Chapter 15

Urban World

INTRODUCTION

Cities are particularly interesting environmental settings, in that they represent are great concentrations of resource consumers and waste producers. That's us, people. The Los Angeles metropolitan area (including Orange County) has about 12 million people living in it. Each person requires his share of living space, food, water, and power. The high number of people in this limited geographic area sets the stage for major environmental issues, and provides me with a nice job. The fundamental purpose of cities is to take resources from the outside, change them onto something new, then distribute this new product within the city itself and to the outside world. Cities are commerce centers and are extremely dependant on large geographic areas outside their borders. Urban environments have proportionally few resources of their own, making them extremely vulnerable to supply interruptions. For example, were we to rely solely on water resources in the L.A. area, we might be able to support only 1 million people here. However, enterprising humans are unwilling to accept such limitations, so we import water from the Colorado River, Owens Valley, and the Sacramento River delta. In fact, one day California may have to invade Oregon, annex it, take its water, and give them Oregonians a good taunting while we're at it. What about food? Most of the area is paved over, so we import food from areas like the Central Valley, Kansas, and Chile. And the production of food in these areas demands substantial resources. For example, it takes about 2600 gallons of water to produce a single pound of beef. Since L.A. area residents consume about 1.7 billion pounds of beef every year, this requires the use of 4.4 trillion gallons of water in cattle country, which is equivalent to an area of land 145 miles x 145 miles square (13.5 million acres) filled with water 1 foot high. So, not only do we directly import water for drinking and other purposes, we also cause the consumption of much larger amounts of water for food production beyond the city's border. And there are many, many cities. It turns out, people in the city are deeply dependant on a healthy, thriving surrounding environment. To the extent that urban wastes spread away from the city and degrade the surrounding environment, the city jeopardizes its own survival. Man, ain't there ever any *good* news?

In turn, each person produces air pollution, garbage and sewage which must be dealt with in environmentally responsible ways. For example, there are about 5.5 million cars in the L.A. metropolitan area, each travelling about 10,000 miles per year. All these cars produce about 150 million pounds of CO_2, 1.6 million pounds of NO_2, and 400,000 pounds of hydrocarbons every day. About 1.2 billion gallons of sewage and about 40 million pounds of garbage must be treated and disposed of every day.

As you can imagine, circulation of resources, wastes and people is vital to the city, lest it become starved or overly-polluted. There are vast distribution systems (infrastructure) installed which move resources like water, electricity and natural gas to the millions of buildings in town, and carry their sewage away to sewage treatment plants, and then, I think it just magically disappears or something. People need to get around too, so the huge system of roads, highways, freeways, railroads, ocean ports, and airports serves this purpose - though less and less efficiently as population growth continues to overtax these systems.

Cities are amazing places in that they virtually re-make the economy of the natural world into one that better serves the commercial interests of humankind. Yet the cities of today are not at all self-contained. Why, even Elvis knows that. In order for them to thrive, cities must cause tremendous impacts on their surrounding natural environment (the laws of Entropy cannot be violated). It is difficult for us to imagine the magnitude of these impacts...just ourselves, alone. So, the purpose of this exercise is to begin to form images of the scope of our collective impacts on our environment.

MATERIALS AND METHODS

You will need the following materials.

Lab manual

Field notebook

Calculator (absolutely necessary. Borrow one if you don't own one.)

Tape measure (I'll provide)

Good walking shoes

Flying Saucer-O-Sensor (just to be on the safe side)

We are going to consider how resources are used, and wastes are dealt with in the urban world, using Fullerton College as our example urban environment. We'll use the tools of simple mathematics to help us develop a quantitative understanding of these relationships (i.e. we'll be working lots of problems, so don't forget your calculator).

Your job is to help solve these problems

We'll be using some general assumptions about the makeup and habits of Fullerton College's human population (Table 1). We need a listing of these assumptions in order to get on "talkin' terms" about these issues.

WHAT YOU'LL BE TURNING IN

Turn in the following:

1) Report of findings
   Include:
   - Standard text format (Intro, M&M, O&R, Discussion)
   - Location Map, showing the (location?) of our study sites (properly labeled)
   - Your calculation sheets that you worked on in the field.

