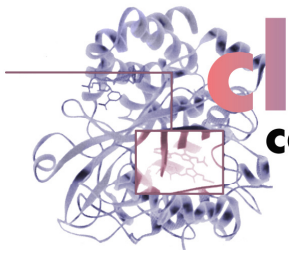

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AP* Environmental Science
Daily Lesson Plans Curriculum
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AP* Environmental Science
Daily Lesson Plans
Population Dynamics Unit

(A Sample Lesson Plan)

Day 4

I. Topic: Estimating Populations

II. Warm-up: 5 minutes

Prior to class, write the following on the board: You have observed flocks of Canadian geese nesting on a lake in your neighborhood. You know that the Canadian goose is a federally protected species but it seems like the populations in your area are in good shape. How can scientists obtain accurate population numbers for species in order to make decisions such as whether to provide protection or allow hunting?

III. Activity One: Capture and Recapture Activity 45 minutes

Objectives:

a) The learner will (TLW) perform a capture and recapture sampling method to estimate the number of items in a known quantity to observe the accuracy of this technique.
b) TLW think of other ways population data can be collected, estimated and used.

Materials:

For each student: one copy of the "Capture and Recapture Method for Estimating Populations" handout. For each pair of students: one colored permanent marker; one plastic zipper baggie containing either 100 or 500 dried navy beans (see step 1 below); and a calculator.

Special note: If you have access to a meadow, your students can practice the capture and recapture method with grasshoppers or any other insect that is plentiful in the area. This method can also be used in a lake with a contained fish or frog population as long as the habitat is large enough to allow sufficient movement of the organisms.

Procedure:

1. In addition to learning the capture and recapture technique, your students will be observing how a sample size and repetition play a role in the

accuracy of research methods. Prior to class, prepare the bags of beans: Prepare bags of 100 beans for half the student pairs and prepare bags of 500 beans for the other half of student pairs. You can use a mass balance to do this instead of counting the beans: Take the mass of ten beans and then use ten times that mass to make the 100-bean bags or 50 times that mass to make the 500-bean bags. Half the groups who get the 100-bean bags will "recapture" their organisms 5 additional times after the original marking session, while the other half of the student pairs with bags of 100 beans will go on to "recapture" 10 times. Half the groups who get the 500-bean bags will "recapture" their organisms 5 additional times after the original marking session, while the other half of the student pairs with bags of 500 beans will go on to "recapture" 10 times. By considering the difference in the estimated population number, the students will observe how the accuracy of this method changes with a larger or smaller initial population. By considering the difference in the estimated population number, the students will observe how the accuracy of this method changes with additional sampling of the marked population.

2. Begin the class by discussing the warm-up question. If students come up with ways to estimate populations, jot their ideas down on the board as they are discussed.
3. Briefly introduce the concept of capture and recapture as a method to estimate a moving population. Then proceed right into the activity, letting the experience speak for itself. After obtaining hands-on experience, the students should be able to draw out the main points based on primary knowledge.
4. After the activity is completed, discuss the reflection questions with the class.
5. Ask the students what they have written in their notes as the main points for today's activity. Allowing them to take notes in the same place that they are writing their warm-up response will help to encourage note-taking during hands-on learning experiences.

HW: Ask the students to write a FR essay for question #3 from the 2003 AP **Biology** Exam. All past AP Exam Free Response essay questions and grading rubrics can be found at the www.apcentral.collegeboard.com website. Sign in, then choose the title "Exam Questions" that appears when you roll over the green button that says "AP Courses and Exams." Simply click "Biology" (instead of "Environmental Science" in this case) on the "Exam Questions" page to find the FR questions for past exams.

HW: Ask the students to finish reading Ch. 6 in *Tales of a Shaman's Apprentice* by Mark Plotkin in preparation for tomorrow's quiz.

HW: Remind the students to look at the year calendar for reading and video assignments.

Capture and Recapture Method for Estimating Populations

Objectives:

a) To understand how scientists can estimate an organism's population size based on a sub-sample of that population.
b) To get an idea of how accurate this method can be as a factor of sample size.
c) To consider other methods of estimating populations.

