PUMPED UP GAS PRICES

Student/Class Goal
Students are outraged about current high gas prices and question the relationship between supply and demand.

Outcome (*lesson objective)*
Students will keep track of mileage and gasoline amounts for one month and calculate miles per gallon, representing information by creating a spreadsheet. Graphs will be created based on average gas prices over time.

Time Frame
2-6 hours

Standard *Use Math to Solve Problems and Communicate*

NRS EFL 3-6

COPS	**Activity Addresses Components of Performance**
Understand, interpret, and work with pictures, numbers, and symbolic information.	Finding unit rate is introduced by students practicing ratio and proportion and learning the miles per gallon (mpg) simple formula. Data is collected and put into spreadsheets and graphs.
Apply knowledge of mathematical concepts and procedures to figure out how to answer a question, solve a problem, make a prediction, or carry out a task that has a mathematical dimension.	Problem solving strategies and predictions are completed about travel situations and discussions are held involving average gas prices. Division is performed when finding the unit rate of mpg.
Define and select data to be used in solving the problem.	Students practice solving word problems by determining the appropriate data and using it to reach the answer.
Determine the degree of precision required by the situation.	Exactness when using gallons to the nearest tens/hundreds or whole numbers.
Solve problem using appropriate quantitative procedures and verify that the results are reasonable.	The process of finding the answer is as important to student understanding as actually getting the answer. Students verify answers as they work through the mathematical processes.
Communicate results using a variety of mathematical representations, including graphs, chart, tables, and algebraic models.	Students convey information learned by writing down answers and having discussions about their work. Creating spreadsheets and graphs provide a visual representation of their learning.

Materials
High Cost of Gasoline Cartoons
Microsoft Excel
What is a Ratio? Teacher Information Packet
Calculating Miles per Gallon Handout
Mileage Word Problems Handout and Answer Key
Current News articles on Gas Prices
Pumped Up Gas Prices Learning Objects

Learner Prior Knowledge
Use political cartoons to begin a discussion on a current hot topic such as gasoline prices. What do students know about determining miles per gallon? Do they know the mathematical concept of ratio and how it plays a part? Are they familiar with how to enter data into a computer program to create a spreadsheet?

Instructional Activities
Step 1 - After evaluating prior knowledge of spreadsheets and ratio, teach concepts as needed by group: Introduce the concept of a spreadsheet, such as Microsoft Excel to the class. Take a class survey reflecting a favorite color, food, car, vacation destination, movie, actor or actress. Enter the class preferences into a spreadsheet and create a pie chart showing preferences.

Introduce ratios to the group. Refer to *What is a Ratio?* Teacher Information Packet or use a classroom resource such as Number Power by Contemporary Books. Additional practice may be needed if this is an unfamiliar concept.

Step 2 - Introduce concept of miles per gallon and the procedure for calculating it. Teacher directs the use of the handout *Calculating Miles per Gallon*. When ready, students can complete the *Mileage Word Problems* Handout.

TEACHER NOTE A discussion needs to occur before the *Calculating Miles Per Gallon* handout that clarifies the mathematical process and not just the procedure. Question students by asking "If I look at my counter (odometer) every time I fill up my car, how can I determine how far I've traveled?" Students should answer that they would subtract the two readings. Use of the word "per" is a

mathematical shorthand students often miss - make sure to explain that it means division as outlined on the handout.

Students will keep track of miles driven and number of gallons of gas purchased and the cost per gallon for 1 month. Students will also calculate miles per gallon based on this data collection. It is also important when determining gas mileage that the tank is completely filled each time. When data has been collected, they can create a simple spreadsheet to show their results.

TECHNOLOGY NOTE Direct students to the Fuel Miser website located at Online Savings Calculator. Refer to data they collected based on Step 2. Use this data to fill in the Fuel Miser miles per gallon. Data they need includes: beginning odometer reading, ending odometer reading, number of gallons pumped in recent fill. Local cost of one gallon of gasoline, average number of miles (estimate) driven in a year. Click on Calculate. The computer will calculate your miles per gallon, gas expense per month and per year.

