Connected Systems in Food Production

One of the reasons why models are so useful in the sciences and social sciences, is that they allow us to very quickly articulate and tests experiments. Especially when we deal with topics that would otherwise be unethical or would take years or decades to do in the real world, models can help us understand the things we model, and help us make better decisions about them.

The purpose of this activity is to explore the relationship between different systems that all have to do with food production, and the consumption of food. We want you to work with the models, exploring these relationships, and use the data that the models produce, to understand how we can optimize each of the different systems individually, and optimize the system as a whole.

The three systems that this model contains are: first, the village model, which shows you the size of your current population, and the lake that your village is located next to. The second system is the food production model, in which you can buy or sell cows, put them out to graze so that they produce food, fertilize the grass, or plant forest. The third model shows you how much co2 is currently in your atmosphere, and calculates your current temperature.

The way in which food is produced is up to you: you can decide whether to use your land for grass, or for forest. You can decide how many cows you want on your field, and you can decide how much fertilizer to use. These decisions affect the other systems in various ways.

# Same rules as yesterday:

- The number of cows you own, and the amount of grass they eat, will determine how much food you produce.

- Cows do not reproduce  
- Forest binds co2.  
- The amount of co2 in the atmosphere, determines your temperature.  
- The temperature in your model affects how quickly grass grows back. There is a "sweet spot" at which grass grows back optimally quickly. Any temperature above or below that will make grass grow slower.  
- You can make grass grow back faster by using fertilizer.

# New Rules:

- The amount of food that you produce will affect how large your population can be

- Your human population reproduces   
- The larger your population, the more co2 it produces.  
- If you use too much fertilizer, your village’s water might get polluted.  
- Members of your population will die of old age.  
- The more polluted your water is, the more sick your population can get. This can cause people to die prematurely.

# Assignment: Optimizing your Population Size

## (please answer each question with 1-3 sentences)

**Your task today is to optimize your population size. Given what you have been told about the simulation, what do you think will be difficult about this? How is it different from yesterday?**

Type answer here:

**What information do you think is important in order to optimize your food production? Can you think of experiments that you want to run in the simulation to find this information?**

Type answer here:

**How will you optimize your food production? What exactly will you do in the model?**

Type answer here:

**Why do you think doing that will help you optimize your food production?**

Type answer here:

**What data would help you determine if you have optimized your food production? What would the shape of the graphs of these data points look like?**

Type answer here:

# Reflection on Data after run 1:

## (please answer each question with 1-3 sentences)

**What did you do, and how did it go?**

Type answer here:

**Did everything you did in the model work as expected? Were there any surprising consequences, or did something not work as well as you thought?**

Type answer here:

**Did you find the highest level for your population size? Could you optimize it even further? Please copy in graphs from your data in Excel that support your claims.**

Type answer here:

**Did you run any experiments this time? What were you trying to find out? Did you find an answer? Please copy in graphs from your data in Excel that support your claims.**

Type answer here:

**What will you do differently next time? What makes you think that this will result in a larger population?**

Type answer here:

# Reflection on Data after run 2:

## (please answer each question with 1-3 sentences)

**What did you do, and how did it go?**

Type answer here:

**Did everything you did in the model work as expected? Were there any surprising consequences, or did something not work as well as you thought?**

Type answer here:

**Did you find the highest level for your population size? Could you optimize it even further? Please copy in graphs from your data in Excel that support your claims.**

Type answer here:

**Did you run any experiments this time? What were you trying to find out? Did you find an answer? Please copy in graphs from your data in Excel that support your claims.**

Type answer here:

**What will you do differently next time? What makes you think that this will result in a larger population?**

Type answer here:

# Reflection on Data after run 3:

## (please answer each question with 1-3 sentences)

**What did you do, and how did it go?**

Type answer here:

**Did everything you did in the model work as expected? Were there any surprising consequences, or did something not work as well as you thought?**

Type answer here:

**Did you find the highest level for your population size? Could you optimize it even further? Please copy in graphs from your data in Excel that support your claims.**

Type answer here:

**Did you run any experiments this time? What were you trying to find out? Did you find an answer? Please copy in graphs from your data in Excel that support your claims.**

Type answer here:

**What will you do differently next time? What makes you think that this will result in a larger population?**

Type answer here:

# Reflection on Data after run 4:

## (please answer each question with 1-3 sentences)

**What did you do, and how did it go?**

Type answer here:

**Did everything you did in the model work as expected? Were there any surprising consequences, or did something not work as well as you thought?**

Type answer here:

**Did you find the highest level for your population size? Could you optimize it even further? Please copy in graphs from your data in Excel that support your claims.**

Type answer here:

**Did you run any experiments this time? What were you trying to find out? Did you find an answer? Please copy in graphs from your data in Excel that support your claims.**

Type answer here:

**What will you do differently next time? What makes you think that this will result in a larger population?**

Type answer here:

# Reflection on Data after run 5:

## (please answer each question with 1-3 sentences)

**What did you do, and how did it go?**

Type answer here:

**Did everything you did in the model work as expected? Were there any surprising consequences, or did something not work as well as you thought?**

Type answer here:

**Did you find the highest level for your population size? Could you optimize it even further? Please copy in graphs from your data in Excel that support your claims.**

Type answer here:

**Did you run any experiments this time? What were you trying to find out? Did you find an answer? Please copy in graphs from your data in Excel that support your claims.**

Type answer here:

**What will you do differently next time? What makes you think that this will result in a larger population?**

Type answer here: