I. Fostering Student-driven Learning in an AP* class

II. Year Calendar and Adapting to Class Schedules

III. Materials List

IV. Daily Lesson Plans
   A. Daily Lesson Plans – Ecology – 23 class days
   B. Daily Lesson Plans – Population Dynamics – 14 class days
   C. Daily Lesson Plans – Water Issues – 20 class days
   D. Daily Lesson Plans – Toxicity and Agriculture – 22 class days
   E. Daily Lesson Plans – Atmosphere Issues – 15 class days
   F. Daily Lesson Plans – Resources and Energy – 24 class days
   G. Daily Lesson Plans – Politics and Economics – 24 class days
   H. Review for AP* Environmental Science Exam
AP* Environmental Science  
Daily Lesson Plans  
Atmosphere Issues Unit  
(sample lesson plan)

Day 6

I. Topics:  
Smog

II. Warm-up:  [5 minutes]
Prior to class, write the following on the board: Which was a bigger problem in Donora, Pennsylvania—photochemical smog or industrial smog? Can you think of a city that has a problem with both of these types of smog? After you have completed your responses to these questions, draw the following chart:

Draw a colored picture of a city with this problem (show the sources) | Industrial smog | Type of smog | Photochemical smog | Draw a colored picture of a city with this problem (show the sources)
---|---|---|---|---
(Grey) | Color of smog | (Yellow-brown) | |
(SO$_x$, CO$_x$, particulates) | Primary pollutants | (NO) | |
(H$_2$SO$_4$) | Secondary pollutants | (NO$_x$, O$_3$, PANs, aldehydes) | |
(Asthma, eye problems, heart failure, premature skin aging, emphysema, increased susceptibility to disease pathogens) | Health problems | (Asthma, eye problems, heart failure, premature skin aging, emphysema, increased susceptibility to disease pathogens) | |
(Beijing, London, Hong Kong) | Example cities | (Los Angeles, Mexico City) | |
III. Activity One: Compare and Contrast Types of Smog 25 minutes

Objectives:

a) The learner will (TLW) experience the different factors that comprise (gray) industrial smog and (yellow-brown) photochemical smog.

b) TLW compare and contrast the sources of, problems with and solutions for these two types of smog.

Materials:

For the class: 2-3 cans of modeling dough; a piece of cardboard or a large lid from a plastic storage container; 10-20 cotton balls; one stick of red chalk; one stick of blue chalk. For each student: one pair of disposable, dark grey, eye dilation glasses (a local ophthalmologist will usually give you these if you explain that your students are learning how atmospheric issues affect their vision, respiration and cardiovascular health); one pair of inexpensive sunglasses with yellow-tinted lenses (I send out an email to my colleagues to collect these or buy inexpensive pairs whenever I can—students can share whatever you are able to collect); one drinking straw; and one painter’s disposable dust mask.

Procedure:

1. Prior to class, use the modeling dough to create a ring of mountains—the topography that is conducive to inversion layers. For example, you can create a model of the Los Angeles basin, which has mountain ranges similar to the drawing below:
Cover ~10 cotton balls in powdered red chalk dust and ~10 cotton balls in powdered blue chalk dust by rubbing the chalk on a rough section of sidewalk and rolling the cotton balls in the chalk dust.

2. When the students have finished answering their warm-up and drawing their compare-and-contrast chart, ask them to put on their dark grey sunglasses and place the painter’s dust mask over their nose and mouth. Asking questions to draw out students’ answer, fill in the compare-and-contrast chart on the topic of industrial (gray) smog. Explain how this type of smog became very common during the industrial revolution’s increased use of coal and that cities without air pollution regulations still have problems with industrial smog. Talk about this type of pollution, describing the setting and the experience the students are having—dark grey air at ground level, with soot and particulate matter that make it difficult to breathe. While the students are still wearing their glasses and masks, describe the long-term implications of this type of pollution on the heart, lungs, eyes and skin. If you have the Internet and projection ability, you can show a slide of Monet’s “Thames” or “House of Parliament” paintings, in which he painted the smog-filled London sky.

3. Ask the students to put on the yellow-tinted sunglasses and place the straw in their mouth. Ask them to breathe out of the straw while keeping their nose closed. Give the students an explanation of photochemical (yellow-brown) smog. Explain how this type of smog is commonly found in places where there is a large amount of automobile traffic and sunshine. Talk about this type of pollution, describing the setting and the experience the students are having—bright sunlit skies with nitrous oxides in the air giving it a brown color, and high levels of ground-level ozone that diminish the elasticity of the lungs, making it difficult to breathe. While the students are still wearing their glasses and breathing out of their straws, describe the long-term implications of this type of pollution on the heart, lungs, eyes and skin.

4. Allow the students to stop breathing through their straws. However, each time you talk about the two different types of smog, ask them to change their glasses to relate the experience to the differences.

5. Use the chart to explain the difference between primary and secondary pollutants. It is not necessary for students to memorize each chemical in every reaction that produces the primary and secondary pollutants, however, they should know the name of the primary pollutant and secondary pollutant for each type of smog.

6. Show the students the mountain ring you created with modeling dough, and explain how topography influences the retention of air pollution. Ask the students to recall the properties of cold and hot air masses (cold air is more dense, so it sinks; warm air is less dense, so it rises). Describe how an inversion layer is created by changes in daytime and nighttime temperatures as the mountains shade the valley floor. Use the blue cotton balls to show the location of the cold air layer in the valley of your model during sunset. Leave a layer of red cotton balls on top of the blue ones to
demonstrate the warm air cap that is still receiving the sunlight in the late afternoon or evening hours. This warm air layer rests on the cold air layer; the warm air layer is rising while the cold air layer is sinking. Remind the students that the air pollution in this valley will sink with the cold dense air mass, infusing the houses in the region with pollutants. Add a few red cotton balls to show the sun rising and heating the top layer of air. Remind the students that this warm air layer on top of the cold air layer will continue to rise away from the cold air mass that is sinking below. Not until the sun comes over the mountain rim and hits the cold air mass will the valley have fresh air. Point out some cities that have this type of topography (Los Angeles, CA; Denver, CO; Missoula, MT; Donora, PN; Mexico City and Beijing).

IV. Activity Two: Presentation of Particulate Experiments 20 minutes

Objectives:
   a) The learner will (TLW) apply the scientific process to the topic of air particulates.
   b) TLW evaluate the scientific merit of various lab experiments.

Materials:
   Each student will need the particulate lab experiment homework assigned in the previous class period.

Procedure:

1. Ask the students to take out a piece of paper and draw a chart with four columns.
2. Have them write the following headings at the top of each column: Name, General idea, Pros, Cons.
3. Ask the students to fill in the chart as they listen to each lab experiment idea (this chart can be turned in for a grade, if desired). Let them know that at the end of the activity they will be asked to vote on the top two experiments based on the qualities recorded in their notes.
4. Allow each student to present their experiment idea.
5. Ask the class to pick the top two experiments based on the scientific merit of the experiments.
6. Record votes on the board for each presenter and announce the winners. If any of the experiments are “do-able” and have caught the interest of your students, consider performing them in class, if time allows.

HW: Ask the students to write a response to FR question #3 from the 2001 APES Exam.
I. Topic: Solar Energy

II. Warm-up: Prior to class, write the following on the board: Using your hand, indicate the path that the sun would take across the sky from sunrise to sunset. Now create a labeled diagram of the path of the sun.

III. Activity One: Solar Energy Principles

Objectives:
   a) The learner will (TLW) predict the apparent path of the sun across the sky.
   b) TLW track the apparent path of the sun across the sky.
   c) TLW recognize the changes that occur in the sun’s apparent height with the change of seasons.

Materials:
   For each student: one overhead transparency marker; one plastic disposable container in the shape of a bowl; one blank sheet of copy paper; and one compass (if this is not possible, then one compass for yourself—see step two, below). For the class: one compass (if you do not have compasses for each individual); one piece of chalk; a stapler; a meter stick.

Special note: This procedure was written for teachers living in North America. If you are teaching in another hemisphere, you will need to make the necessary adjustments.

