BIOL 4961: Human Population
InsightMaker exercise: Footprint and Biocapacity
Feb 10-17  You must complete this exercise before you do Homework 3.

**Part 1: Nature**

Create a stock for renewable resources called [ecological capital].
Create a variable [Earth max]. Set it to 12 billion gha (12e9). Link it to [ecological capital].
Set the initial value of [ecological capital] to [Earth max].

Create a flow into [ecological capital] called [biocapacity], which is the rate of recovery of [ecological capital].

Create a flow out of [ecological capital], called [ecological footprint], in gha.

Create a converter called [regeneration]. Its input is [ecological capital]. It is linked to [biocapacity]. Set the output to be an inverted Holling’s response function Type 2, where [regeneration] reaches zero when [ecological capital] reaches [Earth max] and reaches 1 as [ecological capital] approaches zero.

Make a growth rate variable [max regen] and link it to [biocapacity]. Make it a slider from 0 to 0.10.

Make a variable [minimum capital]. Set it to 1 billion gha (1e9). Link it to [biocapacity]. This is the amount of the global ecosystem that we save, cannot use, or have no access to.

Set [biocapacity] to [max regen]*[regeneration]*Max([ecological capital],[minimum capital]).

Create a variable called [Impact], measured in gha. Make it a slider from zero to a value higher than the maximum value of [biocapacity]. Link it to [ecological footprint], and set [ecological footprint] to have the value [Impact].

Set all values to be non-negative by checking the box in the equation windows.

Simulate. Try different values of [Impact], [minimum capital], and the converter [regeneration].

**Part 2: People**

Create a stock called [people]. Set its initial value to 1 billion (1e9).

Create flows [birth] and [death].

Create variables [Affluence]. Create a variable [max affluence], slider from 0 to 5 in gha/person. Link [max affluence] to [Affluence]. Set [Affluence] to [max affluence] for now.

Create a converter [life expectancy]. Find data suggesting a relationship between life expectancy and [Affluence] and [life expectancy].

Create a variable [death rate]. Link it to [death]. Link [life expectancy] to it. Find a relationship between [life expectancy] and [death rate]. Write an equation in the equation window of [death rate] to express this relationship.

Set [death] to [death rate]*[people].

Simulate for 2000 years. Set the simulation to pause every 50 years. Use the slider to set [max affluence]. What happens at high affluence? Low affluence? At what [Affluence] is the population stable?

**Part 3: People and Nature**

You have made two separate models. But people are not separate from Nature. Create feedback between People and Nature using the I=PAT relationship.

Create a variable [Technology]. Make it a slider from 0 to 5.

Link [Technology], [Affluence] and [People] to [Impact]. Remove the slider and set [Impact] to [People]*[Affluence]*[Technology]. The units of [Impact] are gha.

Create a variable [rationing] and set its value to the maximum possible affluence given the [ecological capital], [Technology] and [People] by solving I=PAT for A. In this equation, impact (I), is assumed to be the maximum allowable impact that the planet can sustain while still leaving [minimum capital] behind. So it is therefore \( \frac{(\text{ecological capital})-(\text{minimum capital})}{(\text{People})\times(\text{Technology})} \). Make it non-negative. There will be other considerations, but we can change it later.

Link [rationing] to [Affluence]. Set [Affluence] to be the lesser of [max affluence] and [rationing].

Create monitoring variables in log-space for [People], [Impact], [ecological capital] and [biocapacity]. Name them as you wish.

Simulate. Monitor log-space variables for ecological capital, people, biocapacity and impact. On a separate display monitor [People]. Set additional displays as necessary or desired.

*Keep this model for use in Homework 3, in which you will be asked to add age demographics, carbon balance, and non-renewables! If you want to preserve the insight, clone it.*