Step 3 – Students will research average gas prices for the past year in major U.S. regions and also investigate U.S. sources of gasoline and causes for price increases or decreases. Gas Price Watch contains gas prices for many zip codes throughout the United States. Users type in their zip code and will receive average gas prices.

Students will enter data for average gas prices in major U.S. regions into spreadsheet to create a bar graph illustrating gas price fluctuation or students can create their graphs on paper.

Step 4 - Encourage class discussion about the production of gasoline and the results of student research from Step 3.
Refer to handout "How Gas Prices Work" from How Stuff Works. Discussion Questions:

- What countries produce most of the world's petroleum? Gasoline?
- What country uses the most petroleum? Gasoline?
- What makes the price of gasoline increase or decrease?
- Why do gas prices vary from region to region?
- Why are gas prices higher during some longer weekends or holiday weekends?
- What is the difference between the cars U.S. citizens drove in the 1970s compared to the cars they drive today? How is this related to rising gas prices?
- How does knowing gas mileage affect what car you buy?
- Why is gas mileage different in the city or highway?
- Should the Government Lower Gasoline Prices? Why? Why not?

Create a graph showing average gasoline prices in the U.S. for the past five years. Be sure to acknowledge your source(s) of information and data.

Assessment/Evidence (*based on outcome)*
Word Problems [Students will calculate miles per gallon, given 12 problems, with 80% accuracy.]
Monthly Results Spreadsheet
Average Prices Bar Graph
Prices for 5 Years Graph

Teacher Reflection/Lesson Evaluation
Not yet completed.

Next Steps
Pumped Up Gas Prices Learning Objects will give students additional practice interpreting political cartoons.

Technology Integration
Decker Gallery Political Cartoons http://the_decker.tripod.com/images/toondir2.htm
Gasoline Prices Update http://blog.energytomorrow.org/2011/05/gasoline-prices-update.html?gclid=CNWp8Juh4KkCFYrJKgodNSLevA
Gas Prices from New York Times http://topics.nytimes.com/topics/reference/timestopics/subjects/g/gasoline_prices/index.html
Gas Prices http://money.cnn.com/news/specials/gasprices/
How Gas Prices Work http://auto.howstuffworks.com/fuel-efficiency/fuel-consumption/gas-price.htm
Online Saving Calculator http://www.fuelmiser.com/calculate.html
Gas Price Watch http://www.gaspricewatch.com/new/default_V3.asp
Watchdog Gasoline Prices http://www.consumerwatchdog.org/search/apachesolr_search/gasoline%20prices
Gas Buddy http://www.gasbuddy.com/
U.S. Retail Gasoline Prices by Formulation, Data and Analysis from the Energy Information Administration

http://www.eia.doe.gov/oil_gas/petroleum/data_publications/wrgp/mogas_home_page.html
A Primer on Gas Prices
http://www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/primer_on_gasoline_prices/html/petbro.html
Gasoline and Diesel Fuel Updates http://tonto.eia.doe.gov/oog/info/gdu/gasdiesel.asp
Consumer Watchdog http://www.consumerwatchdog.org/issues/
American Petroleum Institute http://www.api.org/

Purposeful/Transparent
The teacher is explicit about the process of calculating miles per gallon so students understand more than the procedure, but understand the reasoning behind the formula.

Contextual
Students need to be able to use math skills and apply them to real life situations to make decisions about gas prices and usage.

Building Expertise
The concept of ratio and proportion forms the foundation for determining unit rate and must precede an understanding of mpg.

Mileage Word Problems

1. The gas tank of a minivan holds 23 gallons of gasoline and the van averages 21 miles per gallon on highway driving. How many miles can the van travel on a full tank of gas?

2. John drives an old car that averages only 14 miles per gallon. Last summer he ran out of gas and had to walk to a gas station to get 3 gallons of gas in a gas can. How many miles would these three gallons have allowed him to drive before he ran out of gas again?

3. Jan has a choice of two rental cars, each of which comes with a full tank of gas. The compact car has a 16 gallon tank and it averages 25 miles per gallon. The midsize car has a 21 gallon tank and averages 20 miles per gallon. Which car will go furthest on the provided tank of gas?

