Lesson Title: CO2 Project (Day 1)

Objectives: SWBATS…

Students will understand the carbon cycle. Students will be able to identify types of pollution. Students will be able to understand what a carbon footprint is.

Lesson duration: 50 mins

Aim: To understand the carbon cycle

Do Now: What are different types of pollution?

Materials:

- Projector
- Laptop

Procedure:

- Discuss different types of pollution with the students
  - Air pollution
  - Water pollution
  - Land pollution
  - Noise pollution
  - Radioactive pollution
  - Thermal pollution
- Discuss the carbon cycle
- Discuss sequestration in trees and other things such as substrates
- Explain carbon footprint
- Calculate student's carbon footprint on internet
- Present the outline of the project that will be completed in the following weeks

Homework: None

Lesson Title: CO2 Project (Day 2)

Objectives/ SWBAT:
Understand proportions and use to create a to-scale map of the school area with the aid of Googlemaps.

Lesson duration: 50 mins.

Aim: How can we generate a scaled map of the school block?

Do Now: Set up computers

Materials:
rulers
Graph paper

Procedure:
1. Students will search for their school area on Googlemaps. They will note the scale used online and determine the actual area of their school block.

2. Using the above information they will figure out what scale would enable them to draw a to-scale version of their school block that best fits on the provided pieces of graph paper.

3. Label streets etc on map.

4. Time permitting, have a discussion on how they can best take measurements outside tomorrow, and introduce the concept of 'pacing' (using a pre-measured foot-length to rapidly measure big distances).

Homework:

Students will complete their scaled map.

Lesson Title: CO2 Project (Day 3)

Objectives/ SWBAT:
Calculate distances by measuring paces and converting to meters. Map landmarks. Convert measurements to a scaled map.

Lesson duration: 50 mins.

Aim: How can we generate a scaled map of the school block?

Do Now: Prepare measuring materials (yard sticks, pen/paper/clipboard) to go outside.

Materials:
Yardsticks/rulers
Graph paper/pen/clipboards
(umbrellas, if necessary)

Procedure:
1. Students will break into 2 groups, one group will be responsible for President St. and Classon Ave, the other group will be responsible for Franklin Ave and Union St. The groups will bring their materials downstairs, and go to their designated locations, accompanied by a fellow.

2. Each group will select someone in the group to be the pacer, and another to be the notetaker (depending on group size, other posts can be: calculator, assistant to pacer, map drawer). The pacer's shoe will be measured, and the pacer will begin at the curb and count steps heading towards the first tree on the block. The notetaker will record the number of steps until the tree begins and ends. The calculator will convert the steps into meters, and the mapper will draw a sketch of the trees, complete with measurements.

3. This process will be repeated until the entire block has been mapped. If there is additional time, the groups can return to the classroom, share data between the groups, and begin to produce the final version of their map.

Homework:

Students will complete the conversion of their measurements to generate a scaled map.

Lesson Title: CO2 Project (Day 4)

Objectives/ SWBAT:
Convert measurements from previous lesson into a scaled map.

Lesson duration: 35 mins.

Aim: How can we use the data from Monday to generate a scaled map of the school block?

Do Now: Convert the number of steps counted on Monday into meters.

Materials:
Data from Monday
Graph paper

Procedure:
1. Students from the 2 groups will share data collected from their portions of the block. Each student will draw their own map on graph paper. Begin by deciding on the scale necessary to fit the entire block on a standard sheet of graph paper (make sure to indicate scale on the map). Draw to scale: the block, the school building, and then plot the trees. Designate a code for each tree (to be used on future spreadsheet of tree height and circumference).

2. Time-permitting, introduce the concept of triangulation by having them brainstorm as to how to measure the height of a structure that is too high to reach.

Homework:

Students will complete their maps at home to be collected next class.

Lesson Title: CO2 Project (Day 5)

Objectives/ SWBAT: Carry out triangulation to estimate height. Use measurements of tree height and circumference to calculate weight. Calculate the quantity of carbon dioxide sequestered by a tree based on its weight.

Lesson duration: 50 mins.

