plastic film and bubble wrap

Plastic cups and plastic utensils and dishes

Paper napkins

Shredded paper

Diapers

Rope

Hoses

Car parts

Sharps (razors, syringes)

Wire hangers

Clothing

Propane tanks, batteries, cords, and scrap metals can be safely recycled at



any of the four Full-Service Recycling Centers in specifically designated bins.

When in Doubt, Leave It Out.

<https://www.mecknc.gov/LUESA/SolidWaste/Resources/Pages/Related%20Links%20and%20Resources.aspx>

#### Home lighting

- o Change light bulbs to LEDs.
- o Turn off the lights when they're not in use. Lighting accounts for about 12% of a typical residential utility bill.
- o Use natural light when possible.
- o Control your fixtures with a photocell or a timer to assure dusk-to-dawn only operation of your outdoor lights.

#### Washing clothes and dishes

- o Wash your clothes in cold water if possible.
  - o Run full loads of dishes and laundry to save water and energy.
- <https://www.csmonitor.com/Business/The-Simple-Dollar/2012/0125/Only-run-full-loads-of-dishes-and-clothes>
- o Using dishwashers and clothes washers/dryers at night will keep the house cooler, reduce strain on the power grid during the peak usage hours of 4 PM and 6 PM and reduce the chance of an emergency!
  - o Turn off heated dry on your dishwasher and air dry instead.
  - o Line dry laundry

#### Home heating and cooling

- o Set your thermostat to 78F in the summer and 68F in the winter - every degree of extra heating or cooling will increase energy usage 6% to 8%. Setting your thermostat to a lower temperature than normal will not cool your home faster.
- o Dress for the weather. When you're at home, dress in warm clothing in the winter and cooler clothing in the summer to stay comfortable without making your heater and AC work harder
- o Use your ceiling fan to allow you to raise the thermostat setting about 4°F with no reduction in comfort.
- o Clean or replace all filters in your home regularly. Dirty filters make your system work harder and run longer than necessary.
- o During warmer months, close blinds, shades and drapes on the sunny side of your home to help keep your home's temperature cooler and reduce the work for your AC. Open shades during cooler months to let the sun warm your home.
- o Air seal your home. Sealing cracks, gaps and leaks and adding insulation can save up to 10% on home heating and cooling costs.
- o Install a programmable thermostat that will automatically adjust the temperature according to your schedule.

- o Don't leave bathroom or kitchen ventilation fans running longer than necessary. They replace the inside air with outside air.
- o Replace your windows. If your home has single-pane windows, consider replacing them with more energy efficient windows, or adding solar shades or tinting film.
- o Watch your appliance placement. Avoid placing appliances that give off heat, such as lamps or TVs, near a thermostat.
- o Plant trees in your yard for shade

#### Cooking

- o Use your microwave instead of your stove when cooking to release less heat into the kitchen.
- o Don't peek in the oven while baking! Every time you peek, the temperature can drop 25 F, making your oven use more energy to bring the temperature back up.
- o Turn off the oven a few minutes before cooking time runs out. Your food will continue to cook without using the extra electricity.

#### Refrigerator

- o Defrost your refrigerator and freezer before ice buildup becomes 1/4-inch thick to ensure your appliances are running efficiently.
- o Refrigerators and freezers actually operate most efficiently when full, so keep your refrigerator and freezer as full as possible (using water bottles if nothing else). Be careful about overfilling them as this will reduce airflow and cause the appliance to work harder.
- o Set your refrigerator temperature to the manufacturer's recommendation to avoid excessive cooling and wasting energy.

#### Home electronics

- o Don't leave your electronics on all day long. Only turn on your computer, monitor, printer and fax machine when you need them.
- o Don't leave your mobile phone plugged in overnight. It only takes a couple of hours to charge.

<https://www.directenergy.com/learning-center/25-energy-efficiency-tips>

#### Water use

- o Take short showers instead of baths. Baths can use up to 50 gallons of water. Lowest flow shower heads are rated at 0.625 to 1.5 gallons per minute.

