



Background: Reducing Impacts from Transportation

Background for Lesson 14

Transportation and Air Pollution

Transportation is the network that moves people and goods from place to place. There are many different modes of transportation such as, cars, trucks, buses, trains, ships, and airplanes. These transportation modes generally use fuel for power, and therefore, emit exhaust into the air.

Exhaust emissions, typically made up of particulate matter, nitrous oxides, methane, and carbon dioxide, contribute to air pollution and climate change. Cars also emit HFCs (hydrofluorocarbons), very strong greenhouse gas emissions, from air conditioning units.

Transportation modes emit varying levels of air pollution depending on their engine and fuel usage. For example, diesel engines, found in trucks, trains, and ships, burn much dirtier than gasoline engines and emit high levels of particulate matter harmful to people's health.

Climate Change Connection: Air pollution can lead to serious public health problems like increases in respiratory illnesses and asthma attacks. Children and senior citizens are particularly vulnerable to health problems from air pollution. With climate change, California expects to have more frequent and severe heat waves in California, which will result in more air pollution and related health problems.

Background for Lesson 15

Cars and Climate Change

Cars and trucks are the biggest source of air pollution and greenhouse gas emissions in California, as well as in the San Francisco Bay Area. Vehicles burn fossil fuels for energy, gasoline in the case of most cars and diesel for most trucks, and emit carbon dioxide through their exhaust. Cars emit 19 pounds of carbon dioxide emissions for every gallon of gasoline burned.¹

The amount of carbon dioxide that a car emits depends on its fuel efficiency. **Fuel efficiency** is the measurement of how much fuel a car needs to travel. The more fuel efficient a car is, the less fuel it needs to travel per mile than compared to other cars. Fuel efficiency is measured in miles

per gallon, mpg. The fuel efficiency of a car is related to the car's weight, engine size and type, and maintenance. For example, sedans are more fuel efficient than SUVs because they weigh less and have smaller engines; however a sports car, like a Ferrari, could be less fuel efficient than an SUV because it has a big powerful engine to make it drive fast. Car maintenance, like properly inflated tires and regular oil changes can improve a vehicle's fuel efficiency. The more fuel efficient a vehicle is, the less pollution and greenhouse gas emissions it will emit.

A bus is less fuel efficient than a car because it weighs a lot more and has a much bigger engine. However, a bus has a much higher passenger miles per gallon rate than a car.

Passenger miles per gallon, pmpg, is the mpg of a vehicle multiplied by the number of people in the vehicle. A car with one person and 24 mpg equals 24 pmpg (24x1). A car with four people and 24 mpg equals 96 pmpg (24x4). A bus with 30 passengers and 4 mpg equals 120 pmpg (4x30). The higher the pmpg rate, the less greenhouse gas emission are emitted per passenger. Therefore, a full bus outperforms a full car a full car; and a full car outperforms a single occupant car.

Idling is another important issue surrounding vehicles and climate change. Idling is when people leave their vehicles engines running while not driving. Unnecessary idling, such as leaving car engines running while waiting for someone, wastes gas and emits greenhouse gas emissions and air pollutants into the air. Idling is an especially serious issue at schools when children breathe in the harmful pollutants of buses and cars that idle as they wait for students.

Climate Change Connection: As vehicle travel continues to grow in the United States, so do related greenhouse gas emissions. The best way to reduce emissions from cars is to use fuel efficient vehicles; never idle any engines; purchase local food and products that did not need to travel far; and most importantly, drive less. We can drive less by choosing to walk or bicycle when possible instead of driving; carpool to school and work; and use transit like buses and trains.

¹ EPA, 2005:<http://www.epa.gov/oms/climate/420f05001.htm>



Background: Reducing Impacts from Transportation

Background for Lesson 16

City Planning

Development patterns, the way communities are organized and built, along with transportation planning, shape how people travel. For example, a person who lives in the middle of San Francisco can most likely walk to grocery stores and shops; take the bus or BART to work; and use taxis to go to special destinations. San Francisco's dense development and many transit options make it easy for a person to travel without owning a car. On the other hand, a person living in a suburban neighborhood is most likely dependent on driving because destinations are far apart from one another and few transit options exist.