Aim: How can we estimate the height of a tree?

Do Now: Devise a plan for how you could estimate the height of a tree that is too tall for you to reach the top.

Materials:
Computer for powerpoint
Yardsticks/measuring tapes
Worksheet with practice calculations

Procedure:
1. Show a powerpoint reviewing sources of CO_2 pollution, and explaining how photosynthesis sequesters CO_2. Explain the technique to triangulation.

2. Have students use triangulation to estimate the height of the classroom door, and then confirm with actual measurements.

3. Continue powerpoint with explanations of how the height measurements can be combined with circumference measurements to ultimately yield the amount of CO_2 that a tree can sequester.

4. Distribute worksheet with practice problems to calculate sequestration rate.

Homework:

Complete calculations not covered in class.

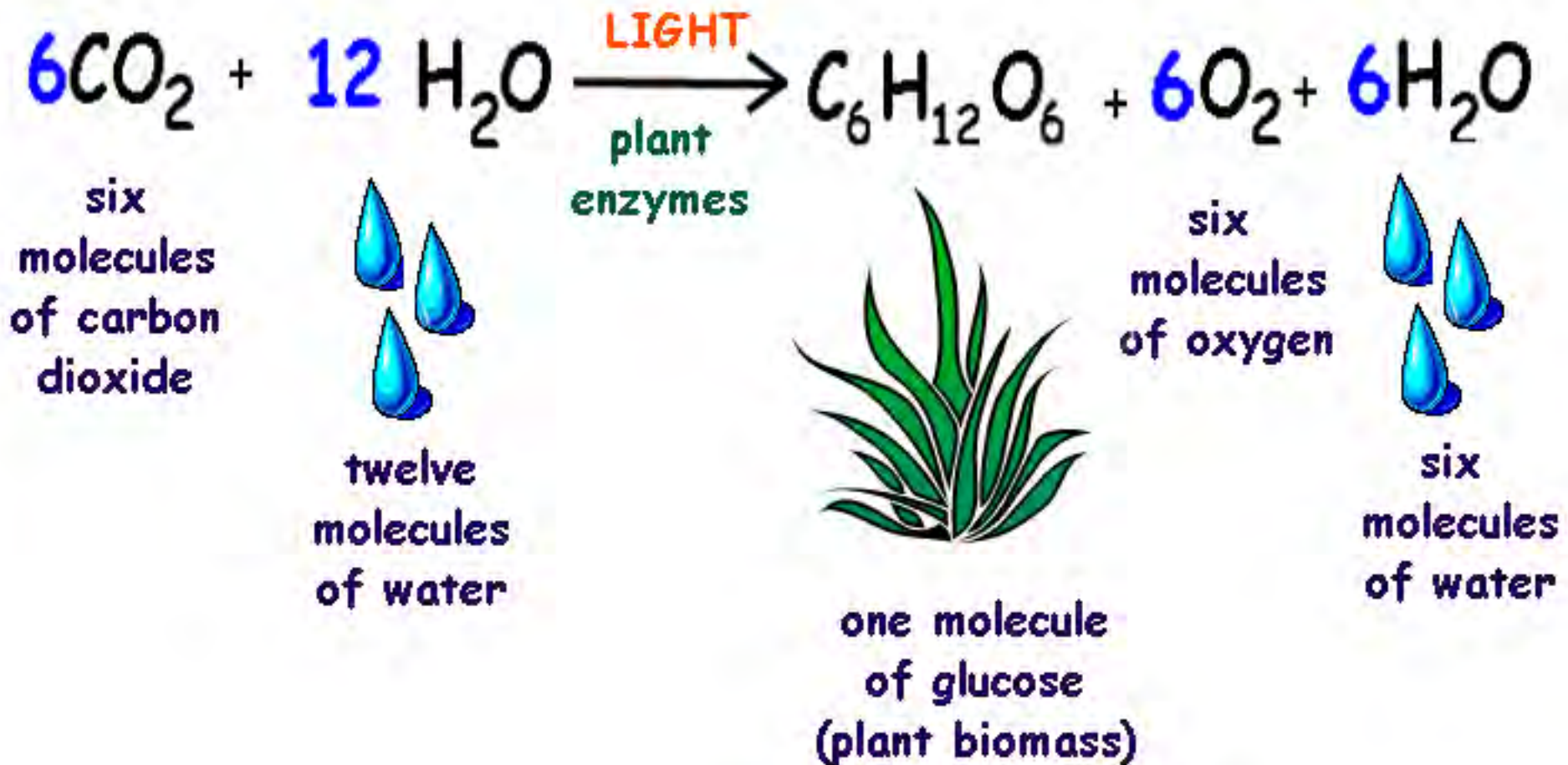# Triangulation

Where Does Carbon Dioxide Pollution Come From?
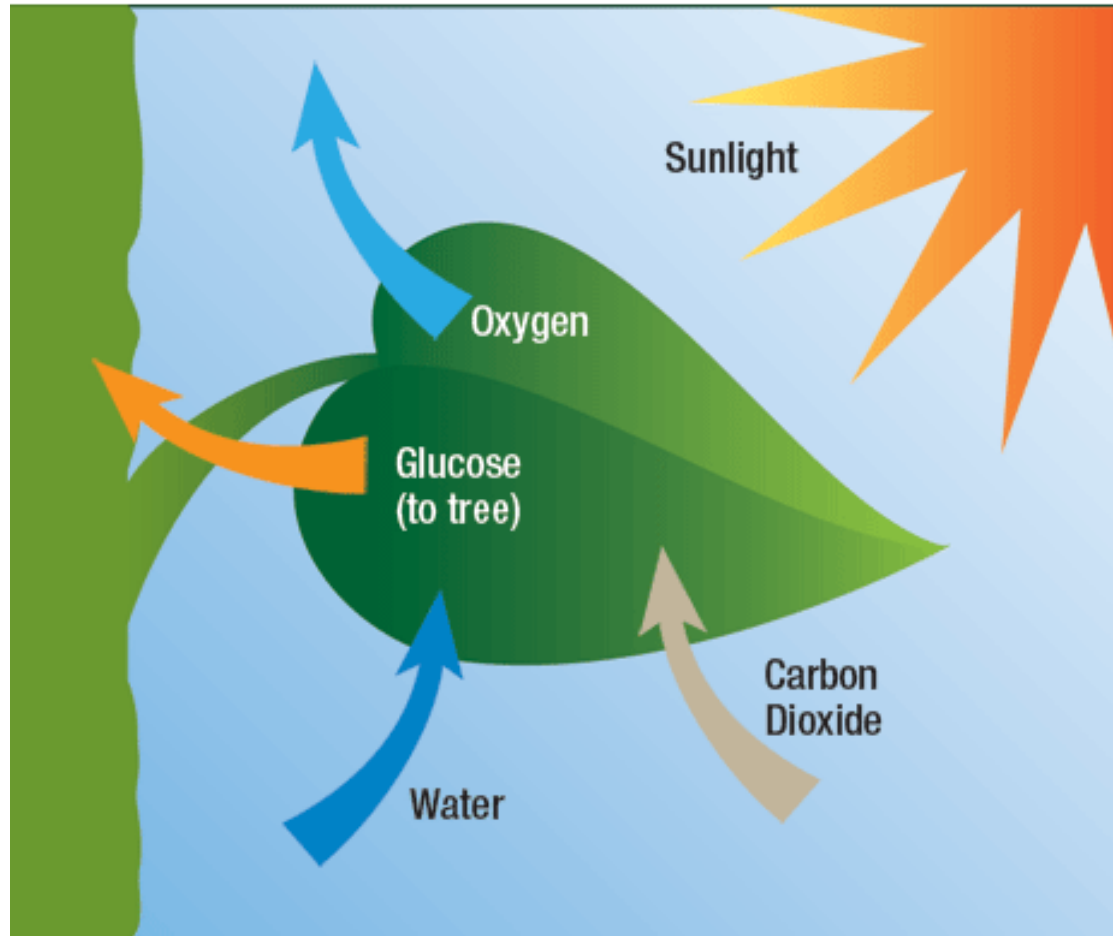
How Does a Tree Sequester CO$_2$?