<https://takecareoftexas.org/hot-wire/shower-vs-bath-debate>

- o Set hot water heater temperature to 120 degrees F to prevent burns and to save energy.

<https://www.cpssc.gov/s3fs-public/5098.pdf>

#### Transportation

- o walk, bike, use public transportation, carpooling, telecommuting
- o replace car with conventional internal combustion engine with

electric car  
 hybrid car  
 fuel-efficient car

o practice eco-driving by reducing rapid acceleration and braking and reducing top cruising highway speed from 70 to 65 mph

o change air filters regularly and keep tires properly inflated

<https://www.sciencenews.org/article/climate-change-actions-reduce-carbon-footprint>

#### Food

o Cut 5 servings per week of

beef, pork, lamb, processed meats, poultry, eggs

nuts

fats, oils sugar, processed foods

dairy

o Limit vegetarian diet choices with high environmental costs in water, pesticides, fertilizer, transportation, CO2 production

imported fruits and vegetables out of season

avocado

mushrooms

mycoprotein

cocoa

almonds and cashews

<https://www.bbc.com/future/article/20200211-why-the-vegan-diet-is-not-always-green>

o compost food scraps to enrich soil and to decrease landfill trash which produces methane

<https://www.epa.gov/recycle/composting-home>

#### Sustainable clothing practices

Wear garments that are manufactured, constructed and marketed in a responsible and conscious way that acknowledges and accounts for their environmental and socioeconomic impacts across a garment's full life cycle, from creation to disposal.

#### Green and clean

- Use eco-friendly materials, like:
  - Organically grown fibers.
  - Post-consumer fibers.
  - Natural and biodegradable materials.
- Practice eco-friendly production, including:
  - Using natural dyes.
  - Little to no-waste pattern-making.
  - Fair and ethical

Rented, loaned, or swapped

Repaired, redesigned, or upcycled

Secondhand or vintage

High quality and timeless design

On-demand or custom made

Domestically produced (made in USA)

<https://www.redressraleigh.org/sustainable-fashion>

For either **requirement # 3g1 or 3g2**, please complete your research and write your report before class.

If you choose **requirement # 3h2**, please complete your research and write your report before class. USDA web pages with links at

<https://www.invasivespeciesinfo.gov/terrestrial>

can provide excellent information.

**Invasive plants** in NC Piedmont include

Autumn olive

Chinese privet

English ivy

Golden bamboo

Japanese honeysuckle

Russian olive.

**Invasive invertebrates** include

red imported fire ants.

**Invasive vertebrates** include

Burmese python

European starling

Wild boar.

Scouts will work on **requirement # 4a** in class. This is not a homework assignment.

Scouts will work on **requirement # 5** in class. This is not a homework assignment.

The course may include an activity during class to explore ideas about the environmental impact of mining, using cookie mining as a model.

Scouts may use the matching quiz and the mining map on pages 5 and 6 of the “Mining for Chocolate” handout posted at

<https://populationeducation.org/sites/default/files/mining-for-chocolate.pdf>

For **requirement # 6**, please complete your research and write your report before class.

## Environmental Science Merit Badge Requirement # 2 Definitions

Words	Definitions
* extra	Ecological systems
biosphere	global sum of all ecosystems
biome*	a natural biological community of flora and fauna with a major habitat and specific climate, such as tropical rainforest, temperate forest, boreal forest (taiga), tundra, grassland, savanna, desert, freshwater, marine <a href="https://askabiologist.asu.edu/explore/biomes">https://askabiologist.asu.edu/explore/biomes</a>
ecosystem	a community of all plants, animals, and micro-organisms interacting with their physical environment
habitat	an ecological or environmental area inhabited by animal and/or plant species
population	a group of organisms of the same species sharing a habitat
community	populations sharing a particular habitat
niche	the role an organism plays in a community, including physical and environmental conditions it requires (like temperature or terrain) and the interactions it has with other species (like predation or competition). <a href="https://www.nationalgeographic.org/encyclopedia/niche/">https://www.nationalgeographic.org/encyclopedia/niche/</a>
	<b>Species interactions</b>
symbiosis	close and often long-term interactions between different species <a href="https://www.youtube.com/watch?v=q2zdiLn3gSE&amp;list=RDCMUC4a-Gbdw7vOaccHmFo40b9g&amp;index=1">https://www.youtube.com/watch?v=q2zdiLn3gSE&amp;list=RDCMUC4a-Gbdw7vOaccHmFo40b9g&amp;index=1</a> <a href="https://www.youtube.com/watch?v=q2zdiLn3gSE&amp;list=RDCMUC4a-Gbdw7vOaccHmFo40b9g&amp;index=1">https://www.youtube.com/watch?v=q2zdiLn3gSE&amp;list=RDCMUC4a-Gbdw7vOaccHmFo40b9g&amp;index=1</a> <a href="https://www.youtube.com/watch?v=8LWYOiGzGhw">https://www.youtube.com/watch?v=8LWYOiGzGhw</a>
mutualism*	species interaction where both species benefit. Clownfish live within sea anemone.

commensalism*	species interaction where one species benefits; the other species experiences no benefit or harm. Bacteria living on your skin or in your gut.
parasitism*	species interaction where parasite benefits and host is harmed. Lice in hair harms host with bites for blood and itching. Tick on skin bites for a blood meal.
competition*	species co-existing with competition for food or water
predation*	one species or population eating another species or population
herbivory*	kind of predation where animals eat plants
	Conservation ideas
conservation	protection of natural resources and proper use of nature
preservation*	protection of buildings, objects, and landscapes and protection of nature from use <a href="https://www.nps.gov/teachers/classrooms/conservation-preservation-and-the-national-park-service.htm">https://www.nps.gov/teachers/classrooms/conservation-preservation-and-the-national-park-service.htm</a>
pollution	<p>Pollution is the introduction of harmful materials into the environment. These harmful materials are called pollutants. Pollutants can be natural, such as volcanic ash. They can also be created by human activity, such as trash or runoff produced by factories. Pollutants damage the quality of air, water, and land. Many things that are useful to people produce pollution. Cars spew pollutants from their exhaust pipes. Burning coal to create electricity pollutes the air. Industries and homes generate garbage and sewage that can pollute the land and water.</p> <p>Pesticides—chemical poisons used to kill weeds and insects—seep into waterways and harm wildlife.</p> <p>All living things—from one-celled microbes to blue whales—depend on Earth's supply of air and water. When these resources are polluted, all forms of life are threatened.</p> <p><a href="https://www.nationalgeographic.org/encyclopedia/pollution/">https://www.nationalgeographic.org/encyclopedia/pollution/</a></p>
pollution prevention	activities that reduce the amount of pollution generated by a process, whether it is consumer consumption, driving, or industrial production

point source pollution*	any single identifiable source of pollution from which pollutants are discharged, such as a pipe, ditch, ship, or factory smokestack. <a href="https://oceanservice.noaa.gov/education/tutorial_pollution/03pointsource.html">https://oceanservice.noaa.gov/education/tutorial_pollution/03pointsource.html</a>
non-point source pollution	a kind of water pollution from different sources such as from land runoff, precipitation, atmospheric deposition, drainage, seepage or hydrologic modification. As the runoff from rainfall or snowmelt moves over and through the ground, it picks up and carries away natural and human-made pollutants, depositing them into lakes, rivers, wetlands, coastal waters and ground waters. Sources can include: Excess fertilizers, herbicides and insecticides from agricultural lands and residential areas Oil, grease and toxic chemicals from urban runoff and energy production Sediment from improperly managed construction sites, crop and forest lands, and eroding stream banks Salt from irrigation practices and acid drainage from abandoned mines Bacteria and nutrients from livestock, pet wastes and faulty septic systems Atmospheric deposition and hydromodification <a href="https://www.epa.gov/nps/basic-information-about-nonpoint-source-nps-pollution">https://www.epa.gov/nps/basic-information-about-nonpoint-source-nps-pollution</a> <a href="https://www.epa.gov/nps/nonpoint-source-hydromodification-and-habitat-alteration">https://www.epa.gov/nps/nonpoint-source-hydromodification-and-habitat-alteration</a>
airshed	a part of the atmosphere that behaves in a coherent way with respect to the dispersion of emissions. <a href="https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_068329.pdf">https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_068329.pdf</a> , page 29 of 32
watershed*	an extent of land where water from rain or snow melt drains downhill into a body of water, such as a river, lake, reservoir, estuary, wetland, sea, or ocean <a href="https://www.fs.fed.us/naturalresources/watershed/index.shtml">https://www.fs.fed.us/naturalresources/watershed/index.shtml</a> <a href="https://en.wikipedia.org/wiki/Watersheds_of_North_America">https://en.wikipedia.org/wiki/Watersheds_of_North_America</a>
river basin	In a river basin, all the water drains to a large river. Within a river basin are many smaller watersheds. <a href="https://milwaukeekeeper.org/whats-a-river-basin-whats-a-watershed/">https://milwaukeekeeper.org/whats-a-river-basin-whats-a-watershed/</a>

continental divide*	an area of raised terrain that separates a continent's river systems that feed to different basins <a href="https://www.nationalgeographic.org/encyclopedia/continental-divide/">https://www.nationalgeographic.org/encyclopedia/continental-divide/</a>
	Species risk levels
threatened species	any species (including animals, plants, fungi) which are vulnerable to extinction
endangered species	any species whose numbers are so small that the species is at risk of extinction
extinction	death of every member of a species or group
	Development ideas
brownfield	abandoned or underused industrial and commercial facilities available for reuse. Expansion or redevelopment of such a facility may be complicated by real or perceived environmental contamination.
greenfield*	development on undeveloped land, like meadows or agricultural land or forest <a href="https://www.millionacres.com/real-estate-basics/types-real-estate/what-greenfield-development/">https://www.millionacres.com/real-estate-basics/types-real-estate/what-greenfield-development/</a>
	Fossil fuels and their consequences
fossil fuels*	carbon-rich products (hydrocarbons) of photosynthesis in algae, bacteria, and plants millions of years ago transformed by pressure and heat buried under layers of sediment. <a href="https://www.nationalgeographic.com/environment/article/fossil-fuels">https://www.nationalgeographic.com/environment/article/fossil-fuels</a> <a href="https://www.britannica.com/science/fossil-fuel">https://www.britannica.com/science/fossil-fuel</a>
fossil fuels*	Examples include coal, petroleum (gasoline, kerosene, jet fuel, Diesel fuel), natural gas.



fossil fuels*	are burned to generate electricity, to power vehicles and heavy equipment, and to supply heat for manufacturing, oil refineries, and other industries [coal-fired blast furnaces for steel production].
fossil fuels*	non-renewable sources of energy
fossil fuels*	"dirty" energy
renewable sources of energy	"clean" energy
renewable sources of energy	solar energy for heat and electricity, hydroelectric power, wind for electricity, geothermal energy for heat, ocean tides and waves for electricity, biomass burning for heat (not clean), nuclear for electricity (not clean)
hybrid vehicle	a vehicle that uses two or more distinct power sources to move the vehicle
hybrid vehicle	combines an internal combustion engine and one or more electric motors.
hybrid vehicle	Batteries can be recharged from plug-in chargers at home or at charging stations while traveling, from a generator (alternator)-starter motor turned by the gasoline engine, or by regenerative braking.
fuel cell	electrochemical conversion device, invented in 1839 by William Grove, that produces electricity from fuel (on the anode side, commonly hydrogen) and an oxidant (on the cathode side, commonly oxygen), which react in the presence of an electrolyte and catalysts, with water and heat as by-products <a href="https://www.gencellenergy.com/gencell-technology/">https://www.gencellenergy.com/gencell-technology/</a>
	Air pollutants
greenhouse gas(es)*	gases that trap heat in the atmosphere <a href="https://www.epa.gov/ghgemissions/overview-greenhouse-gases">https://www.epa.gov/ghgemissions/overview-greenhouse-gases</a>
greenhouse gas(es)*	Carbon dioxide (CO <sub>2</sub> ) is produced by burning fossil fuels (coal, natural gas, and oil), solid waste, trees and other biological materials, and by chemical reactions (e.g., manufacture of cement).

