**Getting Started:** provide groups of students with a plot of land, based on Google maps. Each group would receive a different sized piece of property found in a different geographic region within the United States (could expand), each region representing different geophysical and ecological properties. Students would be required to begin investigating this region as the first unit of study, ecology, got underway.

1. **Ecology** – after the students have had some training in basic ecological principles they would be introduced to this project and would first consider the land area each group has been given. The students would need to consider a number of environmental factors to help them determine what cattle-based business might be possible on the land.
   1. Look at the land area:
      1. is it arid or wet? What type of vegetation is native to the region? Does the region support grazing materials that would sustain a herd of animals?
      2. what is the general layout of the land? Are there steep slopes or rolling hills? Are hooved mammals going to cause a degradation of the land itself? What is the likelihood of losing grazing area to phenomena such as slumping?
      3. do the animals have direct access to water? Is this water system stream based or is it standing water? In either case what measures would the land manager have to consider to prevent land wasting in the riparian areas?
      4. characterize the prevailing weather –will the land manager/owner have to consider special types of cattle that can handle a wide range of weather conditions? Can they handle severe inclement weather or deep, sustained snowfall?
   2. Is the type of farming/ranching under consideration *sustainable* based on the ecology of the land mass under consideration?
   3. Look at the varieties of cattle available. Which type of cattle would be most suitable to the land area? Are some varieties of cattle better suited? What factors might you have to consider?
      1. Are the animals considered easy keepers? That is, can the animals get along on their own with little to no regular human intervention?
         1. Can the cattle under consideration calve without help?
         2. Do the cattle under consideration do well on the type of vegetation available? Does the vegetation provide adequate nutritional value for the animals to flourish?
         3. Will the animals produce a coat that will protect them from the weather that is expected in the region or do the animals need shelter during adverse weather conditions?
         4. Will the cattle be able to gain the water needed naturally or will water supplementation have to be arranged?
      2. How will the land manager/owner be able to access the animals given the land area?
         1. Is this a huge tract of land that will require moving cattle?
         2. Will the animals be herded on a daily basis from one area to another allowing the farmer ready access to his/her animals?

Unit 2 would be based on economics and would attempt to demonstrate for students that working within the ecological context has a cost but that that cost is not only necessary but can reap long term benefits if we work with the land and the region rather than against it.

1. **Economics:** Provide each group of students with *economic constraints/considerations*.
   1. Is the land, family owned or leased or a combination of both?
      1. What factors influence this decision?
   2. What equipment will be necessary to maintain this business? If so, how will the purchase of this equipment (and the cost of maintaining some of this technologically advanced equipment) be financed.
   3. Will government loans or subsidies have to be utilized to make this business plausible?
   4. How will the products be handled?
      1. Sanitation: consider the basics
         1. Dairy – requires heavily monitored procedures for ensuring bacterial contamination, milking and milk-holding equipment
         2. Beef – how will cattle be brought to slaughter?
         3. How will nitrogenous wastes be managed? Will a waste lagoon be needed? If so, consider the environmental regulations necessary.
         4. How will solid waste be managed?
         5. Death & disease – if something should happen, how will carcasses be disposed of?
   5. Consider the cost of maintaining the livestock itself?
      1. Vaccinations?
      2. Cost of the feed; will you have to feed through the winter? What type of feed would be needed and what is the cost of acquiring and shipping that feed? Do you have the potential to grow viable food stocks within your own property?
   6. What is the cost of producing *more animals* as the animals you have age and/or become less productive?
      1. Will you just buy more animals?
      2. Will you be a calf producing farm?
      3. If you plan to produce calves will you consider breeding calves that will be better suited to the environment you are constrained by? If so – where will the breed stock be selected from and how expensive will it be to
         1. Breed your cow(s) to the desired bull or will you purchase a bull?
         2. How will you ensure the proper cow(s) are bred?

Unit 3 would involve the genetics of cattle and how the genetic factors might be used by an educated farmer to produce a herd that is best capable of not only surviving in the environment the land owners are dealing with but will thrive there and maximize the farmers investment. Students will be familiar with Mendelian genetics, the concepts of co-dominance, incomplete dominance, and sex-linked traits as well as being able to calculate the probability of inheriting multiple traits during the same breeding. This unit could be done before or without the benefit of the economic unit but would be best suited to use *after* the environmental unit was complete.

1. **Genetics:** this unit would require a different approach than the previous two units. Students would have likely made some decisions by this point as to what type of farming, beef cattle or dairy, their land and operation seems most suitable for. Given that decision students would have to begin investigating the primary characteristics whose inheritance patterns are at least fairly well documented and understood.

Students would be expected to consider the traits or characteristics each breed is known for and balance that feature with the environmental conditions that typify the region.

For example: consider the following traits:

1. hooves – hardy or do they require trimming?
2. coat – can it provide protection from winter conditions as well as insects and heat in summer?
3. nutrition – will the animals thrive on the native vegetation or will supplementation be required to keep the animals in prime health?
4. calving – does the breed under consideration produce viable weight calves?
   1. are these animals able to calve under natural conditions without assistance?
   2. do calves need to be brought in for protection?

And then consider the land relative to those traits:

1. terrain – is it rocky, rough, dry or wet? What influence will this have on hooves?
2. prevailing weather – what is the range of temperatures the animals will have to endure? Is it very warm in the summer months and very cold in the winter? Will the animal’s coat type provide the protection and insulation needed?
3. vegetation – will the vegetation sustain the animals? How quickly does the vegetation become overgrazed and how readily does it regrow? How many animals can the vegetation support without loss of grazing land due to slumping, erosion, and other forms of land wasting?

To summarize the entire study – ‘What is a farmer?’ and ‘What Can You Do With What You’ve Got’ student groups would have to present their decisions to the class and be able to qualify those decisions based on principles and research.

Each student group would be asked to take what they have learned about the ecology of the region in which their plot of land is located and provide a logical ‘farm plan’ that reviews all the salient points relative to the type of farming the group chooses to support.