Source: ERS/USDA
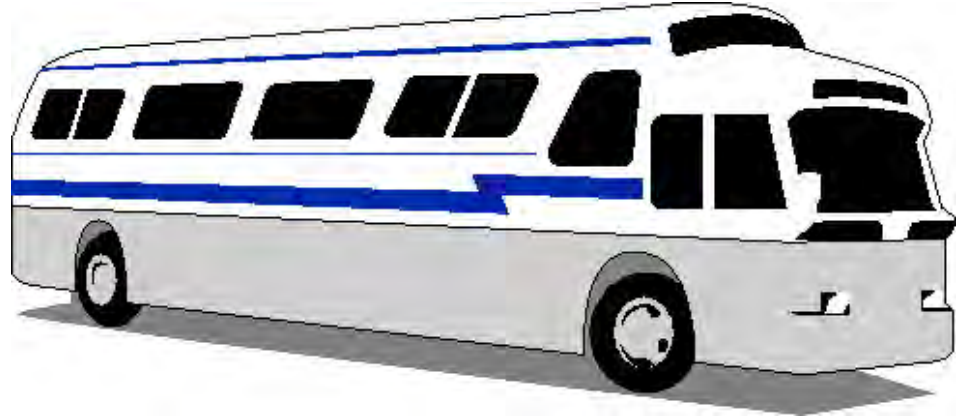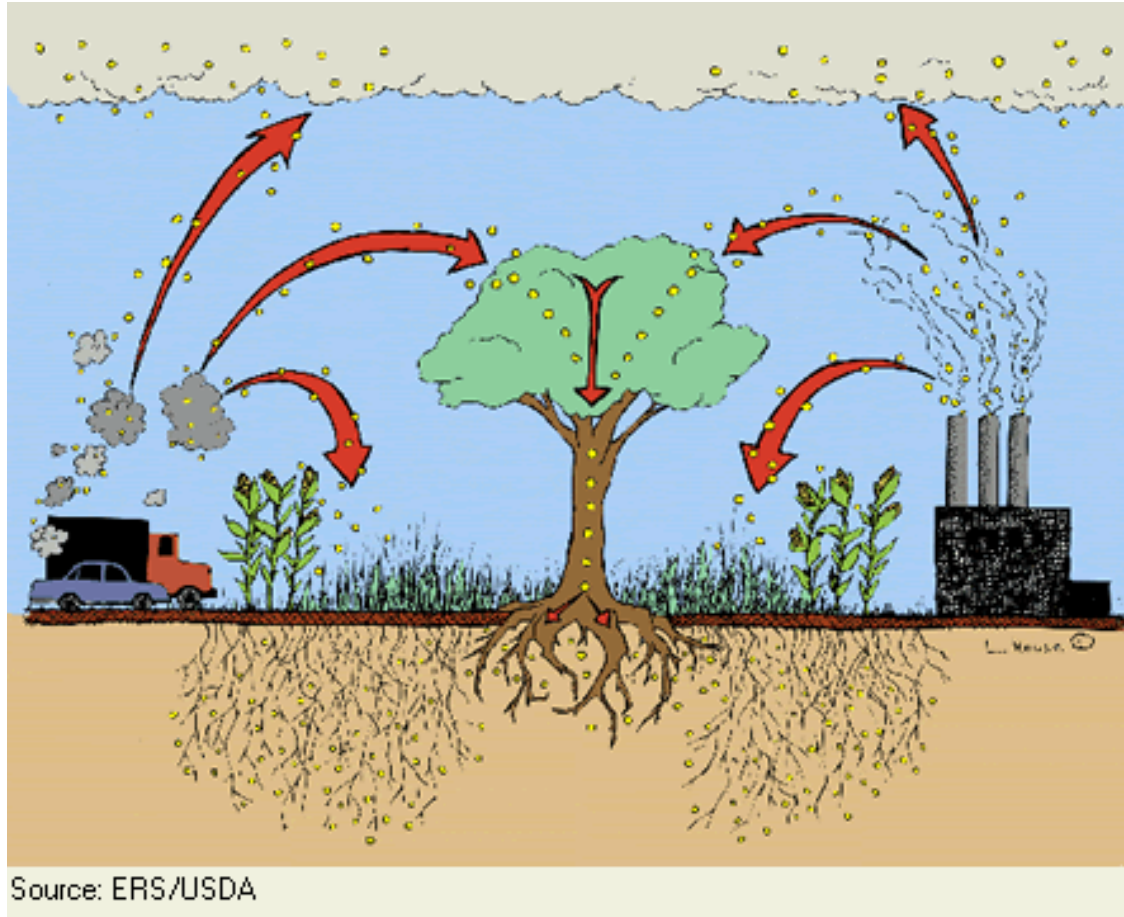
How Does a Tree Sequester CO$_2$?

