TITLE: **Groundwater - Water we doing to our planet??**

TOPIC: How much runoff is created by an average shopping mall parking lot?

GRADE LEVEL: Middle, High

CONTENT OBJECTIVE & SHORT DESCRIPTION: The student will calculate the yearly runoff created by a parking lot, and calculate the loss of water that would have entered the groundwater system.

RESOURCE TYPE: Classroom Activity

TIME REQUIRED: One class

MATERIALS: Lab handout, pencil, calculator, paper

DIRECTIONS FOR INSTRUCTION/ACTIVITY: In order for groundwater to be replenished for our use, precipitation must be absorbed by the ground. People worldwide are crying out due to lack of a stable, adequate water supply. Yet, in many industrialized countries, particularly the US, people are also demanding more construction, more roads, more shopping areas, etc. The over usage of our land is helping to cause the very water problem that used to be relegated to 3rd world countries. This lab will illustrate how much water we lose to runoff that could have infiltrated the land and gone to the replenishment of the water supply. Teachers: Adjust rainfall for your state's average.

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Groundwater - Water we doing to our planet??

Question: How much runoff is created by an average shopping mall parking lot?

Objective: You will calculate the yearly runoff created by a parking lot, and calculate the loss of water that would have entered the groundwater system.

Materials: Lab handout, pencil, calculator, paper

Background: In order for groundwater to be replenished for our use, precipitation must be absorbed by the ground. People worldwide are crying out due to lack of a stable, adequate water supply. Yet, in many industrialized countries, particularly the US, people are also demanding more construction, more roads, more shopping areas, etc. The over usage of our land is helping to cause the very water problem that used to be relegated to 3rd world countries. This lab will illustrate how much water we lose to runoff that could have infiltrated the land and gone to the replenishment of the water supply.

Data:
Mobile, AL's average annual rainfall is about 66"
Average ground absorption rate is 50%
An average shopping mall and surrounding parking areas is 75 acres.
1 acre = 43,560 ft^2 (208 ft x 208 ft)

Calculating the amount of rain / runoff:
Square inches or cm are AREA measurements, as is an acre. But, if square inches are multiplied by another inch (or cm), the resulting unit is a CUBIC inch, which is a unit of volume, just like gallons, liters, etc. This volume unit is what we need to find. Since cubic inches do not translate into gallons, we must convert inches to cm, cm to liters, then liters to gallons.

Conversions:
1) 1 inch = 2.54 cm
2) 1 cubic inch = $(2.54\ cm)^3$
3) 1 cm^3 = 1 ml
4) 1000 ml = 1 liter
5) 1 gallon = 3.8 liters
6) 1 foot = 12 inches

EXAMPLE of how to use conversion factors:
96 eggs = ?? dozen; we know that 12 eggs = 1 dozen

$\frac{96\ eggs}{1} \times \frac{1\ dozen}{12\ eggs}$ = In this step, the "eggs" unit will cancel out, leaving the "dozen" unit

$\frac{96\ dozen}{12}$ = 8 dozen

Now we have successfully used a conversion factor to go from one unit to another!!

NAME: _____Date: _____ Period: _____

Procedure:
YOU MUST FOLLOW THIS EXACTLY, OR YOU WILL NOT GET THE CORRECT ANSWER

Step one:
Convert inches of rain into cm of rain

_____ (inches per year of rain) x 2.54cm = _____cm of rain per year

Step two:
Convert acres into cm^2
acres x 43650 ft^2 x (conversion #6)^2 x (conversion #1)^2 = # cm^2

_____ acres x $\frac{43650\ ft^2}{1\ acre}$ x $\frac{(12\ inches)^2}{1\ ft^2}$ x $\frac{(2.54\ cm)^2}{1\ in^2}$ = _____cm^2

Step three:
Find the volume in cm^3 and in ml
Step 1 answer x step 2 answer

_____ cm x _____ cm^2 = _____cm^3, which is the same as ml !!!!!

Step four:
Convert cm^3 to liters.
Step 3 answer x (conversion #3) x (conversion #4) = liters

_____ cm^3 x $\frac{1ml}{1\ cm^3}$ x $\frac{1\ liter}{1000\ ml}$ = _____ liters

Step five:
Convert liters to gallons.
Step 4 answer x (conversion #)5 = # gallons

_____ liters x $\frac{1\ gallon}{3.8\ liters}$ = _____ gallons

Step six:
Find absorption amount.
Step 5 answer x percent absorption = # gallons lost to runoff

_____ gallons x 50% absorption = _____ gallons

Conclusion questions:
1) How many malls can *you* think of that are located in your area? _____
Multiply this times the runoff amount and put that answer here: _____

2) Now, add in other shopping centers, businesses, roads, and GUESS how many MORE gallons are lost in this area: _____ (your answer may be different from other students)

3) Explain why urban areas are more likely to have a water shortage than farmlands, even though farms use about the same amount of water.

_____
_____
_____

4) How would the absorption rate be different if we had a different type of soil? (Ex.: more rocky or sandier soil). Be specific.

_____
_____
_____

5) Do you have any ideas on how we could recapture some of the runoff from parking lots? Should new parking lots have requirements to address this?

_____
_____
_____

Extension/Extra Credit:
Do research on a "green design" parking lot. What is this and why is it important? Present your findings