4. How many gallons of gasoline would be needed to drive 893 miles in a car that averages 19 miles per gallon?

5. At the start of a vacation trip, the odometer of the Jackson's car read 23,584. When they returned from their trip, the odometer reading was 25,976. The Jackson's car averages 23 miles per gallon of gasoline. How many gallons of gas did they use for this trip?

6. The Frank's are using a rental van and their family car to move themselves to their new home. The van averages 9 miles per gallon of gasoline and the family car averages 22 miles per gallon. If the distance between their old home and their new home is 792 miles, what if the total number of gallons of gasoline that will be needed for the two vehicles?

7. A charter bus company keeps track of gas usages and miles driven for all of its vehicles. One bus just completed a 585 mile trip on which it used 65 gallons of gas. What is its average gas mileage? (How many miles per gallon does this bus get?)

8. During the course of a 2,185 mile trip, the Coopers used 5 full tanks of gasoline. The gas tank of their car holds 23 gallons. What was their average gas mileage?

9. Last week, when Mr. Wyatt filled his car with gas the odometer reading was 8,572. When he next filled it, the reading was 8,832. If the car took 13 gallons of gas during the second fill-up (which means the car used 13 gallons between the fill-ups!), what was the car's average gas mileage between the fill-ups?

10. During a cross country trip the Johnson's accumulated 6 gasoline charge slips from all of their gas stops. These receipts showed that they bought 9.8, 16.5, 14.7, 17.1, 15.5 and 16.4 gallons of gas at these stops. If their car averages 21 miles per gallon, how many miles did they travel altogether?

11. The grand prize for a raffle at a town carnival was 40 free gallons of gasoline per month for the next year. If the winner's car averages 24 miles per gallon, how many miles of "free" driving did he win?

12. During the first week of a driving tour, the Bowden's traveled 2,120 miles on 85 gallons of gasoline. During the second week most of their driving was on back roads and they used 79 gallons of gasoline to travel 1,422 miles. Compute the gas mileage rate for each week of the trip and for the entire trip.

Mileage Word Problem Answer Key

Solution to Problem #1:

a. mpg x gallons = distance
   21 x 23 = D, where D represents the distance

b. The van can travel 483 miles on a full tank of gas.

Solution to Problem #2:

a. mpg x gallons = distance
   14 x 3 = D, where D represents the distance

b. He would be able to drive 42 miles on the three gallons of gasoline.

Solution to Problem #3:

a. mpg x gallons = distance (compact car)
   25 x 16 = C, where C represents the distance for the compact car
   mpg x gallons = distance (midsize car)
   21 x 20 = M, where M represents the distance for the midsize car

b. The compact car will travel 400 miles on the provided tank of gas and the midsize car will travel 420 miles, so the midsize car will go the furthest.

Solution to Problem #4:

a. mpg x gallons = distance
   19 x G = 893, where G represents the number of gallons needed
   G = 893 ÷ 19

b. this car would need 47 gallons of gas to go 893 miles.

Solution to Problem #5:

a. The distance traveled is given by the difference in the odometer readings:
   25,976 – 23,584 = 2,392
   mpg x gallons = distance
   23 x G = 2,392, where G represents the number of gallons
   G = 2,392 ÷ 23

b. The Jackson's used 104 gallons of gasoline for this trip.

Solution for Problem #6:

a. mpg x gallons = distance (rental van)
   9 x V = 792, where V represents the gallons used by the van
   mpg x gallons = distance (family car)
   22 x C = 792, where C represents the gallons used by the car
   V = 792 ÷ 9
   C = 792 ÷ 22

b. The van used 88 gallons of gas and the car used 36 gallons, for a total of 124 gallons.

Solution to Problem #7:

a. mpg x gallons = distance
   M x 65 = 585, where M represents the gas mileage
   M = 585 ÷ 65

b. the bus averages 9 miles per gallon.

Solution to Problem #8:

a. The number of gallons of gasoline used is given by 5 x 23 = 115. mpg x gallons = distance; where M represents the gas mileage

b. The Coopers' car averaged 19 miles per gallon of gasoline.

Solution to Problem #9:

a. It is necessary to determine how many miles Mr. Wyatt traveled between fill-ups.

b. Ending mileage-beginning mileage = miles traveled. 8832-8572 = 250 miles

c. M + gallons gas used = mpg 250/13 =
   19.23 mpg
   Mr. Wyatt's car averaged 19.23 mpg on his trip.

Solution to Problem #10:

a. 9.8 + 16.5 + 14.7 +17.1 + 15.5 + 16.4 = gallons of gas used = 90 gallons

b. The Johnson's car averages 21 miles per gallon.
   To compute the mileage for the entire trip it is necessary to determine the total number of miles traveled:
   Total distance = mpg x gallons = distance (for entire trip)
   21 x 90 = 1890 miles

Solution to Problem #11:

a. The total number of gallons of free gasoline is given by 40 x 12 (40 gallons per month for a full year)
   mpg x gallons = distance
   24 x 480 = D, where D represents the number of "free" miles

b. He won a total of 11,520 "free" miles.

Solution to Problem #12:

a. mpg x gallons = distance (first week)
   F x 85 = 2,210, where F represents the mileage for the first week
   mpg x gallons = distance (second week)
   S x 79 = 1,422, where S represents the mileage for the second week

   F = 2,210 ÷ 85

   S = 1,422 ÷ 79

b. The first week of the trip the car averaged 26 miles per gallon and the second week it averaged 18 miles per gallon.
To compute the mileage rate for the entire trip it is necessary to determine the total number of miles traveled and the total number of gallons used:
Total distance = 2,210 + 1,422 = 3,632
Total gas usage = 85 + 79 = 164
mpg x gallons = distance (for entire trip)
T x 164 = 3,632
T = 3,632 ÷ 164
The car averaged approximately 22.1 miles per gallon for the entire trip.

WHAT IS A RATIO?

Teacher Information Packet

- **A means of expressing a comparison between two values of the same unit**

  In a carton of eggs there were 9 white eggs and 3 brown eggs
  - The relationship between the number of white eggs compared to the number
  - of brown eggs could be stated as 9 to 3

- **Comparisons of this type are written in a specific way. It is called a RATIO.**

- **Ratios have at least three parts**
  - the first term
  - the colon to replace the word "to"
  - the second term

9 : 3

- **The order in which the terms appear is important.**
  - In the case of the eggs, if you want to represent white eggs to brown eggs, you need to write it: as 9:3 which means 9 white for every 3 brown
  - 3:9 would mean 3 white and 9 brown which would be incorrect.

  If there are six men and eight women, how would I write a ratio to show the relationship of men to women? Women to men?

  6 : 8
  8 : 6

- **Finding a UNIT RATE**

A rate shows a relationship between two quantities measured in different units. Rates are a commonly used type of ratio. A **unit rate** is the rate for one unit of a quantity. Examples of unit rates are miles per gallon, meters per second, and dollars per pound.

At a constant speed, it took Glenn 6 hours to drive 360 miles. How fast did he drive?

Write a ratio: $\frac{360 \text{ miles}}{6 \text{ hours}}$ Simplify: $\frac{360 \div 6}{6 \div 6} = \frac{60 \text{ miles}}{1 \text{ hour}}$

Answer: 60 miles per hour

- **Like fractions, ratios can be written in more than one way or PROPORTION**
  - FRACTIONS 1/2 2/4 3/6
    in each case you only have one out of every two pieces of the pie
  - RATIOS 9:3 3:1 6:2
    in each case the first term is three times as large as the second term.

JUST AS WE HAVE EQUIVALENT FRACTIONS WE CAN HAVE EQUIVALENT RATIOS, AND JUST AS WE CAN HAVE LOWEST TERMS IN FRACTIONS WE HAVE LOWEST TERMS IN RATIOS.

- **Different forms**

When beginning to work with ratios, one of the first things we should do is look at the various ways that a ratio can be written. For instance, we can write the first ratio discussed in the preceding paragraph as 6 to 8, 6:8, or 6/8. Because it is easier to manipulate for mathematical purposes, we will usually use the fraction form. For example, when written as a fraction, we can simplify it. Let's take a look at a sample question to illustrate this point:

James took his family to an all-you-can-pick apple farm. They picked two bushels of apples comprised of 110 red, 90 yellow, and 75 green. What is the ratio of red to yellow apples?