Most suburban development may be described as sprawl. **Sprawl** is low-density development where residential and commercial buildings are usually located far from one another. Sprawl development generally contains roads designed for high speeds, large parking lots, and little or no pedestrian, bicycle, and transit access. Due to the far distances between destinations and limited access options, most travel in sprawl development occurs through driving, which in turn produces air pollution and greenhouse gas emissions.

With consideration to increasing fuel prices, climate change, and other environmental issues, many local governments are now placing greater priority on transit, pedestrian, and bicycling access. **Mixed use** is development that combines residential, commercial, and recreational land uses in close proximity to one another. Mixed-use development best fits around a transit station or commercial corridor to encourage accessibility by transit, pedestrian, and bicycling. This type of land use planning reduces the need for extensive vehicle travel and can reduce greenhouse gas emissions.

Urban planning, the way communities are planned, shapes the way we live and travel, even down to the school level. The development pattern around a school can determine students' travel behavior. Short distances between home and school and pedestrian friendly environments can encourage walking or biking to school. On the other hand, long distances and unsafe walking conditions discourage walking and

biking to school. Urban planners are interested in improving walking and biking access to school to reduce greenhouse gas emissions from driving and promote a healthy active lifestyle.

Sustainability, only using nature's resources at a rate that they can be replenished naturally, has become a major concern in today's world. We are consuming Earth's resources faster than they can be replaced naturally and generating greenhouse gases which speed up global warming. Scientists, engineers, inventors, designers, and ordinary citizens are working on ways to conserve the Earth's limited resources by reducing consumption, generating power using renewable energy sources, and preserving trees which convert carbon dioxide into food through photosynthesis. Sustainability is being incorporated into all aspects of life from urban planning, agriculture, energy production, water usage, and construction.

Need More Information?

- Fuel efficiency
 - Department of Transportation Center for Climate Change and Environmental Forecasting. This site includes information on transportation and emissions, www.climate.volpe.dot.gov/trans.html.
 - Environmental Protection Agency and the Department of Energy provide a comprehensive listing of fuel economy ratings for most vehicles, <http://www.fueleconomy.gov/>
 - Air Resources Board provides vehicle fuel efficiency information, <http://www.arb.ca.gov/msprog/msprog.htm>
- Transit
 - The American Public Transit Association, <http://www.apta.com/>
 - Transit resource for the San Francisco Bay Area, <http://transit.511.org/>
 - Safe Routes to School, <http://www.dot.ca.gov/hq/LocalPrograms/saferoutes/saferoutes.htm>
- Sustainability
 - [Sustainable practices website, www.howstuffworks.com](http://www.howstuffworks.com)



Estimated Time: 1 hr

Objectives:

- Understand the link between vehicle exhaust and climate change.
- Analyze data on vehicle occupancies at their school.
- Use their observations and analysis to recommend ways to reduce emissions from transportation.

CA State Standard Connections:

5th Grade Statistics, Data Analysis and Probability

Know the concepts of mean, median, and mode; compute and compare simple examples to show that they may differ.

5th Grade Visual Literacy

Identify and design icons, logos and other graphic devices as symbols for ideas and information.

Tool Kit Materials:

- Handout 1 (one per group)
- Handout 2 (one per group)

Additional Materials:

- Drawing paper (one per group)
- Clipboards (one per group)
- Timer or watch

Car Tally

Single occupant car travel is a major contributor to air pollution and climate change. In this lesson students investigate car use and driving habits at their school, and develop alternatives for the single occupant vehicle commute.

Key Words

Carpool: to share a ride with other people in one vehicle.

Traffic: the movement of cars and other vehicles on the road.

Idling: an engine running while not doing useful work, such as a car sitting still with its engine running.