Photosynthesis!

$$6CO_2 + 12 H_2O \xrightarrow[\text{plant enzymes}]{\text{LIGHT}} C_6H_{12}O_6 + 6O_2 + 6H_2O$$

six molecules of carbon dioxide

twelve molecules of water

one molecule of glucose (plant biomass)

six molecules of oxygen

six molecules of water

How much CO₂ does a tree sequester?

What do we need to know to calculate the sequestration rate?

The Weight of the Tree

1. measure the height of the tree

2. measure the circumference

How to Estimate the Height of a Tree

Triangulation
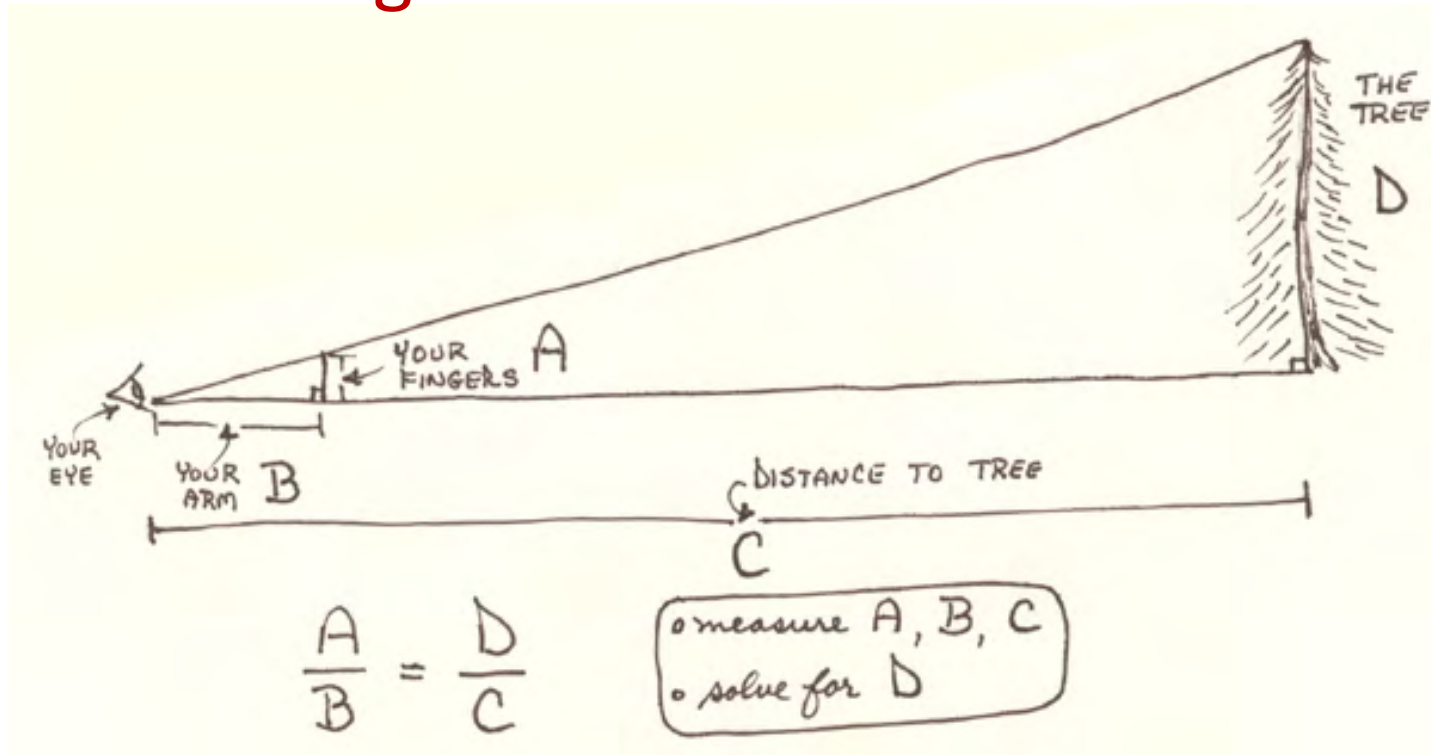
Converting Circumference to Area