We know from the question above that the red apples equal 110 and the yellow apples equal 90. Therefore, we would write the ratio of red to yellow apples as 110/90.

When simplified to lowest terms, however, it is more easily understood or **11/9**

- **Ratios can be written in fraction form**

  Ratio of men to women = 6/8.

  This fraction can be reduced by dividing each number by 2 (lowest common denominator)

  6/8 = 3/4

- **The fraction for a ratio represents the relationship between the first and second terms.**
  - In the ratio 1:2 the first term is half of the second term or 1/2
  - To create an equivalent ratio in which the second term is known to be 8, you would multiply 8 by 1/2 to find the first term (4)
    How would I write an equivalent ratio for 2:3 that has a second term of 12?

    12 is 3 x 4 so you must multiply 2 by 4 to get 8:12

- **Preliminary Steps**

Sometimes ratio questions can be a little tricky. For instance, they might require a preliminary step before you can work with the ratio. Here's an example of this type of question.

There are 125 women and 75 men working at the Morris Shoe Factory. What is the ratio of women to the total workforce of the factory?

The question above does not tell us the number of the total workforce, but we can arrive at that number by adding the number of men and women together. Solving the problem, then, requires performing 3 steps:

1. First, we add the number of women and men together: 125 + 75 = 200
2. Then, we compare the number of women to the total workforce: 125/200
3. Finally, we reduce the ratio to lowest terms: 5/8

So, there are 5 women in every 8 people employed at the factory.

Now that you have the general idea, try these questions to practice the concepts:

John has gone deer hunting every fall for the last 10 years. During this time, he has gotten a deer every year. Of these 10 deer, 4 have been bucks. What is the ratio of bucks to does that John has shot?

Chicken must be cooked 25 minutes for every pound. How long does it take to cook a 6 pound chicken?

Carol uses 3 tomatoes for every 8 ounces of sauce. How much sauce can she make from 15 tomatoes?

How many tomatoes does Carol need to make 2 quarts of sauce?

Jim shares 12 donuts with the class. He gives the class 1 donut for every 3 he takes. How many donuts does the class get?

Alicia gives her oldest son 5 dollars for every 2 dollars she gives her youngest son. Alicia gave her oldest son 15 dollars. How much money did she give to her youngest son?

A large assembly plant has a ratio of 3 women for every 5 men employed there. If there are 750 men working at the plant, how many women work there? Which of the following expressions would show the correct answer?

3/5 = 750/w
3/5 = w/750
w/5 = w/750
3/8 = w/750
5/3 = w/750

CALCULATING MILES PER GALLON

Gas mileage means the number of miles a vehicle will travel on one gallon of gas.

1. Write down the odometer reading when the gas tank is filled up.
2. The next time the gas tank is filled, write down how many gallons of gas it takes.
3. Then write down the odometer reading again.
4. Subtract the first odometer reading (step 1) from the second odometer reading (step 3). This will tell you the number of miles traveled between the two fill-ups.
5. Divide the number of miles traveled (step 4) by the number of gallons of gas used (step 2). This number equals the gas mileage of your car.

Mileage Math

First fill up:

_____ = A
(odometer reading)

Second fill up:

