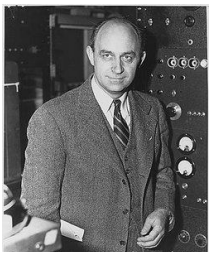
Fermi Problems/Questions

Name: _____ Date: _____

Due: _____



Who was Enrico Fermi?

Enrico Fermi was born in Rome, Italy in 1901 but spent much of his working life in the United States. He is most noted for his work on the development of the first nuclear reactor and for the development of quantum theory which is a framework underlying much of physics and chemistry. Fermi won the 1938 Nobel Prize for Physics. Fermi disliked complicated theories, and while he had great mathematical ability, he would never use it when the job could be done much more simply. He was famous for getting quick and accurate answers to problems which would stump other people. This method of getting approximate and quick answers through "back of the envelope" calculations became informally known as the 'Fermi method'.

What are "Fermi Problems/ Fermi Questions"?

Fermi problems are estimation activities that encourage students to make justified guesses and follow them through. Here is a classic Fermi problem: *How many piano tuners are there in Chicago?*

A typical solution to this problem would involve multiplying together a series of estimates that would give the correct answer if the estimates were correct. For example, we might start with the following assumptions to head towards a solution:

1. There are approximately 5,000,000 people living in Chicago.
2. On average, there are 2 persons in each household in Chicago.
3. Roughly one household in twenty has a piano that is tuned regularly.
4. Pianos that are tuned regularly are tuned on average about once per year.
5. It takes a piano tuner about two hours to tune a piano, including travel time.
6. Each piano tuner works 8 hours in a day, 5 days in a week, and 50 weeks in a year.

The result is that we could calculate that there are 125 piano tuners in Chicago. The answer we got is probably not correct but this sort of problem solving strategy does tell us what to look for to get a better answer: for example, we might try to find a better estimate of the number of pianos tuned by a piano tuner in a typical day, or look up an accurate number for the population of Chicago. It also gives us a rough estimate that may be good enough. (written with information from Wikipedia, the free encyclopedia -- http://en.wikipedia.org/)

In this activity you will choose an interesting problem situation, form a question to answer, and clearly write out your steps that you followed to get an answer. Turn the page over to see the format you should follow.

Fermi Problems/Questions

On a 12 X 18 sheet of cartridge paper, record the following information
and include subheadings and pictures or charts/graphs.

The situation: Describe the initial situation that you encounter that you are curious about.
"Mr. Reynolds assigns a great deal of homework. In fact, I finished three sheets of paper just last night and that is the amount I finish almost every night! I'm going to need some new pencils soon…."

The question: Make a clear question to solve out of the situation you present.
"How many days would it take our class to create a stack of homework papers that would reach the ceiling of our class?"

Assumptions: You cannot usually find all the exact numbers to solve this problem so here the place to state what types of assumptions and roundings you'll use. For example you could state that class sizes are usually around 30 and that paper comes in bricks of 500 pages. Assumptions will be different from problem to problem. Make a guess about the final answer.

Solution:
Begin your exact calculations.
Use subheadings to describe what you are calculating in each step.
Add pictures and/or charts and/or graphs to show your work.
Make exact measurement when possible.
Use a calculator when it helps.
You need to have a few stages.

Example:
There are 27 students in our class which is rounded off to thirty. A brick of 500 sheets of blank paper is about 5 centimetres thick. At three pages per day it would take one student about 160 days of writing to equal one brick of paper. 30 bricks are about 150 centimetres tall which equals 1.5 metres. I guess that our class is about 4.5 metres high because our doorway looks about 2 metres tall, so my thirty students need to work about 150 days three times in a row, which is about 450 days. Most students don't work 450 days in a row, so this means I need to find out how long a school year is. I'm estimating about 450 days though.

(INCLUDE A PICTURE, CHART OR GRAPH HERE.)

Solution: Answer in a complete sentence. Use the full 12 X 18 sheet for your work.