Area = circumference^2/12.6

Practice:

Circumference = 150cm = 1.5m

Area = 2.25/12.6 = 0.179m^2

Final Calculations

- Volume = height x area

- Weight = volume x density

 * density = 700kg/m³

Review of Calculations

- Measure height

- Measure circumference

- Use circumference to calculate area

- Multiply height and area to find volume

- Multiply volume and density (700kg/m³) to find weight

** During photosynthesis, the amount of CO_2 sequestered = 1.5kg x tree weight

Tree Code	Circumference (m)	Height (m)	Area (Circum²/12.6)	Volume (Height * Area)	Weight (Vol. * 700kg/m³)	CO_2 sequest. (1.5kg * weight)
ITAVA Tree Data Collection						
A						
B						
C						
D						
E						
F						
G						
H						
I						
J						
K						
L						
M						
N						
O						
P						
Q						
R						
S						
T						
U						
V						
W						
X						

Y						
Tree Code	Circumference (m)	Height (m)	Area (Circum²/12.6)	Volume (Height * Area)	Weight (Vol. * 700kg/m³)	CO₂ sequest. (1.5kg * weight)
Z						
AA						
BB						
CC						
DD						
EE						
FF						
GG						
HH						
II						
JJ						
KK						
LL						
MM						
NN						
OO						
PP						
QQ						
RR						
SS						
TT						
UU						
VV						

Lesson Title: CO2 Project (Day 6)

Lesson duration: 50 mins.

Aim: How can we use the tree data to calculate carbon dioxide sequestration?

Do Now: Define sequestration.

Materials:
Tree measurement data
Computers with excel

Lesson:
1. Students will practice converting tree size into the amount of carbon dioxide using the worksheet provided.

2. Students from the 2 groups will share data collected from their portions of the block. They will set up a spreadsheet in excel and enter in the data collected. They will enter in formulas to complete the calculations, as shown in worksheet.

Homework:

Students will complete their calculations.

Carbon Dioxide Sequestration

Steps:

- Measure height

- Measure circumference

- Use circumference to calculate area

- Multiply height and area to find volume

- Multiply volume and density (700kg/m³) to find weight

** During photosynthesis, the amount of CO_2 sequestered = 1.5kg x tree weight

Practice Equation:

1. The height of the tree is 17m

2. The circumference is 1.5m

3. Calculate the Area

Area = circumference²/12.6

4. Multiply height and area to find volume

Volume = height x area

5. Multiply volume and density to find weight

Weight = volume x 700kg/m³

6. How much CO_2 has been sequestered by this tree?

CO_2 sequestered = 1.5kg x weight of tree

Lesson Title: CO2 Project (Day 7)

Lesson duration: 35 mins.

Objectives: SWBAT…
Identify various classes of vehicles based on emissions. Collect data to determine carbon dioxide production around BASE

Aim: How can we estimate the carbon dioxide production around BASE?

Do Now: Collect materials (data sheet) for going outside.

