Assignment #1: Feedback and Circular Causality

(1) Recall the graph and loop diagram of U.S. residential per capital energy use (from USA Today, 3/23/09, "Consumers Can Sabotage Energy Conservation").

The map of feedback loops asserted there was one balancing loop and three reinforcing loops.

(a) Assign polarities (+ and – signs) to all the links in the figure below.

(b) Then verify that the four loops are labeled correctly, one balancing loop and three reinforcing loops.

(c) Pick one of the loops and tell the story the loop tells. Start wherever you think the story communicates best (or is easiest for you). It makes the most sense to tell the story with Per Capita Residential Energy Use increasing (as in the data), but your loop should also tell a sensible story if it were to decrease.
(2) Feedback loops in highway construction and traffic density.

(a) Highway construction loop

- Assign polarities to all the links.
- Identify the polarity of the feedback loop.
- Tell the story this loop tells.

(b) Migration loops (these assume that city workers would rather live out in the country than in the city if they could get to their city jobs quickly)

- Assign polarities to all the links.
- Identify the polarity of the two feedback loops.
- Tell the story each loop tells by itself.
(c) Now tell the story that all these loops together tell (see composite figure next page).

(3) A view of some feedback loops underlying the dynamics of terrorism and opposing efforts to suppress terrorist actions.
   - Draw separately three feedback loops passing through "Efforts to suppress terrorists." (There are actually six; just pick three you want to talk about.)
   - What are the polarities of your three loops?
   - What stories do those loops tell?
(4) A view of stocks and flows and feedback loops for gasoline in gas stations and vehicles in a gasoline shortage. There are three feedback loops passing through Purchase Rate and Gas in Stations (the solid lines).

- What are the polarities of these three loops? [Remember that the Purchase Rate *subtracts* from Gas in Stations, so there is a negative link implicit in the outflow pipe.]
- Describe the role of each of these three loops when gas is perceived to be in short supply.
- What is the effect of the two bold loops in a gasoline crisis?

(5) In Robert King Merton's famous article "The Self-Fulfilling Prophecy" (1948), the author describes dramatic feedback tendencies underlying the dynamics of prejudice.

...when the gentleman from Mississippi (a state which spends five times as much on the average white pupil as on the average Negro pupil) proclaims the essential inferiority of the Negro by pointing to the per capita ratio of physicians among Negroes as less than one-fourth that of whites, we are impressed more by his scrambled logic than by his profound prejudices.

Invent a feedback loop diagram that captures the thinking in this excerpt. What kind of loop(s) do you expect to find?

[Suggestion: Include in your diagram spending per black pupil, educational achievements of black students, number of black physicians, per capita ratio of physicians among blacks, per capita ratio of physicians among whites, and perception of]
"the inferiority of the Negro." Include if you like the some of the same variables for the white population.]

(6) In each of the following groups, identify a stock (an accumulation) and one or more related flows into or out of the stock. In each group assume there is just one important stock. Draw a stock-and-flow diagram.

Some of the words represent concepts that are neither stocks nor flows -- they are just information in the system. Show in a diagram like the one in question (4) how you think those other concepts in the group are related to the stock-and-flow sets you identify. [Suggestion: don't add any more concepts to these lists. Just deal with what's there in each one.]

(a) Highways, highway construction, traffic density  
(b) Births, deaths, population, fecundity, life span  
(c) Knowledge, learning, forgetting, intelligence  
(d) Deficit, debt, income, spending, interest payments on debt, payments on debt principle