Procedure:

1. Prior to class, make a sun tracker for each student in your class (or, if you have longer class periods, have the students make their own during class): Fold a blank sheet of paper in half, each direction. Using a thin-tip marker, trace both folds so the lines cross at right angles in the center of the page (see step 7 for a diagram of a sun tracker). Staple the plastic
bowl container upside-down onto the piece of paper such that the bowl is centered directly over the place where the two lines cross. Label the top of the paper “North”, the bottom of the paper “South”, the right side of the paper “East” and the left side “West”.

2. Near your classroom, find a place outside where you are able to see the east and west horizons fairly well. Use a compass to find true north and draw a one-meter line alongside the compass on the sidewalk using a piece of chalk. Place an arrow and the letter “N” at the top of this line to give the students a place to orient their sun trackers. About four students can line their sun trackers up to this line at one time. Repeat this process about a meter away for the next four students to use until there are enough north lines for all the students in your class.

3. Give each student a sun tracker and an overhead transparency pen. Ask the students to predict the path of the sun on their sun trackers by drawing a line across the bowl showing the sun's path for the winter and summer solstices and the spring and autumn equinoxes. Ask them to label each path.

4. Discuss the concept of the equinoxes and the solstices, including mention of the relative position of the sun. You may need to review the positions of the earth and sun in this discussion, to remind the students how the seasons change due to the tilt of the earth (students often have misconceptions of how the seasons occur, based on misinformation they received while growing up). Here are a few questions you can use to test their understanding and identify misconceptions:
   a. Does the sun ever appear directly overhead where you live? (If you live north of the Tropic of Cancer (i.e., anywhere but Florida or southern Texas), the sun will never appear to be directly overhead—it will always appear to travel across the southern part of the sky, and it will come to its highest point in the sky at the summer solstice.)
   b. If, on December 21st or 22nd, the sun appeared to travel directly from the east to the west and was directly overhead at noon, where would you be? (Anywhere along the Tropic of Capricorn—for instance, in South Africa, southern Australia or central Chile.)
   c. Using your finger, draw a path in the sky tracing the correct direction for the apparent journey of the sun on June 21st, if you lived on the equator. (The sun would appear to rise just north of due east, travel across the northern sky, and set just north of due west.)

5. Ask the students to trade transparency pens, so that each has a different color pen with which to track the path of the sun on their sun tracker.

6. To begin collecting data on the sun’s apparent path, all the students need to orient their sun trackers so that the N at the top of their page is pointing to north. They can do this by aligning the edge of the paper on the ground against one of the north line marks that you drew before class or by laying their paper on the ground against a compass that is aligned to north.
7. Once their sun tracker is correctly lined up with north, the shadow of the tip of a transparency pen can be lined up with the crosshairs in the center of the piece of paper. Keeping the shadow of the pen tip on the crosshairs, they should then lower the pen until it is touching the plastic bowl and make a small dot. Have them label the dot with the exact time and date. This dot represents what the sun’s position in the sky would be if the student were standing on the crosshairs under the plastic bowl.

8. Tell the students they will need to come back to this exact place with their sun tracker at least three more times today to take data points at a minimum of 30 minutes apart. Tell the students they should also take at least one measurement tomorrow morning before class.

9. Return to the class to introduce the topic of solar energy, or hold class outside if possible to use the sun’s energy as a demonstration.

IV. Activity Two: Solar Energy Applications 25 minutes

Objectives:

a) The learner will (TLW) discover how solar energy can best be captured and used.

b) TLW understand the difference between passive and active solar energy systems.

Materials:

For the class: a slide show of images as described in step one below; a computer, or a screen and projector; several passive and active solar energy collectors borrowed from a solar energy supplier or installer (such as an evacuated tube solar collector, a photovoltaic cell, super-insulated windows, solar tube lights, etc.).

Procedure:
1. You may want to have a home energy company come in to talk to your students about active and passive solar energy applications. They will be able to bring in collectors for hot water and for electricity and show pictures of how the systems are used in residences and businesses. If you do not have a guest speaker, you can create a slide show to give your students a visual of how solar energy is applied in passive and active forms. Following are some images you will want to collect for your slide show. Examples of passive solar applications: south-facing windows with blinds; a diagram of triple-glazed super-insulated glass; greenhouses; greenhouses attached to houses; black water barrels or stone flooring to act as a thermal mass that heats during the day and radiates during the night; solar tube lights; skylights; roof eves long enough to block summer sun and short enough to maximize winter sun; a solar oven, solar collecting pool covers, etc. Examples of active solar applications: a diagram of an enveloped house; a flat-panel solar hot water heater installed on a house or next to a house; an evacuated tube solar collector and an assembly of tubes set up to heat water for a house; a solar pond and diagram of how it works; a diagram of a photovoltaic (PV) cell; a PV panel; and a PV array mounted on a building or free-standing, a large-scale solar energy generating station, etc.

2. Relate what the students did in Activity One to the concepts of solar energy collection by asking questions to generate a discussion:
   a. How does the position of the sun affect how and when a person can use solar energy? *(The amount of energy available differs according to the device’s location on earth, the season, the angle of the device and the direction it is facing.)*
   b. What parts of the world have the maximum amount of solar energy available for collection? *(Places nearer to the equator and places with clear weather and little vegetation to block collectors.)*
   c. What can you do to collect solar energy in places that do not have the maximum solar gain? *(Collectors can be angled toward the sun or can be moved to track the sun’s movement.)*
   d. What is the difference between passive solar and active solar? *(Active solar requires a motor, pump or some mechanical device.)*
   e. How can we benefit from solar energy? *(We can obtain light, heat, ventilation, electricity, hot water, cooking fuel, etc.)*

3. Introduce some passive ways to obtain heat, light or ventilation using solar energy. Use the slide show of images you have collected to explain the concepts of passive solar energy use. Explain how solar gain can be regulated with compartmentalization, fans and other techniques. For instance, a greenhouse with sliding doors can be attached to the daytime living area of a house to let in light and heat the space for use in the winter. If the greenhouse is able to absorb heat (perhaps the floor is made of slate, or there are water barrels in this area or a rock wall), it can radiate the heat into the house all night when the sun is down. If the
greenhouse gets too hot during the day or too cold during the night, the room can be closed off.

4. Be sure to remind the students that often, during the summer, heat and light are unwanted in the amount available and so there are heat and light reducing designs as well (roof eves; smaller south-facing windows; plants positioned to grow over windows/greenhouses/patios/roofs; awnings, shutters and louvered windows; mature deciduous trees on the south side of a house that block out sun with summer foliage and allow light and heat during the winter when they are bare).

5. Introduce how active solar systems work, starting with the least complicated concepts (solar hot water heating, enveloped house with a basement and fans to circulate air, solar ponds, etc.).

6. Explain how a photovoltaic cell is able to convert solar radiation into electricity. Use images to show the students what PV panels and arrays look like (they may not realize that they have seen these used to light up billboards or power emergency phones, etc.).

7. Remind the students about their EcoHome project. Ask them if they will need to maximize or minimize light and heat in their particular location. Ask the students which systems and ideas might be useful for their particular project.

8. Tell the students they will work in pairs (or lab groups) tomorrow to create a solar oven based on what they have learned about the basic principles of passive solar energy collection. The students will be allowed to build their own solar oven based on an original design. In order to determine which oven has the best design, a one-liter bottle of water will be placed in each and water temperatures will be compared after all of the ovens have been in the sun for the same amount of time. Therefore, each oven design must feature an interior space large enough to accommodate a one-liter water bottle. Ask the students to begin working on their solar oven design in pairs or lab groups.

**HW:** Ask the students to bring a completed drawing of their solar oven for tomorrow’s class.
Day 1

I. Topic: Functional Urban Areas

II. Warm-up: 5 minutes
Prior to class, write the following on the board: Why would you prefer to live in the city instead of the country? Why would you prefer to live in the country instead of in a city?

III. Activity One: Lego® City Planning 45 minutes

Objectives:
  a) The learner will (TLW) manipulate the elements of a city to find the most functional and sustainable arrangement.
  b) TLW assess the pros and cons of city living while trying to minimize the negative aspects.

Materials:
One box of Lego® Creator contains enough pieces to supply eight lab groups with the following supplies:
  4 pieces of yarn cut in lengths that are 24cm long
  4 pieces of 2 x 4 to represent industrial facilities
  2 pieces of 2 x 3 to represent transportation facilities
  1 piece of 1 x 6 to represent a medical facility
  17 pieces of 2 x 2 to represent businesses and city buildings (police and fire departments, libraries, schools, shops, restaurants)
  2 pieces of 1 x 4 to represent water supply and sewage
  46 pieces of 1 x 2 to represent houses or apartments
  1 32 x 32 grid upon which to place pieces

Place each set of pieces in eight plastic zipper bags and set each on a single grid sheet to be picked up when the students are ready to begin.
One student handout of “Designing Sustainable Urban Areas” that follows this lesson plan,
Procedure:

1. Give each student the handout, “Designing Sustainable Urban Areas” (following this lesson plan), and ask them to read over the activities.
2. Ask that one person from each lab group pick up a grid and bag of supplies. Tell the class to begin working on Activity A and tell them they’ll have five minutes to complete it.
3. After the groups have arranged their pieces, allow them to each bring up or hold up their grid to let their classmates see the layout. Ask the students the questions on the handout and allow them to discuss any issues that arise.
4. Ask the lab groups to spend the next five minutes completing Activity B.
5. After the groups have arranged their pieces, again allow them to each bring up or hold up their grid to let their classmates see the layout. Ask the students the questions on the handout and allow them to discuss any issues that arise.
6. Ask the lab groups to spend the next 15 minutes completing Activity C.
7. After the groups have arranged their pieces, allow them to each bring up or hold up their grid to let their classmates see the layout. Ask the students the questions on the handout and allow them to discuss any issues that arise.
8. Use the planning questions from Activity C to ascertain if the students have developed some conclusions about the issues concerning urban areas.
9. Allow time for the students to organize themselves as lab groups to complete Activity D. Remind them that they must complete this assignment so that they are ready to share their research at the beginning of the next class.

HW: Ask the students to finish Activity D from today’s handout at home tonight. Tell them to be ready to share their findings at the beginning of the class period tomorrow.

HW: Tell the students that they must watch the video for this week, The Power of Community, for an activity in class tomorrow.
Designing Sustainable Urban Areas

Materials:
- 4 pieces of yarn cut in lengths that are 24cm long
- 4 pieces of 2 x 4 to represent industrial facilities
- 2 pieces of 2 x 3 to represent transportation facilities
- 1 piece of 1 x 6 to represent a medical facility
- 17 pieces of 2 x 2 to represent businesses and city buildings (police and fire departments, libraries, schools, shops, restaurants)
- 2 pieces of 1 x 4 to represent water supply and sewage
- 46 pieces of 1 x 2 to represent houses or apartments
- 1 32 x 32 grid upon which to place pieces

Activity A – Maximizing Personal Space

Using all the Lego® pieces you have been given and the grid that represents your total land space, take about 5 minutes to design an urban area that maximizes the amount of personal/private space for each citizen.

Reflection Questions:
1. Describe the city that you have designed:

2. Quantify the amount of open/green space in the city you have designed:
   There are 1024 (32 x 32 = 1024) bumps on the empty grid. How many bumps have been left for open/green space in the city you have created? ________________ bumps

3. Describe the most important things that are gained from maximizing personal living space that is privately owned and utilized:

Activity B – Maximizing Public Space

Using all the Lego® pieces you have been given and the grid that represents your total land space, take about 5 minutes to design an urban area that maximizes the amount of public space that is available for all citizens’ use.

Reflection Questions:
1. Describe the city that you have designed:

2. Quantify the amount of open/green space on your grid: _________bumps

3. Describe the effect of open/green space on each of the topics below:
   a. Human quality of life:
   
   b. Urban and suburban animals:
   
   c. Weather and climate:
   
   d. Noise pollution:
   
   e. Air quality:
   
   f. Water quality:

**Activity C – Designing a Sustainable City**

Using all the Lego® pieces you have been given and the grid that represents your total land space, take about 15 minutes to design an urban area that maximizes the positive aspects of city life and minimizes the negative aspects of city life. Use the following questions to help plan your city before you present your final idea:

1. Which buildings need to be nearest to each other to minimize transportation and congestion?
2. Which buildings need to be placed apart from others due to sight, smell, noise or toxicity? Which buildings need to be near others despite their negative attributes?
3. Which buildings should be buffered by open/green areas? How can adding green spaces be used to reduce urban sprawl?
4. How can urban agriculture reduce the negative attributes of a city?
5. How do you design cities so that the people who live there have a sense of community, support and knowledge of one another?
6. How can the design of a city reduce poverty and crime?
7. What configuration of transportation veins would be most useful?
8. How do you design communities to minimize the need for duplicate resources? Are there ways to reduce waste or concentrated pollutants?
9. If nothing could be imported into a city (food/resources) or exported out (pollutants/waste), how would you alter an urban layout during planning? Remember that autonomy on an unlimited time scale is what makes a city “sustainable.”

