**Farming Activity**  
*Teacher Handout*

Note: This activity is modified from a version presented as a part of the Farming and Biotechnology Module for "UNC DNA Day" created by Michelle Leslie, Mindy Roberts, and Rachel Liesman.

Divide the students into small groups and hand each group the worksheet of "Possible Gene Insertions." Introduce the following:

*It costs $2,000 - $2,500 per acre to produce a crop of potatoes. For a 100 acre field, a grower has invested up to $250,000 by the time his crop is sold.*

The students will choose three possible gene insertions/breeding selections from the sheet for their crop of sweet potatoes (Note: these modifications may or may not currently be available in sweet potatoes, but many are examples of real genetic modifications in a variety of crops).

Once all of the groups have decided on their three choices – hand out 15 "potatoes" to each group – these can be an object of any kind or printed out pictures of a sweet potato, etc (a sheet of these is attached):

Make sure you have a lot of extra to give to groups when they "gain" potatoes. Read out the attached scenarios – these will indicate whether the groups have gained or lost potatoes based on their choices (any "lost" potatoes should be returned to the pile of extras). At the end of the farming season, figure out who has won and or if anyone has lost their entire crop! This would be a good time to discuss what some of the positives and negatives of some of the insertions are and why choosing is such an important and challenging investment (and why some farmers opt out of genetic modifications entirely).
May: Planting

There is a late-season frost at the end of the May. If you did not choose the anti-freeze gene, you lose 3 potatoes.

The neighboring lettuce farmer offered to lease your fields to double his early summer lettuce crop. If you bought seed for potatoes for a shorter growing season, you are able to lease him your land and still plant your own sweet potato crop in late June. Add 4 potatoes.

June - September: Growth

It’s been a bad year for potato farmers. Many farms have been overtaken by caterpillars that eat anything green in sight. If you didn’t choose the Bt-modified potatoes, you lose 4 potatoes.

It’s been a very windy year, leading to greater amounts of weed seed dispersal. Weeds are threatening to overtake your farm, and you need to spray Round-up to get the problem under control. If you do not have Round-up ready sweet potatoes, lose 3 potatoes.

Your state is experiencing a severe drought. If you bought drought resistance sweet potatoes, add 5 potatoes.

Your farm has not been bothered by weeds, but your neighbor’s has been overrun with weeds. Your neighbor sprayed Round-up and it affected non Round-up ready plants on your farm. If you do not have Round-up ready sweet potatoes, lose 1 potato.

There is a root-knot nematode infestation on your farm. If you did not grow sweet potatoes that were resistant to the parasite, lose 3 potatoes.

There was no sweet potato virus disease this year in North Carolina. If you paid extra for SPVD-resistance potatoes, it didn’t pay off. Lose 1 potato.

October - January: Sales & Storage

Overseas sales of products with high levels of vitamin C skyrockets. You can double your asking price if you grew sweet potatoes with enhanced levels of vitamin C. This lets you buy more seed for next year. Add 3 potatoes.

A new report on the prevention of cancer came out indicating vitamin A as the most important component of a cancer-prevention diet. If you grew sweet potatoes with enhanced levels of B-carotene, the precursor for vitamin A, you can sell your potatoes at an increased profit. Add 3 potatoes.

High protein diets are back in vogue. If you are growing sweet potatoes with increased protein content, add 2 potatoes.

McDonalds has decided to sell sweet potato fries. As a mass food producer, they are only interested in getting as many fries per potato as possible. If you bred for increased size, add 3 potatoes.

Martha Stewart has come up with a new sweet potato dish to celebrate Memorial Day. Regular sweet potatoes only last until March. If you grew sweet potatoes that were bred for a longer shelf life, add 2 potatoes.

Ben & Jerry’s started to make sweet potato ice cream. If you are growing sweet potatoes with enhanced sweetness, they will pay double for your crop. Add 4 potatoes.

Blue sweet potatoes do not sell. Parents are concerned that the blue color is related to an outbreak of the vaccine-resistant measles. If you are growing blue sweet potatoes, lose 6 potatoes.
Possible Genetic Modifications

1. **Insertion of the antifreeze gene**: A gene is inserted that allows crops to survive very cold conditions, thus making the crops frost resistant.

2. **Bt sweet potatoes**: The gene encoding the protein Bt delta endotoxin from the bacterium *Bacillus thuringiensis* is inserted into the genome of the sweet potato, preventing crop damage by caterpillars that feed on the leafy portion of the plant.

3. **Roundup Ready sweet potatoes**: A gene encoding resistance to the chemical glyphosate, commercially known as ‘Roundup,’ allows plants to survive treatment with the Roundup herbicide.

4. **Enhancement of Vitamin C**: A gene encoding an enzyme in the GDP-L-GP pathway for vitamin C synthesis is inserted into the genome. These plants will make 10X more vitamin C than unmodified sweet potatoes.

5. **Enhancement of B-carotene**: B-carotene is a precursor of vitamin A and also has strong antioxidant properties and may help protect the body against certain cancers and other degenerative diseases.

6. **Increase in protein content**: Sweet potatoes were genetically engineered to express the soybean glycinin gene, resulting in an increase in overall protein content in each potato.

7. **Increase in size**: Sweet potatoes are selectively bred for increased size.

8. **Increase in shelf life**: Sweet potatoes with longer shelf lives are selectively bred. Grocers are able to sell this sweet potato for a longer period of time.

9. **Resistance to root-knot nematodes**: Sweet potatoes were selectively bred for resistance to the root-knot nematode, a worm that destroys the crop.

10. **Shorter growing season**: The normal sweet potato growing season requires 120 – 150 days and lasts from May to mid-September to October. Sweet potatoes modified to have a shorter growing season, requiring only 90 – 120 days and can be planted until late-June.

11. **Drought resistance**: Most sweet potato crops must be watered daily. Drought resistance sweet potatoes can grow in environments with less than optimal water conditions.

12. **More uniform color**: Most sweet potatoes have imperfections in skin color (i.e. mottled skin). These potatoes have been selectively bred to have uniform skin color.

13. **Increase in sweetness**: Sweet potatoes made even sweeter!!!

14. **Resistant to SPVD**: Sweet potato virus disease (SPVD) causes yearly loss of potato crops. Sweet potatoes were genetically modified to confer resistance to SPVD.

15. **Change in skin and flesh color to blue**: Sweet potatoes were selectively bred for a skin and flesh color with a blue tinge.