

Designing a Clean-Air Environment



Target Grade Levels

Fourth - Ninth

Time

30 minutes in first class

40 minutes in second class with guest presenter

Materials

- chalk
- chalkboard
- pencils a plastic

Knowledge and Skills (TEKS)

- Science:
 - Independent and group exercises;
 - Acquire data through the senses; and
 - The student shall be given opportunities to observe properties and patterns of objects, organisms, and events in the environment.

Overview

This activity gives students an opportunity to explore how air pollution in a city can be minimized due to the arrangement of living areas, working areas, and urban landscaping.

Background Information

By giving some thought to the location of different required elements of a city, we can reduce the use of polluting fuels and use environmental processes to aid us in our goals. If the places we go to often are near one another, we drive less and pollute the air less.

The number one pollution problem in the San Antonio area is ground-level ozone. Ground-level ozone is an odorless, colorless gas that can damage the respiratory system, causing symptoms including coughing and wheezing or difficulty breathing. Over the long-term, excess ground-level ozone exposure can cause lung damage. Children, the elderly, and individuals with lung diseases such as asthma and emphysema are especially susceptible. Ground-level ozone is created by a reaction between nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in sunlight. Major sources of these precursor pollutants include vehicles, fueling stations, construction equipment, landscaping equipment, and power generation.

The NO_x and carbon dioxide (CO₂) in automobile exhaust contribute to the greenhouse effect. The global temperature rise that is a predicted result of the greenhouse effect could cause major shifts in global weather patterns and a rise in sea levels.

Reductions in overall traffic volume and congestion are important solutions to air pollution problems; however, population growth and economic growth tend to increase both traffic volume and congestion. Therefore, to accommodate growth and protect air quality, planners must plan for and consider various transportation modes and planning elements to help make citizens "Drive Clean Across Texas."

By planting trees near highways, CO₂ in automobile exhaust will be absorbed by the leaves and turned into oxygen through photosynthesis. By planting trees and shrubs to shade the roofs, windows, and air conditioning units of our homes in the summer, we don't need to run the air conditioner as much. This, in turn, reduces air pollution because it reduces the need to burn fossil fuel to generate electricity generation at power plants. Power plants that run on fossil fuels typically emit many pollutants, including sulfur dioxide, carbon monoxide, nitrogen oxides, and particles. Burning fossil fuels or wood also produces large amounts of carbon dioxide, which contributes to the greenhouse effect. While designing a city with these considerations in mind, students will see that their choices have important consequences and that not all problems have satisfactory solutions. This is related to real tradeoffs, such as short-term gain versus long-term benefit and convenience versus conservation.

Suggested Reading

- Bruning, Nancy. *Cities Against Nature*. Chicago, IL: Children's Press (1992).
- Shaffer, Carolyn. *City Safaris: A Sierra Club Explorer's Guide to Urban Adventures for Grownups and Kids*. San Francisco, CA: Sierra Club Books (1987).

Procedure

1) Vocabulary

- | | |
|-----------------|----------------------|
| a) carbon cycle | d) greenhouse effect |
| b) electricity | e) planning |
| c) energy | f) smog |

2) Activities

- Explain that the students are going to do two related activities. They will work alone on the first project. Hand out a copy of the attached worksheet to each student and ask them to cut out and arrange the elements from the worksheet on another piece of paper to layout a "city" that looks like the one they live in. For this exercise, define the boundaries of the city: the neighborhood near the school, each student's home neighborhood, or the whole city. You may want to get them started by identifying the relative location of a few important landmarks or highways. You can decide which of the elements on the worksheet the students are to use.
- While the students are working, lead a discussion about how much time families must spend driving around in their cars because of the distances between places. Does the layout of the city contribute to air pollution by separating, for example, working and living areas? Students can analyze their city layouts as the discussion progresses. Have them save their layouts for the second part of the exercise on another day.
- For the second exercise, you or the guest presenter will need to review with students the concepts of air pollution and smog, and how the production and use of energy (heating, electricity, cooling) causes air pollution.
- This second exercise will be done in small groups. Form the groups and hand out a clean worksheet to each group. Explain that the students are going to pretend to be urban planners. Urban planners are professionals who determine the arrangement of

roads, buildings, and parks in a city. Students are to design a city from the ground up. When deciding on the placement of the necessary elements and choosing energy sources, their primary goal will be to minimize air pollution.

- e) After the students have designed their “perfect” cities, lead a discussion with the goal of coming to consensus on the best location for each element. Layout the elements on the students’ worksheets. Reposition the elements as students debate the best arrangement of elements.

3) Review

Compare the drawings of the actual cities from the first class to the “perfect” cities designed in the second. Have the class discuss the following questions:

- a) How are the two cities different?
- b) What are some reasons you would want the workplaces—factory, office building—near homes? Far from homes? (They are more convenient if they are nearby. The farther away, the more pollution caused by cars.)
- c) Does the city have a public transportation system? Why or why not? Do people use them? Why or why not?
- d) What are the advantages of urban areas and their high population density? Disadvantages? (Fewer trees per person need to be cut down in order to build apartments as compared to suburban single-family homes. Smog is more apparent in downtown areas.)
- e) What are advantages of suburban areas and their lower population density? Disadvantages? (Residents have to use cars more often for everyday activities, but residents get to have yards, trees, landscaping, and gardens.)
- f) Is there a limit to the size a city can be for it to be efficient?
- g) How can the placement of trees help lower the use of utilities? (Examples: shading buildings to lower the use of air conditioning, as windbreaks to lower use of heating.)

4) Evaluation

- a) Group participation can be evaluated.
- b) Participation in discussion can be evaluated.
- c) Extension activities can be performed as graded exercises.

5) Extension

Students may enjoy trying this activity using commercially available computer programs like Sim City™. While the program allows the user to design a city, numerous built-in modules reflect the effects of the user’s decisions. For example, if the user builds a freeway, air pollution levels rise and are displayed in a pop-up graph. If the user builds ten new office buildings, smoke starts belching from the stacks at the power plant.

- a) Suggested Modifications
- b) For higher grades, expand the project to be a multi-session activity, exploring in more depth each of the pollutant sources and reduction measures discussed in the activity. A different guest presenter could be invited to discuss each topic.
- c) For grades 8 and 9, have students collect data to support the decisions they made during the discussions in the second exercise. For example, they may locate actual figures on energy savings from not running the air conditioner, data on air pollution from cars, and case studies that show how the use of public transportation reduces pollution or ways factories can cut emissions. Have them make presentations on their findings.

STUDENT WORKSHEET 1

DESIGNING A CLEAN AIR ENVIRONMENT



single-family homes



office buildings



walking & jogging trails



apartments & townhouses



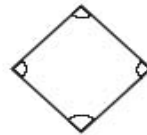
industries



trees, parks, forests



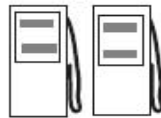
bike trails



playgrounds & ballfields



schools



gas stations



restaurants



highways



stores & shopping malls



bus & subway routes