Work out the answers to the questions below.

You will have to do some field work in order to perform your calculations.

URBAN WORLD QUESTIONS

1. How much water is used to water turf grass at Fullerton College every day?

2. How many households could this amount of water support?

3. If 50% of the College's water comes from the Colorado River, how much money does this cost every day? every year?

4. If Fullerton College converted 25% of its existing turf grass to xeriscape, how much water would be used for turf grass and xeriscape irrigation every day?

5. What percentage is this compared to current conditions?

6. This change to more xeriscape represents a water savings of what percentage?

7. How many kilowatt hours of electricity does Fullerton College burn for interior lighting each day? Assume lights are on 18 hrs./day

8. How much money does this cost in electricity?

9. How many gallons of gasoline is this equivalent to?

10. If Fullerton College converted 50% of its old fluorescent lighting fixtures to new, highly reflective, and energy-efficient fluorescent lighting fixtures, how many kilowatt hours of electricity would the College burn for interior lighting each day?

11. This represents a savings of what percentage?

12. How much money would the College save in electricity costs if it made this change?

13. The energy savings would be equivalent to how much gasoline?

14. How many miles are driven by Fullerton College students each day while commuting to school and back?

15. How many gallons of gas is burned each day by commuting students?

16. What would the fuel consumption be if all Fullerton College students rode the bus to school?
    - assume buses are half full.

17. This represents a savings of what percentage?

18. How many kg of meat protein are consumed by Fullerton College students each day?

19. Assuming all meat protein consumed is beef protein, how many:
    - kg of grain is required to supply the needed beef?
    - gallons of water is needed to supply this amount of beef?

Table 1
General Assumptions

PARAMETER	VALUE
Average daily student population at FC	15,000 students (about 50% male : 50% female)
Average daily staff population at FC	1025 staff members (50% male : 50% female)
Average fuel economy for cars	17 mpg (city)
Distance driven between oil changes	5000 miles
Average travel distance from home to school	10 miles (round trip)
Burning 1 gallon of gasoline	20 pounds of CO2 0.2 pounds of NO2 0.05 pounds of hydrocarbons
Transit Bus	Fuel economy = 3.8 mpg Motor oil capacity = 30 quarts Oil change frequency = every 10,000 Annual mileage = 50,000 Seating capacity = 45
Dimensions of amount of paving needed for a typical parking space	Parking space 10' x 20' = 200 SF Adjacent driveway 10' x 15' = 150 SF Total 350SF
1 acre foot	325,851 gallons
Cost of Colorado River water to FC	$350 / acre foot
1 acre	43,560 square feet
Turf water requirements	27,000 gallons / acre week
Xeriscape water requirements	7,000 gallons / acre week
Toilet flush	5 gallons (1 per day for all female students) (2 per day for all female workers)
Urinal flush	1 gallon (1 per day for all male students) (2 per day for all male workers)
Handwashing, drinking water & misc. water use	4 gal per student and worker - day
Lighting requirements (current, old technology)	1 40W fluorescent bulb / 20 SF
Lighting requirements (new technology)	1 40W fluorescent bulb / 40 SF
To figure Kilowatt hours from N number of watts	(1 hr. x N watts) / (1000 watts/kW)
Gallons of gasoline per kilowatt hour	0.0225 gallons gasoline / kWh
Typical Household	3 people
Household water consumption	125 gallons / person day
Cost for electricity	$0.09 / kWh
Primary productivity: kg(C)/m^2 yr	cattle pasture 0.23 cropland 0.29 Turfgrass 0.35
Average dietary intake per day while at FC kg(C)/day dry weight (based on 1 meal)	Meat protein 0.035 Carbohydrates 0.013 Fat 0.004
Average CO2 exhaled	0.95 kg / 24 hours - person
Energy pyramid relationships	1 kg beef requires 16 kg of grain 1 kg beef requires over 5500 gallons of water
Conversion factors	1 meter = 3.281 feet 1 sq. meter = 10.763 sq. feet 1 kg = 2.205 lbs.