Transportation: ways of moving people or goods from one place to another.

Preparation

Hold the activity during Kindergarten pick-up time. If your school does not have Kindergarten, identify a nearby street with regular vehicle traffic and with a safe location, such as a sidewalk, for students to stand and observe traffic. Review mean, median, and mode with your class or introduce them to the concepts, using the Car Tally data.

Setting The Stage

- Give each student a small piece of paper (2x3 inches, or a sticky note) and have them write or draw a picture of how they get to school on a typical day. Have them put their name on the back of the paper.
- Next, brainstorm all the categories, or ways, a student could get to school. Write these categories as sections on the bottom axis of a bar graph, either on a whiteboard or on separate chart paper. Last, have students tape their paper on the board with their means of transportation above the appropriate category, walking, car, bus, etc.
- Discuss the results of this bar graph, what was the most common means of getting to school, least common, what might be the effects on the environment?
- Ask the students what it is like in the school's parking lot or in front of the school when they arrive, specifically asking about traffic?
- Ask if most of the cars are filled with people or more often have just one or two occupants?
- Ask if students have noticed if most cars on the road or around town have multiple passengers, or more often just one.

Activity 1 – Car Tally

1. Divide the class into small groups of 3-5 students. Provide each group, or each student, with Handout 1 and a clipboard. Each group should have a pen or pencil. Explain to the groups that they will be investigating the number of people in cars after picking up Kindergarteners.
2. Escort the groups to the pick-up/drop-off area before Kindergarten is dismissed. Give groups fifteen minutes to count how many people are in each car after the driver has picked up the kindergartener.
3. Return to the classroom and help groups complete their tally sheets by adding up the total number of people inside the vehicles and finding the average, median, and mode. If this is their first experience with the concepts, you may want to integrate this part of the lesson into your math lesson, so that you have additional time to work on the math concepts.

Activity 2 – Carpool Benefits

1. Encourage discussion of Handout 1 by asking the following questions:
 - “What was the average number of people in a car?” (To find the average, add up the total number of people in the cars and divide that result by the total number of cars.)
 - “What do the median and mode numbers for people in cars tell you?” (When arranged from lowest to highest, the median is the middle number of people in the cars. The mode is the number of people in the cars that is observed most often.)
 - “Did you find that the average and mode numbers for people in the cars were the same or different?” (This will depend on students' observations.)

- “Which vehicle occupancy category does the most to protect the climate?” (The 5 people in the car category is the best protector of the climate.)
 - Read some of this section’s background information to students including how cars and trucks are the biggest source of air pollution and greenhouse gas emissions in California.
 - Cars emit 19 pounds of carbon dioxide emissions for every gallon of gasoline burned. Unnecessary idling, leaving car engines running, while waiting for someone, wastes gas and emits greenhouse gases and air pollution into the air.
 - “Did all of the groups have the same answers?” (This will depend on the accuracy of students’ observations.)
2. Distribute a copy of Handout 2. Have students complete the handout in their groups by developing recommendations to reduce the amount of single occupant driving at the school, and by designing a logo or symbol to remind students to drive less on the backside of the handout.

After groups have completed Handout 2, ask students to share their responses and designs. What can students do to help? What can the school’s staff and teachers do?

Assessment

Walk around while groups are working together to assess who is participating in the group discussions, and how well they understand the concepts. Collect everyone’s papers, Handouts 1 and 2, at the end of the lesson to determine if students were able to collect the data required and to recommend alternatives to driving alone.

Extensions

1. Students develop a campaign to reduce car traffic at the school, which can include making posters to place around the school, writing letters to staff and to parents, and organizing carpools.



Design a Car-Free Weekend

Lead students in designing a car-free weekend for their families. Discuss with students which weekend activities require use of a car, which activities are best without cars, and which activities can be done using other modes of transportation. Students will identify how to spend the weekend without traveling by automobile and how to travel from their homes to destinations using only public transit, walking, or biking. Students can share their experiences with their classmates.