Reflection Questions:

1. Sketch the city you designed in the grid below, labeling the buildings for clarity.

2. What are the strengths of this city layout?

3. What are the weaknesses of this city layout?

4. Consider the urban areas created by the other lab groups. Did everyone emphasize the same strengths and weaknesses? Were some aspects of city life given greater priority?
5. In your ideal urban area, what form of mass transportation would be most prominent? Explain how this form of transportation fits into your city design.

Activity D – Modern Model Cities

In some cities, efforts have been made to improve the quality of life for residents—certain practices have been implemented through government programs, the city layout has been redesigned and/or public works such as schools, parks or mass transportation have been enhanced. Below is a list of several cities that have made strides in one area or another. Have each person in your lab group choose a different city from the list and research that particular city’s improvement projects. Have each lab member share their findings with the group. Make note of the long term effects that each of these changes will have next to the name of the city below:

1. Davis, CA, USA –

2. Curitiba, Brazil –

3. Land Conservation and Development Commission in Oregon (Urban and Rural Issues) –

4. Tapiola, Finland –

5. Chattanooga, TN –
Designing Sustainable Urban Areas

Teacher’s Version

Activity A – Maximizing Personal Space

Reflection Questions:

1. Describe the city that you have designed:
   *(Answers will vary, but the students should have their housing pieces spaced wide apart for maximum private land space.)*

2. Quantify the amount of open/green space in the city you have designed:
   *There are $32 \times 32 = 1024$ bumps on the empty grid, how many bumps are left open for green space in the city you have created?*
   *Somewhere around 800 bumps.*

3. Describe the most important things that are gained from maximizing personal living space that is privately owned and utilized:
   *Aesthetics, relief from crowding, less tension, possibly less crime.*

Activity B – Maximizing Public Space

Reflection Questions:

1. Describe the city that you have designed:
   *(Answers will vary, but all the pieces should be stacked and take up a small amount of board space.)*

2. Quantify the amount of open/green space on your grid: *Around 1000 bumps.*

3. Describe the effect of public green space on each of the following:
   a. Human quality of life: *aesthetic value, feeling of more rural placement, people spend more time outdoors in communal areas, areas are available for teaching and exploring*
   b. Urban and suburban animals: *there are passageways through urban areas, as well as nesting, foraging and mating areas*
   c. Weather and climate: *cooler days, more shade and less heat-retaining concrete/asphalt, trees provide wind breaks, less albedo*
   d. Noise pollution: *vegetation absorbs noise and reduces the conduction of noise along traffic areas, reduces aggression and crime*
Air quality: vegetation absorbs toxic air pollutants and breaks down chemicals

Water quality: green areas absorb precipitation instead of creating run-off so water does not pick up toxins from asphalt and concrete and run into the local surface waters, and there is reduced flooding

Activity C – Designing a Sustainable City

The following italicized responses are examples of points of discussion:

1. Which buildings need to be nearest to each other to minimize transportation and congestion? Houses should be near workplaces and schools, industries should be near transport centers and businesses, etc.

2. Which buildings need to be placed apart from others due to sight, smell, noise or toxicity? Which buildings need to be near others despite their negative attributes? Sewage and industry away from houses, but houses need more piping to be further from sewage, etc.

3. Which buildings should be buffered by open/green areas? How can adding green spaces be used to reduce urban sprawl? If noisy, smelly or unsightly buildings are buffered by vegetation, they can be placed nearer to other buildings that necessitate their proximity.

4. How can urban agriculture reduce the negative attributes of a city? Less materials need to be imported, less transportation is used, vegetation can act as buffers, etc.

5. How do you design cities so that the people who live there have a sense of community, support and knowledge of one another? Create common spaces that are pleasant gathering locations—plazas, open market areas; clean/reliable public transportation that is used by all people; create smaller sub-cities within cities so that residents often see familiar faces, etc.