Procedure:

1. Ask your teacher which chart you and your partner will be using (see below).
2. You have a bag of white beans that represents a population of a particular type of organism. If you have a bag of 100 beans, remove 10 beans and mark them with a colored permanent marker. If you have a bag of 500 beans, remove 50 beans and mark them with a colored permanent marker. This represents the act of a scientist capturing and tagging a species. All groups in the class will begin with 10% of the population tagged on the initial capture.
3. Return the marked beans to the bag and shake the bag. This represents the release of the tagged organisms back into their environment.
4. After the organisms have had a chance to mingle with their population, take a sample of 20 organisms out of the population.
5. Using the chart below, write down the number of organisms that you collected on the second sampling (20) and the number in that sample that featured a mark given during the first sampling (this number will vary for each pair of students).
6. Do not mark the new beans (the beans that do not feature a mark given during the first sampling).
7. Return the beans to the bag and shake the bag before repeating steps 3-6 four more times or nine more times, depending on what your teacher tells you to do.
8. When you have completed the data collection, use the Lincoln Index equation to calculate the estimate of the total population after each recapture. Average all 5 or all 10 of the population estimates to get the most accurate population estimate.
9. Write your average population estimate on the board labeled with the number of beans in your bag and the number of recaptures your group performed.
10. Record the information from your classmates in the appropriate place on the data sheet below and answer the reflection questions that follow.

Data:

Estimate the total population using the Lincoln Index equation below:

(Original # tagged in 1st capture) x (total # taken in the resampling) = Estimate of
(# of organisms in the resampling that were already tagged) total popul.

Ex: (10 tagged) x (20 sampled) = 100
(2 already marked)

Your group's data:

Number of beans in your bag: 100 or 500 ?
Number of times you recaptured: 5 or 10 ?

Trials:	1	2	3	4	5	6	7	8	9	10
# of beans recaptured										
Lincoln Index population										

Estimate of the population as an average of all Lincoln Indices:

Class Data:

Place the averages of all class data in the chart below:

	Few trials (5 samples)	Many trials (10 samples)
Small population (100 beans)		
Large population (500 beans)		

Reflection Questions:

1. Considering the estimated population differences reflected in the class data chart above, what techniques yield the greatest accuracy?

2. This method of estimating a population requires that organisms be marked in a permanent manner that does not interfere with the animal's survival, locomotion or reproductive success. Describe a different marking technique that could be used on each of the following organisms:

    a. Beetles –

    b. Bobcats –

    c. Salmon –

    d. Albatross –

    e. Crocodile –

3. What determines the ideal length of time scientists should wait between recapture events?

4. Describe a population estimation situation in which this method of estimating a population would not be useful.

5. What other methods can be used to estimate populations?

Capture and Recapture Method for Estimating Populations

Teacher's Version

Reflection Questions:

1. Considering the estimated population differences reflected in the class data chart above, what techniques yield the greatest accuracy? *The most accurate results should come from the smaller population and the greatest number of sampling trials.*

2. This method of estimating a population requires that organisms be marked in a permanent manner that does not interfere with the animal's survival, locomotion or reproductive success. Describe a different marking technique that could be used on each of the following organisms: *Answers will vary, but here are some possible responses:*
    a. Beetles – *paint or nail polish on carapace*
    b. Bobcats – *radio collars*
    c. Salmon – *plastic fin tags*
    d. Albatross – *metal leg bands*
    e. Crocodile – *implanted radio transceivers*

3. What determines the ideal length of time scientists should wait between recapture events? *The population needs enough time to remix so that the researcher does not immediately sample the same organisms that were just caught. The population should not be left so long that there is death, birth, immigration and emigration occurring to the point that the group of organisms has essentially become a new population.*

4. Describe a population estimation situation in which this method of estimating a population would not be useful. *Answers will vary, but common responses would include populations that are too small or delicate to mark, organisms that shed their marking, populations that are either so large or that migrate or remix in such a large habitat space that it is unlikely that any sampling would include previously marked organisms.*

5. What other methods can be used to estimate populations? *Radio telemetry, counting all individuals in a contained population, counting individuals in a region and extrapolating up to a larger area, etc.*

AP* Environmental Science Daily Lesson Plans
Resources and Energy Unit

(A Sample Lesson Plan)

Day 17

I. Topic: Solar Energy

II. Warm-up: 5 minutes

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 20 minutes

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; and a meter stick.