Transit information for Bay Area: <http://511.org/>

NAMES: _____

DATE: _____

Car Tally

Lesson 14, Handout 1

- As a group, count the number of cars you see in five minutes. Complete the chart below. In the first column, tally the number of cars you see with one, two, three, four, or five inside after they have picked up the kindergartener(s). Later, in the second column, multiply the tallied number of cars by the number of people in those cars.

Vehicle Occupancy	Number of Cars (Tally)	Total Number of People
2 PEOPLE IN THE CAR		
3 PEOPLE IN THE CAR		
4 PEOPLE IN THE CAR		
5 PEOPLE IN THE CAR		
CARS IDLING		
TOTAL		

- How many cars were idling while waiting for Kindergarteners to come out? _____
- Find the average number of people in a car at your school by dividing the total number of people in the cars by the total number of cars:

Average number of people in a car: _____

- Now, calculate the median number of people in the cars. Write down the number of people in each car from fewest to most, and then find the middle number. For example, if you saw four 1-person cars, two 2-people cars, and one 3-people car, those seven numbers in order would look like this: 1, 1, 1, 1, 2, 2, 3. The middle number is the fourth number, which is 1. If there is an even number of cars, add the two middle numbers and divide the total by two.

Median number of people in a car: _____

- Finally, calculate the mode number of people in the cars. The mode is the number that appears the most often. To find the mode, look at the row of numbers of passengers, and count how many times each number appears. The number that appears the most often is the mode. In the example above, 1 appears most often.

Mode number of people in a car: _____

NAMES: _____

DATE: _____

Car Tally

Lesson 14, Handout 2

As a group, answer the following questions:

1. How can carpooling reduce air pollution?

2. What can students do to help reduce car travel and air pollution?

3. Did you see cars idling? If so, why could this be bad for air pollution?

4. What can teachers and school staff do to help reduce car travel and air pollution?

5. On the backside, draw a design for a logo or symbol to remind the school or the community to drive less. For example, the logo could be a symbol for walking more and driving less.



Estimated Time: 1 hr

Objectives:

- Determine the amount of CO₂ emitted in their travel to school.
- Calculate emissions for various vehicles and occupancies.
- Understand how transportation contributes to climate change.

CA State Standard Connections:

4th Grade Number Sense

Students solve problems involving addition, subtraction, multiplication, and division of whole numbers and understand the relationships among the operations.

Tool Kit Materials:

- Handout 1 (one per student)

Calculating School Trip Emissions

Changing personal transportation choices is a critical step to protecting the climate. In this lesson, students will calculate the pounds of CO₂ released into the atmosphere from their commute to school. This exercise introduces students to the concept of passenger miles per gallon and underscores the important role that carpooling and public transportation plays in curbing air pollution and climate change.

Key Words

Miles per Gallon: the number of miles a vehicle can travel on one gallon of fuel.

Passenger Miles per Gallon: the number of miles a single vehicle can travel on one gallon of fuel multiplied by the number of passengers.

Fuel Efficient Vehicle: vehicle that requires less fuel to travel compared to other vehicles.

Preparation

Review the Background for Lesson 15 for an overview on calculating passenger miles per gallon. Prior to this lesson, ask students to collect information on the vehicles in which they get to school. Included in this information should be type of vehicle, miles per gallon, fuel type (diesel or gas), number of passengers including driver, and number of miles roundtrip to school.

Setting the Stage

- Ask students to describe a time they rode the bus; ask them if the bus was full of people or mostly empty?
- "Which holds more fuel, a bus or a car?" (A typical bus gets about 4 – 8 miles to the gallon, while most cars get over 20 miles to the gallon.)
- "What form of travel do you think is more fuel-efficient, a full bus or car?" "Why?"
- Explain that the bus is more fuel-efficient because it uses less fuel to transport each person compared to many cars carrying only one person each.

Activity 1 – Calculate Commute Emissions



Bus and Transit Image on CD.