_____ = B
(gallons of gas)

_____ = C
(odometer reading)

Formula

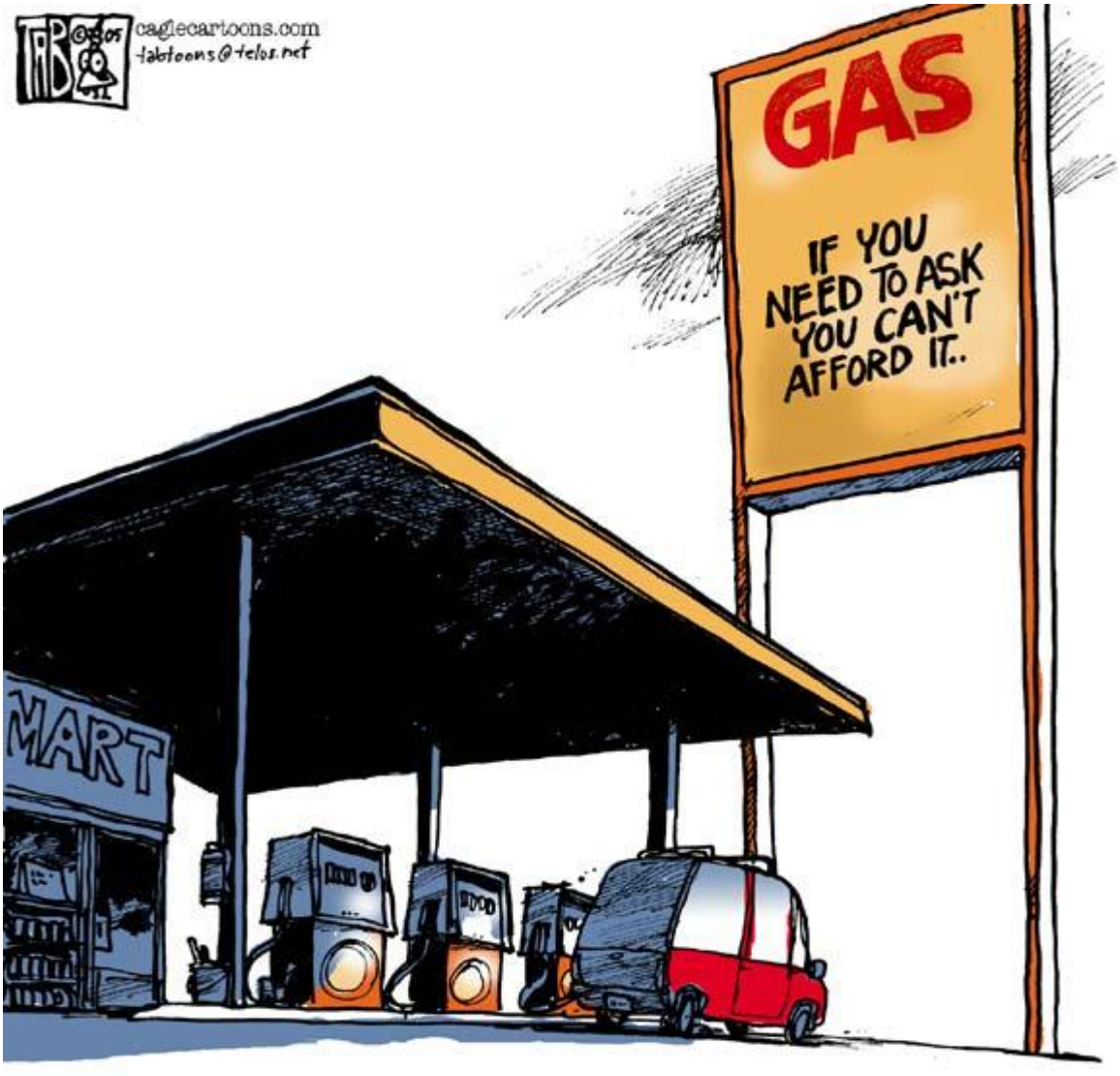
C – A = D (miles traveled)

D/B = MPG (miles per gallon)

http://www.wisconline.org

Understanding Political Cartoons
Author: Barbara Laedtke
School: Fox Valley Technical College **Date:** 4/22/2002
Description: In this interactive object, students follow a two-step process to unlock the meaning of political cartoons.
http://www.wisc-online.com/objects/index_tj.asp?objID=SOC102

