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# How long will the earth's oil reserves last?

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## *Abstract*

Is the world running out of oil? How much oil is there on earth? How much oil have we already used? And how long are the world reserves going to last? These are some of the questions to solve under the Essential Question:

*How long will the earth's oil reserves last?*

The problem has been divided in four parts:

***Part I:*** **Preliminary Analysis Based on Naïve Assumptions**

The objective of this part is to introduce students to the concept of modeling. Using a basic approach we introduced the problem and the basic concepts of modeling. Students will get an idea about how to create basic mathematical models, and how the change of variables can affect the results of the model.

***Part II:*** **Refining the model**

All the assumptions on part one can be challenged and refined.

The objective of this section is to make students research and make their own changes to the model justifying the numbers chosen.

***Part III***: **Combining the Work**

In this part of the project students will take the work from part two and combine it into a single spreadsheet/model for the oil consumption.

***Part IV***: **Further Refinement**

Students will generate a list of at least four different things they could modify in the assumptions of the model.

The objective is to describe

a) What the change is and why students think it would be important and

b) How students think this change will affect the ultimate answer to the question of how long the oil reserves will last.

## *Modeling Software Used*

- To make all the calculations required by the problem it was necessary to use graphing calculators and EXCEL.

## *The Process of designing a Model*

***Part One: Preliminary Analysis Based on Naïve Assumptions (exploration through a guided inquiry)***

For this part, students guided by the teacher answered the questions:

a) Which elements or variables are necessary to estimate how much gas does your Dad's car will consume during one year?

b) If we know the miles that your Dad travels per year and the miles that your Dad's car gives per gallon (gas mileage) how can we find the gas that your Dad's car needs in a year?

c) Do all the cars have the same consumption of gas than your Dad's car?

d) How can we find the consumption of gas of a truck?

e) How does the consumption of gas per one car can help us to find the gas that we need for all the cars owned by the parents of the students of this classroom?

One student said: "Multiplying by the total of cars that our parents have?

f) If we know the amount of gas that a car and a truck require per year, what do we need to find the gas necessary for all the vehicles of the world per year?

g) If we know the total amount of oil on earth, how much will it last if we know the total consumption of gas in a year?

After the inquiry process students delimited the elements necessary to estimate how much gas is consumed in one year. These elements were:

a) Miles that a car/truck travels per year

b) Gas mileage that a car/truck gives per gallon

c) Number of cars/trucks in the world

***Part Two: Improving the Accuracy by Refining the Model***

Students worked in teams to research information that they considered was important to solve the problem. This resulted in three different estimates each built on the initial work.

The variables detected that required to be modeled where three:

A. How many miles will a car/truck be driven during a year?

B. How would the gas mileage change every year?

C. How will the total number of cars in the world change every year?

Students need to understand different kind of models, constant, linear and exponential. For example the number of miles driven during a year for a car and truck will be constant all the time in the model.

The gas mileage will also be constant, to facilitate calculations.

The number of cars will have a linear growing.

***Part Three: Combining the Work***

In this part students combined all the work researched from part two, combining all the information into a single spreadsheet/model for the oil consumption.

***Part Four: Further Refinement***

Students generated a list of at least four different things they could modify in the assumptions of the model. They described the change and how these changes would affect the model.

- Fuel efficiency would improve, therefore gas will last more.
- Gasoline represents the 41.66% of the consumption of oil in the world, therefore gas will last less considering than cars and trucks are not the only consumers of gas in the world.
- Number of cars increases without limit (around 11 million per year), gas will last less.
- The number of miles driven by a car in a year is not 15,000. It is different in each country. Students do not know how this factor would affect the model.

## *Problems Encountered*

- The research was done in a bilingual group, where there are students with different proficiency in English. During the research I had to make sure of combining and pairing students with different language proficiency levels.
- It was hard to work with big numbers. However Excel resulted and excellent tool to make all the necessary calculations.
- It was hard to set planning times, since we did not have a class or time exclusively for the elaboration of the problem.

- The names of some students were registered but many members of the bilingual classroom helped to find numbers and also gave ideas to solve or modify the results.

## *Evaluation of Results*

Since this project was planned as an open ended problem, we never pretended to get the right answer. The objective was to provide students with the experience of designing a mathematical model.

## *Summary of Experiences*

***Answers from students during the Inquiry process***

a) Which elements or variables are important to know how much gas does your Dad's car needs consumes in one year? Some student's answers were: type of car, gas mileage (miles per gallon), price of the gas and, miles that the car travels per year

b) If we know the miles that a car travels per year and the miles that the car gives per gallon (gas mileage) how can we find the gas that your Dad's car needs in a year?

Some students said: dividing.

-> What do we need to divide?

Students said: the total amount of miles that the car travels per year by the gas mileage.

c) Do all the cars have the same consumption of gas?

Students said: "No, because there are also trucks and bigger vehicles, and their consumption of gas is more".

d) How can we find the consumption of gas of a truck?

Students said: "same way that what we did with a car".

e) How does the consumption of gas per one car can help us to find the gas that we need for all the cars owned by the parents of the students of this classroom?

One student said: "Multiplying by the total of cars that our parents have?

f) If we know the amount of gas that a car and a truck require per year, what do we need to find the gas necessary for all the vehicles of the world per year?

Students responded "…the number of cars in the world and multiply the consumption of gas per car by the total of cars in the world and the consumption of gas per truck multiplied by the total of trucks in the world".

***Some Resources Provided to Students were:***

- ✓ Conversion tables/calculations for any units are available from the site www.onlineconversion.com.
- ✓ Information on automobiles worldwide is available from www.bts.gov/publications/nts/index.html, but you will need to make some assumptions about the number of SUVs, minivans, and pickups, since these are not included in the data tables. Be sure to spell out the assumptions your group makes.
- ✓ You can learn about the process of oil refining from www.howstuffworks.com. This will help you determine the amount of gasoline you can get from a single barrel of oil, as well as the size (gallons or liters) of a barrel of oil.
- ✓ If you need other information (like the size of the earth and the thickness of the earth's crust) can be found by asking questions at www.askjeeves.com.