1. Explain to students that today they will learn how to calculate the amount of fuel used on their daily trips to school and the quantity of CO₂ produced. Distribute a copy of Handout 1 to each student in the class.
2. Have students look at the chart titled "Average Miles per Gallon" on the handout.
 - "Which type of vehicle gets the worst miles per gallon?" (The bus. Large trucks. Large SUVs.)
 - "Which type of vehicle gets the best miles per gallon?" (The hybrid car.)
 - "What are some things that determine how fuel-efficient a vehicle is?" (The size and type of motor help determine a vehicle's fuel efficiency. The weight of the car.)
3. Next, explain to students that **passenger miles per gallon** is a term to describe the number of miles that all passengers in a vehicle can travel on a gallon of fuel.
 - "What determines a vehicle's passenger miles per gallon?" (The number of passengers in that vehicle times the vehicle's miles per gallon.)
 - "How is a bus' miles per gallon figure different than the bus' passenger miles per gallon?" (The bus' will always get around 4 miles per gallon, but the bus' passenger miles per gallon will change depending on the number of riders.)
4. Have students complete Handout 1, providing assistance as necessary.

Activity 2 – Passenger Miles per Gallon and Climate Change

1. Once students have completed the handout, ask students
 - "Why do vehicles generate CO₂ and other forms of air pollution?" (A vehicle's engine combusts gasoline or diesel for power, and CO₂ is a byproduct of combustion.)
 - "What does CO₂ have to do with the fuel efficiency of vehicles?" (The more efficient the vehicle, the less CO₂ it will produce.)
 - "What does CO₂ have to do with passenger miles per gallon?" (The more people riding in a vehicle, the fewer pounds of CO₂ will be generated per person in that vehicle.)

- “Why is riding the bus or carpooling better than driving in a car alone?” (Fewer pounds of CO₂ will be emitted per person in a bus or carpool than in driving alone in a car.)
2. Discuss student results and facts about vehicle emissions in the handout. Ask students to name ways they can reduce personal travel emissions, such as, walking, cycling, carpooling, or taking the bus.

Assessment

Collect student papers to see if they were able to calculate the CO₂ emissions for various vehicles and occupancies. Look at question 10 to see if they understand the correlation between the mode of transportation and the amount of emissions produced.

Extensions

1. Calculate which vehicle gets the higher passenger miles per gallon – a minivan with six passengers or a hybrid car with two passengers? Students find the answer using the calculations in Handout 1.
2. Students keep a travel emissions log and track their emissions over a week or month. They are then asked to summarize their log and make suggestions about how they could improve their emissions.



Sponsor Bicycle Workshops!

This project inspires students to increase their safe use of bicycles as an alternative to traveling by car. Local bicycle advocacy organizations offer free classes to your students on bike safety, bike maintenance and safe riding to and from schools. These organizations will lead short bike trips around the school, teach students about proper helmet use, proper signaling and the use of bike lanes. Coordinate with an organization to hold one or more bicycling workshops at your school (e.g., for after school or lunchtime programs, or as a special assembly).

San Francisco bicycle coalition: <http://www.sfbike.org/>



Community Tire Check / Inflation Days!

This project can inspire community members to pay closer attention to their tire pressure and maintenance as a way to save gas and reduce air pollution. Guide students in partnering with local filling stations to host tire check and inflation events. Set up a ‘tire inflation station’ at the school to check tires at the end of the school day. Work with students to develop and distribute a pamphlet about proper tire inflation and vehicle maintenance.

Information on the benefits of proper tire inflation:

http://www.carcare.org/Tires_Wheels/inflation.shtml

NAME: _____

DATE: _____

Calculating School Trip Emissions

Lesson 15, Handout 1

Students travel to school in many ways. Some students walk; some ride bikes, skateboards, or scooters; most drive in a car or take the bus. This lesson will assist you in developing a way to find out how many pounds of carbon dioxide (CO₂) you create by traveling to school each day. Remember that CO₂ is one of the main greenhouse gases contributing to climate change.