Materials:
Car counting data sheet, timers

Lesson:
1. Students will break into groups, with each group being responsible for two sides of the block. They will count vehicles as they pass by placing a tally stripe in the appropriate vehicle class box on the data sheet.

2. Students from the 2 groups will share data collected from their portions of the block. They will set up a spreadsheet in excel and enter in the data collected, and perform calculations using information provided in the data sheet.

Homework:

Students will complete their calculations.

Categorizing Cars

In order to figure out how much CO_2 is being emitted by cars on each block, we must categorized cars into 5 categories, based on how many gallons they consume per kilometer. The 5 categories are:

Small Car   =   ~35km/g

Large Car   =   ~28.8km/g

Box Truck   =   ~17.6km/g

Semi-truck =   ~9.6km/g

Bus   =   ~12.8km/g

Counting Cars

Now, we must count the cars as they pass. You will stand on one block for 15 minutes. In the fifteen minutes, you must count the number of each type of car that has passed. Once the fifteen minutes are done, groups will share data.

Street Name: _____   Time: _____

Type of Car	Small Car	Large Car	Box Truck	Semi Truck	Bus
Number of cars counted					

Street Name: _____   Time: _____

Type of Car	Small Car	Large Car	Box Truck	Semi Truck	Bus
Number of cars counted					

Lesson Title: CO2 Project (Day 8)

Objectives: SWBAT…

Understand the profile of carbon dioxide production and sequestration at ITAVA (or another area that is not BASE)

Lesson duration: half day

Aim: How can we assess the carbon dioxide production and sequestration at ITAVA?

Do Now: Prepare materials for the field trip

Materials:
Data sheets
Maps of area
Yard sticks, tape measures, timers

Lesson:
1. Students will break into groups and first complete tree triangulation measurements (tree location data will have been provided beforehand).

2. Students will collect car counting data

3. Groups will share data.

Homework:

Students will complete their calculations.

Categorizing Cars

In order to figure out how much CO_2 is being emitted by cars on each block, we must categorized cars into 5 categories, based on how many gallons they consume per kilometer. The 5 categories are:

Small Car   = ~35km/g

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Bus   =   ~12.8km/g

Counting Cars

Now, we must count the cars as they pass. You will stand on one block for 15 minutes. In the fifteen minutes, you must count the number of each type of car that has passed. Once the fifteen minutes are done, groups will share data.

