## Connection to Characteristics of Complex Systems Project

**Lesson Title:**
*Modeling Dynamic Systems*, Section 6: News Articles

**Overview:**
*Modeling Dynamic Systems: Lessons for a First Course (3ʳᵈ Edition)* is a model-based curriculum developed by Diana Fisher.

**Related Characteristic(s) of Complex Systems:**
- Action is often ineffective due to application of low-leverage polices (treating the symptoms, not the problem).
- High-leverage policies are difficult to apply correctly.
- Could be others depending on topics chosen by students.

**Ideas and Examples for Connecting to the Characteristic:**
Section 6 of *Modeling Dynamic Systems* encourages teachers to assign a modeling project to their students. The class prepares by first practicing the modeling process together, using an article included in the book. Students then complete an independent study project using the same process but with a newspaper article of their choosing.

The newspaper article for the classroom example project discusses population growth trends in various countries and highlights how growth is slowing in some developing countries due to higher death rates rather than better education or family planning. The following ideas can help guide a classroom discussion about leverage in complex systems:

1. What is a "high leverage" policy? What is a low leverage policy? (High leverage policies involve a small change that produces a large effect due to aligning the goals of various parts of the system; low leverage policies seem to promise change but do not deliver due to compensating action from feedback in the system.)
2. What policies/laws can a government enact to affect birth rates within its borders? For example, if a country wants to proactively slow its own growth by lowering birth rates rather than experience high/increasing death rates, what choices does the government have? It may be helpful to brainstorm ideas first as a class, then allow students to research effectiveness of each using the internet. As a class, discuss the ones that are high leverage, i.e. effective at lowering birth rates. This can also be done for death rates.
3. What are some examples of population policies that real governments have attempted in the past or are currently imposing on their people? (China's one-child policy may be considered successful by some and unsuccessful by others; Romania under Ceausescu implemented a disastrous ban on abortions and severely restricted birth control in an attempt to raise birth rates.) Discuss implications of these real-world policies, including using force versus incentives.
4. For student projects, have students identify what policies may be effective in changing the problematic behavior they have modeled. Ask them if, in real life, it would be possible to actually implement their ideas as intended? If not, why not?

**Resource(s)**

*Modeling Dynamics Systems*, Diana Fisher, available here:
http://www.iseesystems.com/store/ModelingBook/default.aspx

Diana Fisher's website
http://www.ccmodelingsystems.com/

Article by Donella Meadows about Ceausescu and Decree No. 770
http://www.sustainer.org/dhm_archive/index.php?display_article=vn318cohort_of67ed

Wikipedia article about abortion in Romania
http://en.wikipedia.org/wiki/Abortion_in_Romania