greenhouse gas(es)*	Carbon dioxide is removed from the atmosphere (or "sequestered") when it is absorbed by plants as part of the biological carbon cycle.
greenhouse gas(es)*	Methane (CH <sub>4</sub> ) is emitted during the production and transport of coal, natural gas, and oil, from livestock and other agricultural practices, from the decay of organic waste in municipal solid waste landfills.
greenhouse gas(es)*	Fluorinated gases (hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride) are synthetic emissions from industrial processes.
greenhouse gas(es)*	Nitrous oxide (N <sub>2</sub> O) is emitted during agricultural, land use, industrial activities, combustion of fossil fuels and solid waste, and during treatment of wastewater.
acid rain	any form of precipitation with acidic components, such as sulfuric or nitric acid, that falls as rain, snow, fog, hail, or dust <a href="https://www.epa.gov/acidrain/what-acid-rain">https://www.epa.gov/acidrain/what-acid-rain</a> ]
acid rain	occurs when fossil fuels burn to release sulfur dioxide (SO <sub>2</sub> ) and nitrogen oxides (NO <sub>x</sub> ) that react with water, oxygen and other chemicals to form sulfuric and nitric acids
ozone	a chemical that is made of three oxygen atoms joined together and found in the Earth's atmosphere. <a href="https://www.epa.gov/ozone-pollution-and-your-patients-health/what-ozone">https://www.epa.gov/ozone-pollution-and-your-patients-health/what-ozone</a>
ozone	a good chemical formed high in the atmosphere (stratosphere) when solar UV radiation interacts with molecular oxygen (O <sub>2</sub> )
ozone	a good chemical layer about 6 through 30 miles up reducing harmful UV radiation reaching the Earth's surface
ozone	a bad chemical formed in the air close to the Earth's surface (troposphere) from photochemical reactions between VOCs and NO <sub>x</sub> .
ozone	a chemical that can damage the lungs of animals and humans
NO <sub>x</sub> *	Nitrogen Oxides are produced by high temperature combustion in power plants, industrial furnaces and boilers, and motor vehicles.
NO <sub>x</sub> *	Nitrogen Oxides are produced in combustion processes, partly from nitrogen compounds in the fuel, but mostly by direct combination of

	<p>atmospheric oxygen and nitrogen in flames. Nitrogen oxides are produced naturally by lightning, and also, to a small extent, by microbial processes in soils.</p> <p><a href="http://www.apis.ac.uk/overview/pollutants/overview_nox.htm">http://www.apis.ac.uk/overview/pollutants/overview_nox.htm</a></p>
VOCs*	<p>Volatile Organic Compounds are emitted by chemical plants, gasoline pumps, oil-based paints, auto body shops, and print shops.</p>
particle pollution	<p>Particle pollution is the mixture of solid and liquid droplets suspended in the air. Particle pollution comes in many sizes and shapes and can be made up of a number of different components, including acids (such as sulfuric acid), inorganic compounds (such as ammonium sulfate, ammonium nitrate, and sodium chloride), organic chemicals, soot, metals, soil or dust particles, and biological materials (such as pollen and mold spores).</p> <p>Primary particles are emitted directly from a source, such as construction sites, unpaved roads, smokestacks or fires. Secondary particles form in complicated atmospheric reactions involving chemicals such as sulfur dioxides and nitrogen oxides that are emitted from power plants, industries and automobiles. Secondary particles make up most of the fine particle pollution in the United States.</p> <p>Cooking, smoking, dusting, and vacuuming can also produce particle pollution, particularly in indoor settings. Particles produced by combustion are more likely to be fine particles, while particles of crustal (earth) and biological origin are more likely to be coarse particles.</p> <p><a href="https://www.epa.gov/pmcourse/what-particle-pollution">https://www.epa.gov/pmcourse/what-particle-pollution</a></p>