Street Name: _____   Time: _____

Type of Car	Small Car	Large Car	Box Truck	Semi Truck	Bus
Number of cars counted					

Street Name: _____   Time: _____

Type of Car	Small Car	Large Car	Box Truck	Semi Truck	Bus
Number of cars counted					

Map of Trees measured near ITAVA
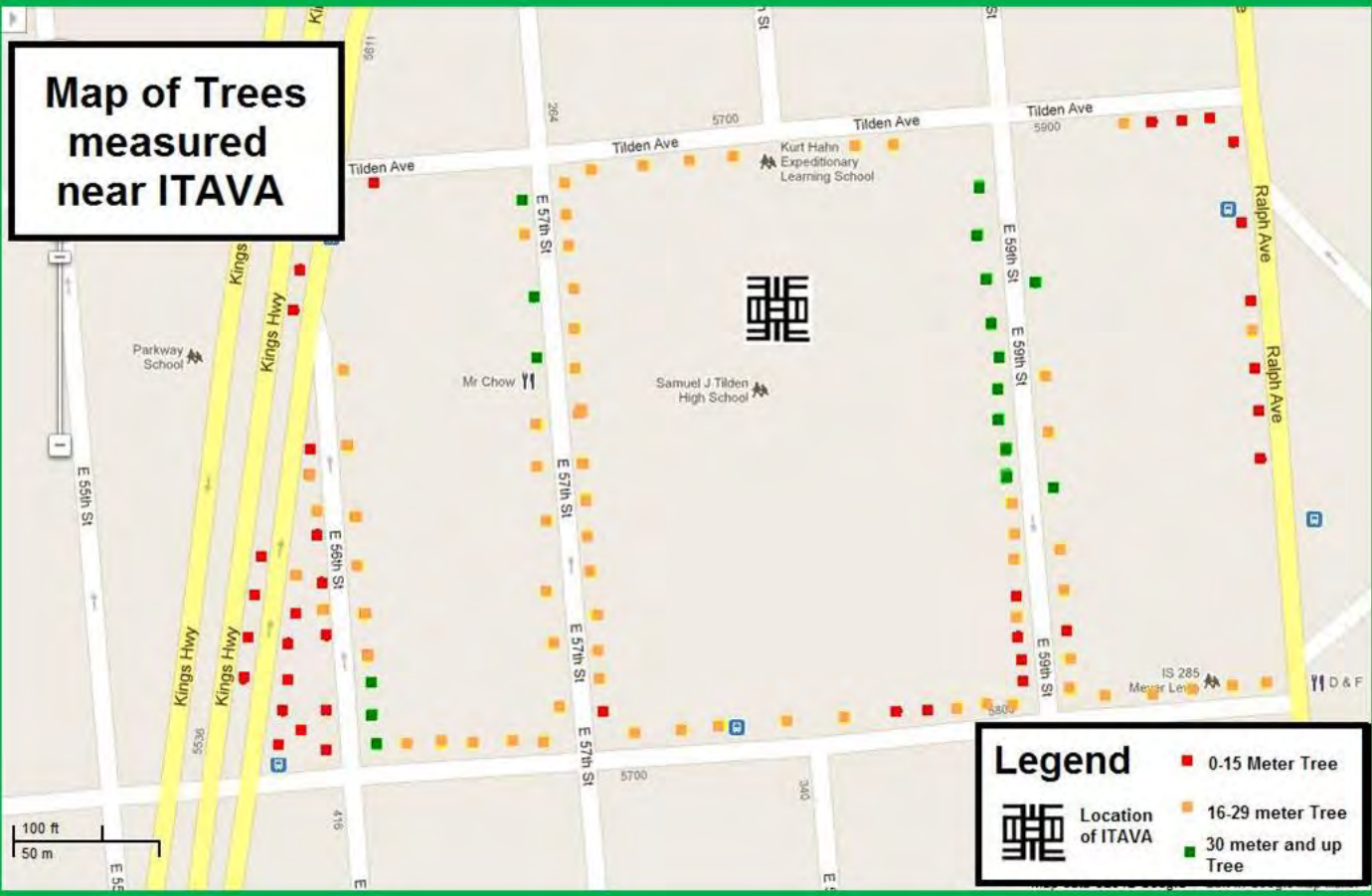
Lesson Title: CO2 Project (day 9)

Objectives: SWBATs…
Students will discuss their initial observations of ITAVA and compare it to BASE. Students will be able to calculate CO_2 emissions from cars and CO_2 sequestration for trees.

Lesson duration: 50 mins

Aim: To compare the carbon dioxide data from ITAVA with data from BASE

Do Now: Tally up the cars counted at ITAVA and exchange data with each person.

Materials:
-Projector
-Laptop
-Data sheets

Procedure:
1. Write car counting data on white board and calculate averages.
2. Ask the students about their initial observations about the differences between ITAVA and BASE
3. Discuss the differences in CO_2 output between cars and ask the students why there are differences
4. Go over how CO_2 is produced by cars
5. Calculate how much CO_2 is produced by the different cars
6. Walk students through tree data sheet and the calculations

Homework:
Complete 5 calculations on tree data sheet

	CO2 sequestered (trees)	CO2 produced (cars + humans)	difference (kg/km)	%
ITAVA	335.71 kg/km	122.91 kg/km	212.8	273.13
BASE	17.83 kg/km	93.34 kg/km	-75.51	19.102

after adjusting cars from 15 mins to 1 day:

	CO2 sequestered (trees)	CO2 produced (cars + humans)	difference (kg/km)	%
ITAVA	335.71 kg/km	9532.07 kg/km	-9196.36	3.5219
BASE	17.83 kg/km	4778.49 kg/km	-4760.66	0.3731

Conclusion: at ITAVA 3.5% of the CO2 is being sequestered, at BASE only 0.37%.