Average Miles per Gallon Chart

Walk, Bike, Skate, Scoot	Food is your fuel, you can go forever!
Hybrid car	48 miles per gallon
Small compact car	30 miles per gallon
2-seater sports car	25 miles per gallon
Station wagon	25 miles per gallon
Small pick-up	22 miles per gallon
Minivan	23 miles per gallon
Small SUV	23 miles per gallon
Large pick-up	16 miles per gallon
Large SUV	15 miles per gallon
Motorcycle	50 miles per gallon
Bus	5 miles per gallon

*If your parents know the exact city mileage of your vehicle, you can enter that as A for question #2.

1. What kind of vehicle do you usually take to get to school in the morning?

2. Now look at the chart above to find out how many miles the vehicle can go from burning up one gallon of fuel. What is the mileage of your vehicle? We'll call this amount A.

A = _____ mpg

3. How many people are usually in the vehicle? We'll call this amount B.

B = _____ people

4. Multiply A times B. This is your Passenger Miles per Gallon. We'll call this amount C.

C = _____ passengers mpg

5. Choose one of the next two choices. If you drive in a vehicle that uses gasoline, it creates 18.8 pounds of CO₂ gas for each gallon of fuel used. If you travel in a bus or diesel vehicle, it uses diesel fuel and creates 21.9 pounds of CO₂ gas for every gallon burned. Which is it for you? Write that below. We'll call this amount D.

D = _____ lbs of CO₂

6. Now we will calculate the CO₂ produced per mile by the vehicle you take to school. Take amount D and divide by amount A. We'll call this amount E.

E = _____ lbs

7. To determine the pounds of CO₂ per Passenger Mile for your vehicle, take amount E and divide by amount B. We'll call this amount F.

F = _____ lbs

8. Determine the exact number of miles from your house to school (visit google maps or mapquest online). We will call this amount G.

G = _____ miles

9. Multiply the distance traveled (G) x the Pounds of CO₂ per Passenger Mile (F) to know exactly how many pounds of CO₂ gas is created to commute to school each morning.

Pounds of CO₂ Gas = _____ lbs

10. What is the best way to reduce emissions from your commute to protect the climate?
-

Inspiring Change Projects



Design a Car-Free Weekend

Lead students in designing a car-free weekend for their families. Discuss with students which weekend activities require use of a car, which activities are best without cars, and which activities can be done using other modes of transportation. Students will identify how to spend the weekend without traveling by automobile and how to travel from their homes to destinations using only public transit, walking, or biking. Students can share their experiences with their classmates.

Transit information for Bay Area: <http://511.org/>



Sponsor Bicycle Workshops

This project inspires students to increase their safe use of bicycles as an alternative to traveling by car. Local bicycle advocacy organizations offer free classes to your students on bike safety, bike maintenance and safe riding to and from schools. These organizations will lead short bike trips around the school, teach students about proper helmet use, proper signaling and the use of bike lanes. Coordinate with an organization to hold one or more bicycling workshops at your school (e.g., for after school or lunchtime programs or as a special assembly).

San Francisco Bicycle Coalition: <http://www.sfbike.org/>



Explore Food Miles in the Lunchroom

This project inspires students to examine where their food comes from and the impacts that long distance transportation of food might have on the environment. Students can map where the ingredients of particular menu items typically come from (a hamburger equals bread from Kansas, tomato from Modesto, meat from Argentina, and cheese from Vermont). On the maps, indicate the distances from these locations to the school, estimate product weight and transportation (truck, rail, air, ship) and calculate total carbon costs for items. Recommend local food options and share results with students, administration, and families.

Food miles resources: http://attra.ncat.org/farm_energy/food_miles.html



Community Tire Check / Inflation Days

This project can inspire community members to pay closer attention to their tire pressure and maintenance as a way to save gas and reduce air pollution. Guide students in partnering with local filling stations to host tire check and inflation events. Set up a 'tire inflation station' at the school to check tires at the end of the school day. Work with students to develop and distribute a pamphlet about proper tire inflation.