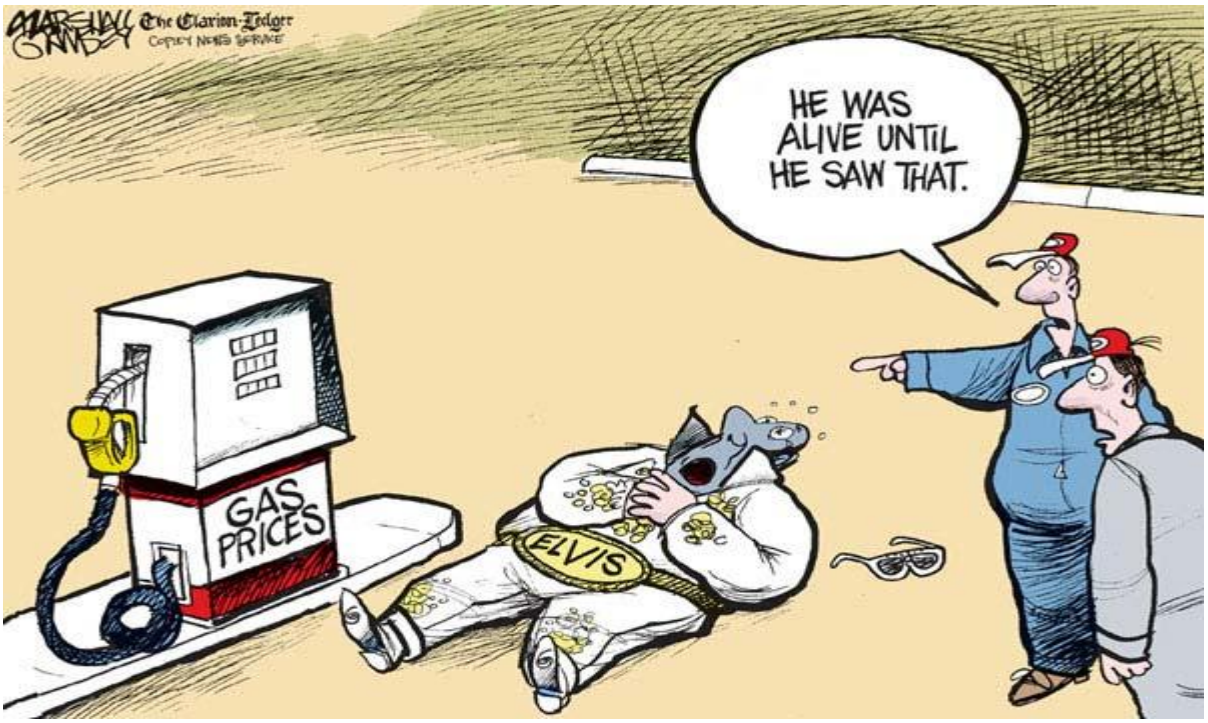

S.KELLY
THE TIMES-PICAYUNE
©2005
COME ON, WHEN I WAS YOUR AGE, I HAD TO WALK SIX MILES THROUGH SNOW TO GET TO SCHOOL...
SO, YOUR PARENTS COULDN'T AFFORD GAS EITHER...