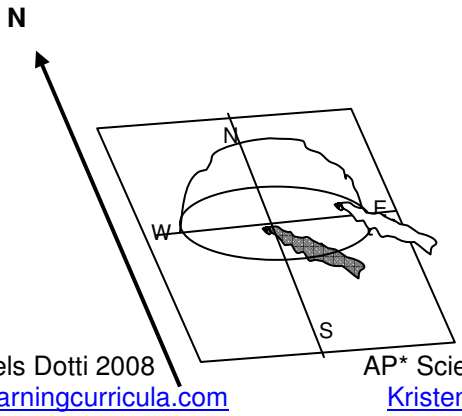
Special note: This procedure was written for teachers living in North America. If you are teaching in another hemisphere, you will need to make the necessary adjustments.

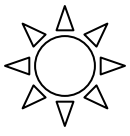
Procedure:

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 lines 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.





The shadow of the pen-tip must fall where the lines cross under the 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 block out sun with summer foliage and allow light and heat during the winter when they are bare, etc.).
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.

AP* Environmental Science Daily Lesson Plans
Politics and Economics Unit

(A Sample Lesson Plan)

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 copy of the "Designing Sustainable Urban Areas" handout (that follows this lesson plan) for each student.

Procedure:

1. Distribute the handout, “Designing Sustainable Urban Areas” (following this lesson plan), and ask the class 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 whether the students have developed some conclusions about the issues concerning the planning of 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:

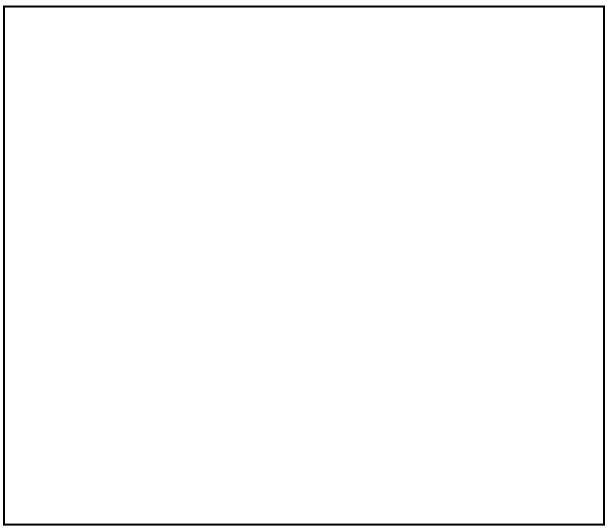
Activity C - Designing a Sustainable City

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 the addition of 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, etc. 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 x 32 =) 1024 bumps on the empty grid. How many bumps have been left for open/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 and reduces aggression and crime.*

   e. Air quality: *Vegetation absorbs toxic air pollutants and breaks down chemicals.*

   f. Water quality: *Green areas absorb precipitation reducing flooding and run-off so water does add toxins from asphalt and concrete into surface waters.*

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 the addition of 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, etc. 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:

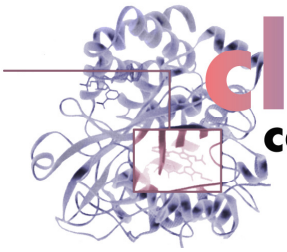
1. Davis, CA, USA - *City restrictions on cars will encourage bicycle use and the continued development of non-petroleum transportation and promote residents' physical fitness; constraints on building and sprawl will serve to protect local farmland; green areas will help maintain the climate of the region; 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.*



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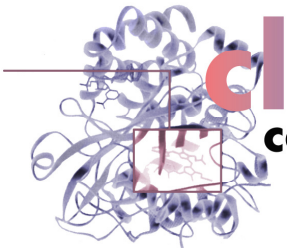

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