6. How can the design of a city reduce poverty and crime? Thoughtful design can result in cities that are more community-oriented, where crowding is limited, housing is affordable, the economy supports jobs for all skills levels, a strong education system exists, as well as social and economic equality among residents, etc.

7. What configuration of transportation veins would be most useful? To and from housing/work/school; to import and export centers, etc.

8. How do you design communities to minimize the need for duplicate resources? Are there ways to reduce waste or concentrated pollutants? Use cooperatives for resources that are not used 24/7, such as dump trucks, churches or office space, so that they can be shared by another business/person when not in use; mass transportation; institute resource exchange webs, etc.
9. If nothing could be imported into a city (food/resources) or exported out (pollutants/waste), how would you alter an urban layout during planning? Remember that autonomy on an unlimited time scale is what makes a city “sustainable.” The design would allow room for agriculture, wastes would need to be reusable/recyclable, etc.

**Reflection Questions:**

1-5. *(Answers will vary.)*

**Activity D – Modern Model Cities**

In some cities, efforts have been made to improve the quality of life for residents—certain practices have been implemented through government programs, the city layout has been redesigned and/or public works such as schools, parks or mass transportation have been enhanced. Below is a list of several cities that have made strides in one area or another. Have each person in your lab group choose a different city from the list and research that particular city’s improvement projects. Have each lab member share their findings with the group. Make note of the long term effects that each of these changes will have next to the name of the city below:

1. **Davis, CA, USA** – *City restrictions on cars will encourage bicycle use and the continued development of non-petroleum transportation and promote residents’ physical fitness; constraints on building and sprawl will serve to protect local farmland; green areas will help maintain the climate of the region; use of solar energy will enable the city to be more autonomous and have sustainable electricity production without needing to import coal or oil from other regions.*

2. **Curitiba, Brazil** – *Strict regulations on tree planting and cutting will help lower temperatures, clean air of pollutants and keep noise pollution down; no-car zones and bike paths will promote residents’ physical fitness and keep air and surfaces free of pollutants; innovative ideas such as grazing sheep within city limits as a means of grass maintenance in green areas encourages waste-resource webbing and will help keep the economy flowing; high density housing allows more people with less habitat destruction and growth outward; placement of shops in residential facilities will keep transportation demands low; placement of clean industries near town allows for easy walking commute, a strong economy and lower crime; systems to help the poor improve their quality of life such as the education buses, child care facilities, healthcare and the food-for-trash exchange system will serve to reduce crime and increase the quality of life for all citizens.*
3. Land Conservation and Development Commission in Oregon (Urban and Rural Issues) – The changes implemented to limit urban sprawl will ensure the future availability of land for agricultural use; the use of zoning, businesses mixed with housing, elimination of the expressway and a limit to parking spaces, mass transportation and constraints placed on cars will all help reduce the demand for fossil fuels and limit the dependence on imported petroleum products.

4. Tapiola, Finland – A community-based design places mixed income housing, commercial shops and open spaces in a centralized area to help reduce transportation demands, high temperatures and crime. Vegetation has been strategically used to reduce noise, air and visual pollution while keeping industries close enough to allow for a walking commute.

5. Chattanooga, TN – Chattanooga’s turnaround—from being a dismally polluted city to one in which residents are enjoying dramatic environmental and economic improvements—will likely remain a source of pride and encourage the citizens to keep facing the challenges before them. The zero-emissions, zero-waste industrial park that has been proposed to renovate the South Chattanooga area is likely to be successful, given that the city has already identified a method for gaining support and achieving goals in its completion of other projects. Chattanooga’s success will likely inspire other cities to tackle similar improvement projects.
Price List

Complete Year in CD-ROM format: $520.00
(142 days of lesson plans)

Complete Year in print format: $590.00
(142 days of lesson plans)

Any single unit can be purchased individually for $100.00

AP* Biology:
- Review Unit
- Cell Biology Unit
- Genetics Unit
- Evolution Unit
- Anatomy Unit
- Botany Unit
- Ecology Unit

AP* Environmental Science:
- Ecology
- Population Dynamics
- Water Issues
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