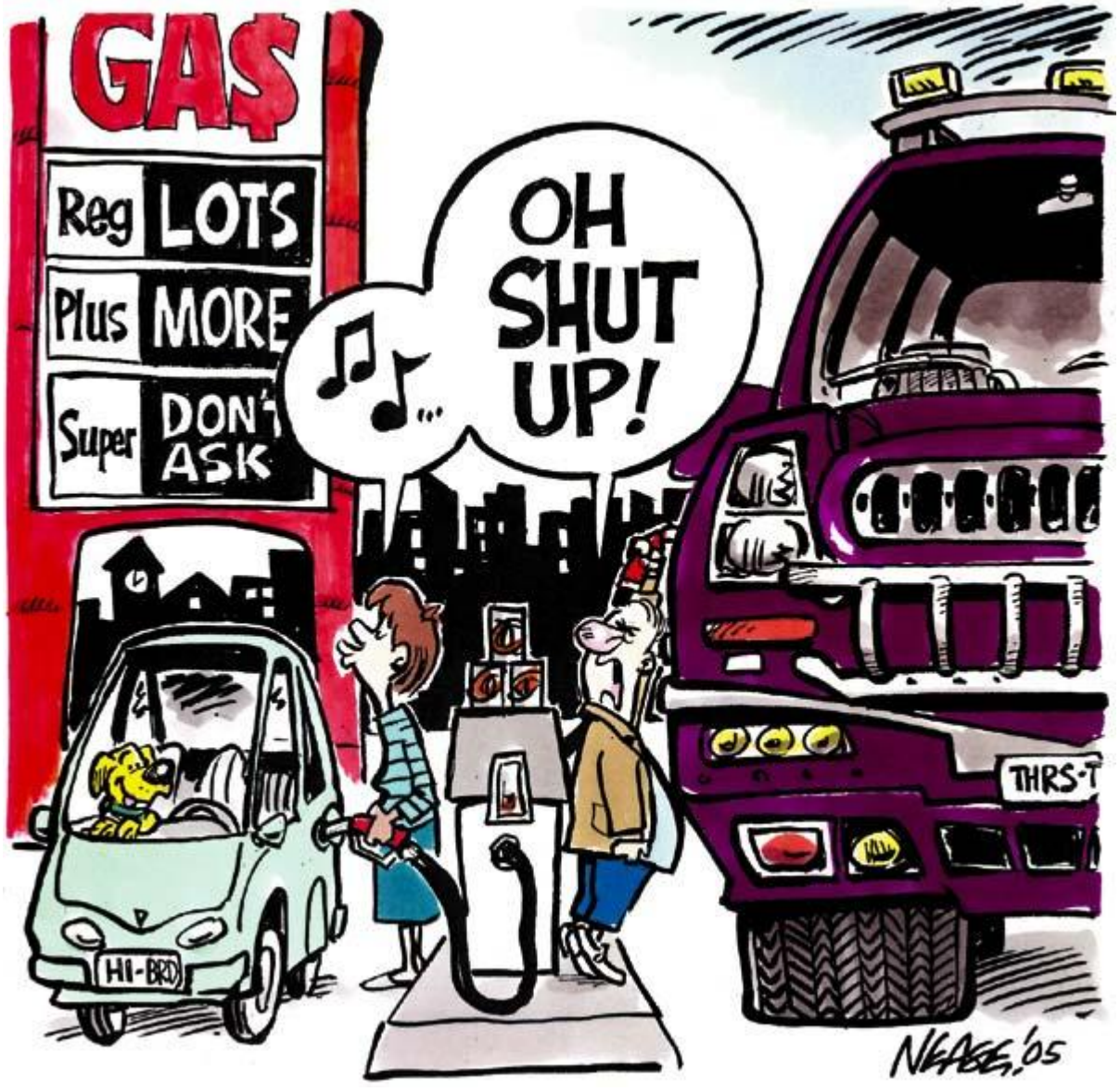

TRIB ©2005
caglecartoons.com
tabtoons@telus.net
GAS
IF YOU NEED TO ASK YOU CAN'T AFFORD IT..
MART


IT CAME WITH A LIVING WILL THAT SAYS IF GAS PRICES KEEP RISING TO THE POINT WHERE I CAN'T AFFORD TO DRIVE IT ANYMORE, SOMEBODY SHOULD JUST SHOOT ME.
©2005 LARRY WRIGHT THE DETROIT NEWS
caglecartoons.com


BACK IN 1952, GASOLINE COST 20 CENTS A GALLON.
WHEN YOU PULLED UP TO THE PUMPS, THREE GUYS CAME OUT AND CHECKED YOUR OIL AND YOUR TIRES AND CLEANED YOUR WINDOWS
THIS MUST BE THAT THING THEY CALL "SENILITY"


DERING
ARKANSAS DEMOCRAT-GAZETTE
THE NEXT ITEM IN OUR CATALOG IS A CAN of PREMIUM UNLEADED...
GAS


MARSHALL GRADY
The Clarion-Ledger
Copley News Service
HE WAS ALIVE UNTIL HE SAW THAT.
GAS PRICES
ELVIS


GA$
Reg LOTS
Plus MORE
Super DON'T ASK
OH SHUT UP!
HI-BRD
THRS-T
NEASE, '05


...AND WE'RE REGISTERED AT SHELL, MOBIL, BP AND TEXACO.
STAHLER.
©THE COLUMBUS DISPATCH · 2005