Information on the benefits of proper tire inflation: http://www.carcare.org/Tires_Wheels/inflation.shtml



Create a Local Bicycle / Walking Map

This project can inspire more walking and biking by providing students with maps of routes for walking and biking to school. Invite a local biking or walking organization to the classroom to share information and lead school based local excursions. Work with the art teacher to make colorful and informative maps of different bicycle and walking routes. Coordinate an event to share the maps and encourage using them to travel to school.

Marin County Bicycle Coalition Bike Map: <http://www.marinbike.org/Map/Index.shtml>

Safe Routes to School program site: <http://www.saferoutestoschools.org/>



Create a Local Green Business Guide

This project helps students understand the power of the choices they make as consumers. Work with students to collect information about local green products and businesses such as businesses that sell, manufacture, or encourage recycled carpets, EnergyStar® appliances, organic food, and green building materials. Work with students to create a guide to share with school administrators, families, and the community. San Francisco green business: http://www2.sfenvironment.org/greenbiz/where_index.htm



Estimated Time: three to four
45 min. periods

Objectives:

- Describe the connection between urban planning, air quality, and climate change
- Define sustainable and give examples of sustainable actions

CA State Standard Connections:
4th Grade California:

A Changing State

Use maps, charts and pictures to describe how communities in California vary in land use, population density, and transportation.

Additional Materials:

- One roll of butcher paper
- Pencils with erasers (one per student)
- Crayons, colored pencils, paints
- Street maps of local town or city

Designing a Clean Air City

Students will have a chance to apply all they have learned about climate change basics, reducing impacts from electricity use, reducing impacts from product use and disposal, and reducing impacts from transportation to create a “Sustainable Clean Air City.” Reduction of greenhouse gas emissions from product cycles, waste disposal, transportation, and electricity production can all be a part of their dream city. In this lesson, students will map out ideal cities to learn how thoughtful land use planning and environmentally responsible choices can lead to improved air quality, through the reduction of greenhouse gas emissions, and improved quality of life.

Key Words

Urban Planner: person who helps plan communities.

Mixed Use Community: community with schools, offices, homes, stores, green space, and public spaces easily accessible to one another.

Sustainable: actions done in a manner that do not deplete natural resources faster than they can be naturally replenished.

Commute: regular travel from two destinations, such as home to work or home to school.

Preparation

Review Lesson 16 Background for an overview on the effects of land use planning on climate change. Prior to this lesson, make a chart or overhead listing the items to be included or considered in the students’ planning of their “Sustainable Clean Air City.”

Prepare map materials for pairs or small groups of students.

Setting the Stage

- Display a map of your local town, city, or the San Francisco Bay Area. Begin by having students think about where they live, play, shop and go to school.
- Ask students "How do you usually commute to these places?"
- Explain to students that people in most cities and suburbs have to drive/commute to their destinations because the distances are too far, there is no public transit, or it is too dangerous to walk or bike.
- Ask students what would change in their lives if they could live, shop, play and go to school in a mixed use neighborhood, with a mixture of homes, stores, parks, work,, etc. all close together so a person can walk or bike between them. "What would they do that they can't do now?" "Would there be things they couldn't do that they do now?"
- Tell students that they will have the chance to become **urban planners**. Explain that their task as urban planners will be to design a 'sustainable clean air' city. Explain that sustainable describes human activity that uses nature's resources at a rate that they can be replenished naturally, and that a "clean air" city is one that has no or few air pollution sources.



Suburban and Urban City, Farms, Parks/Forest Land Images on CD.

Activity – Design a Clean Air City

1. Divide the class into small groups. Explain to the groups that today they will work together as urban planners to design their own imaginary cities using their creativity and all the things they have learned about air pollution and greenhouse gases. Their goal is to design a sustainable clean air city. Being a city planner is very much like being one of the early settlers and pioneers in our country. They came to an area and had to decide how to use the land and where to locate all the different parts of a community. They had to deal with many issues including waste disposal, food production, power production, and water supply.
2. In their groups have students brainstorm and record a list of things they would need to include or think about in their planning. Use the ideas below to guide the discussion.
 - **Energy sources:** Non-combustion, solar, wind, hydro, biomass
 - **Product Use:** Where does food come from? Locally grown fresher and less emissions; stores close to houses.
 - **Waste:** Transfer stations, composting and recycling stations.
 - **Transportation:** Reduce automobile travel with bike paths, subways, walking paths. Housing close to schools, stores, places to work, access to green space.
 - **Green Space:** Plants and trees take up carbon dioxide and make your city attractive.

3. You may want to generate a set of basic map symbols, which everyone uses for common sites such as homes, schools, roads, etc. Teams may add additional symbols of their own choosing, as needed. This will help simplify reading the maps.
4. Guide students with the following instructions:

Planning a Sustainable Clean Air City

- Create a name for your city, and write it at the top of your paper
 - Draw the city limits and natural landmarks such as rivers or forests
 - Create symbols for homes, shopping centers, schools, parks, community gardens, farmer's markets. Make a map legend showing each symbol and its meaning.
 - Mark transportation routes by type, of travel (bike routes, light rail)
 - Each city plan should show:
 - Transportation means and routes
 - Energy sources
 - Food sources
 - Work places
 - Homes
 - Stores, libraries, parks, and entertainment
 - Mixed use neighborhoods
 - Waste disposal area/Recycling centers
 - Create a list of choices/actions which environmentally responsible citizens can make to reduce greenhouse emissions, that cannot be shown on a map, such as taking shorter showers, using less of something, and bringing their own bags when they shop. Attach the list to your map.
5. Provide each group with a large sheet of butcher paper and pencils with erasers. Markers, colored pencils, etc. can be used later when the planning is complete.
 6. Circulate around the classroom and assist as needed. Once the groups have completed their maps, have each group come to the front of the class, one group at a time, to explain their map and their list of choices/actions to the rest of the class.

Assessment

Listen to students as they plan their cities. Are they using the vocabulary and ideas they have learned? Are they applying their knowledge to create something new? Are they talking about decisions and trade-offs that must be made?

Use each group's list of ideas for the Sustainable Clean Air City and their final product, the map of their city and the choices and actions list to assess how well they understand the factors that influence the generation of greenhouse gases and what can be done to reduce them.

Extensions

1. Display sustainable clean air city maps – Provide each group with markers, paints, etc. to label and color their clean air city maps. Hang maps in the classroom or in another part of the school for others to see. Invite a “buddy class” to come visit the classroom and have each group explain what makes their city a “sustainable clean air city.”
2. Research clean air cities and sustainable cities – Have the student’s research actual sustainable cities and clean air cities that have been or are being designed in real life. Students can search key words such as: sustainability, green city, eco-city clean air city, or mixed use city.



Create a Local Bicycle / Walking Map

This project can inspire more walking and biking by providing students with maps of routes for walking and biking to school. Invite a local biking or walking organization to the classroom to share information and lead school based local excursions. Work with the art teacher to make colorful and informative maps of different bicycle and walking routes. Coordinate an event to share the maps and encourage using them to travel to school.

Marin County Bicycle Coalition Bike Map: <http://www.marinbike.org/Map/Index.shtml>

Safe Routes to School program site: <http://www.saferoutestoschools.org/>



Create a Local Green Business Guide

This project helps students understand the power of the choices they make as consumers. Work with students to collect information about local green products and businesses such as businesses that sell, manufacture, or encourage recycled carpets, EnergyStar® appliances, organic food, and green building materials. Work with students to create a guide to share with school administrators, families, and the community.

San Francisco green business guide: http://www2.sfenvironment.org/greenbiz/where_index.htm