



# A Dairy lesson: What to do with all that...waste!

This Project begins with a **challenge** to design a way to dispose of the manure produced by cows in a dairy farm. First you will **explore** ways in which farmers currently dispose of this waste. You will familiarize yourself with on site disposal methods, anaerobic digesters in Rutland, MA or Barstow's Longview Farm, MA. What other options do farmers have to manage the waste? Learn the pros and cons of the various methods and discuss with farmers some of the issues they find most pressing when dealing with waste management. From this information and research students will be asked to **create** and test a new method for waste disposal. **Share** your idea with colleagues and the farmer in an Elevator Pitch. Convince the farmer and other Environmental Engineers that your solution is the best.

**Goal:** To create and test a novel waste disposal method for cow manure

**Role:** Environmental Engineer consultant that have been asked to come up with the solution to the overflow of waste in the farm with data to back it up

**Audience:** You need to pitch your idea to the farmer and convince the farmer that your solution is ideal to solve the problem by your

**Product/Performance and Purpose:** You will need to develop and test a new method for waste disposal that is environmentally sound and from which the farmer can generate a source of income. After all this is material can be recycled and made into various products!

**Standards & Criteria for Success:** Your work will be judged by your consulting firm and the farmer. Your proposal will compete with other environmental companies. The idea that is

-  most environmentally conscious
-  with real application to the farm
-  financially advantageous
-  the one that reduces most waste will be the chosen to win the contract (backed up by data).

Some Resources:

Waste to fuel <http://www.truckinginfo.com/article/story/2011/10/dairy-operation-to-recycle-natural-waste-of-cows-into-fuel-for-delivery-vehicles.aspx>

Anaerobic Digester: <http://www.barstowslongviewfarm.com/anaerobic-digester/>  
<http://www.cetonline.org/cow-power-tour-massachusetts-anaerobic-digester/>

Other ideas:

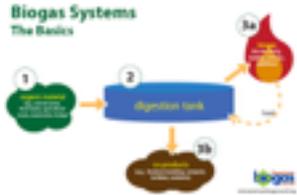
Cattle bedding: <https://www.youtube.com/watch?v=Mj5ci91xWqY>

Fertilizer/composting: <https://www.youtube.com/watch?v=Ki4vnDEprdg>

Listen to some of this ideas and create your own experiment to test your own ideas.

# Explore

## Current disposal methods for farmers

Method	Pros	Cons	Information source
<p><b>Anaerobic Digesters</b>            “is a series of biological processes in which microorganisms break down biodegradable material in the absence of oxygen. One of the end products is biogas, which is combusted to generate electricity and heat, or can be processed into renewable natural gas and transportation fuels.”</p>	<p>Makes electricity cheaper for the farmer            source of income for the farmer</p>	<p>Some waste still present and hard to get rid off due to transportation and amounts produced that varies with season (more in winter due to frozen ground)            Start cost is high</p>	<p><a href="https://www.americanbiogasouncil.org/images/genericDigestionProcess.gif">https://www.americanbiogasouncil.org/images/genericDigestionProcess.gif</a></p>  <p>The diagram, titled "Biogas Systems The Basics", illustrates a four-step process: 1. Agricultural waste (represented by a green pile) is fed into 2. a digester tank (blue cylinder). From the tank, 3. biogas (represented by a red flame) is produced and used for energy, and 4. digestate (represented by a brown pile) is returned to the agricultural field. The logo for "biogas" is visible in the bottom right corner of the diagram.</p>

# Interview with a farmer

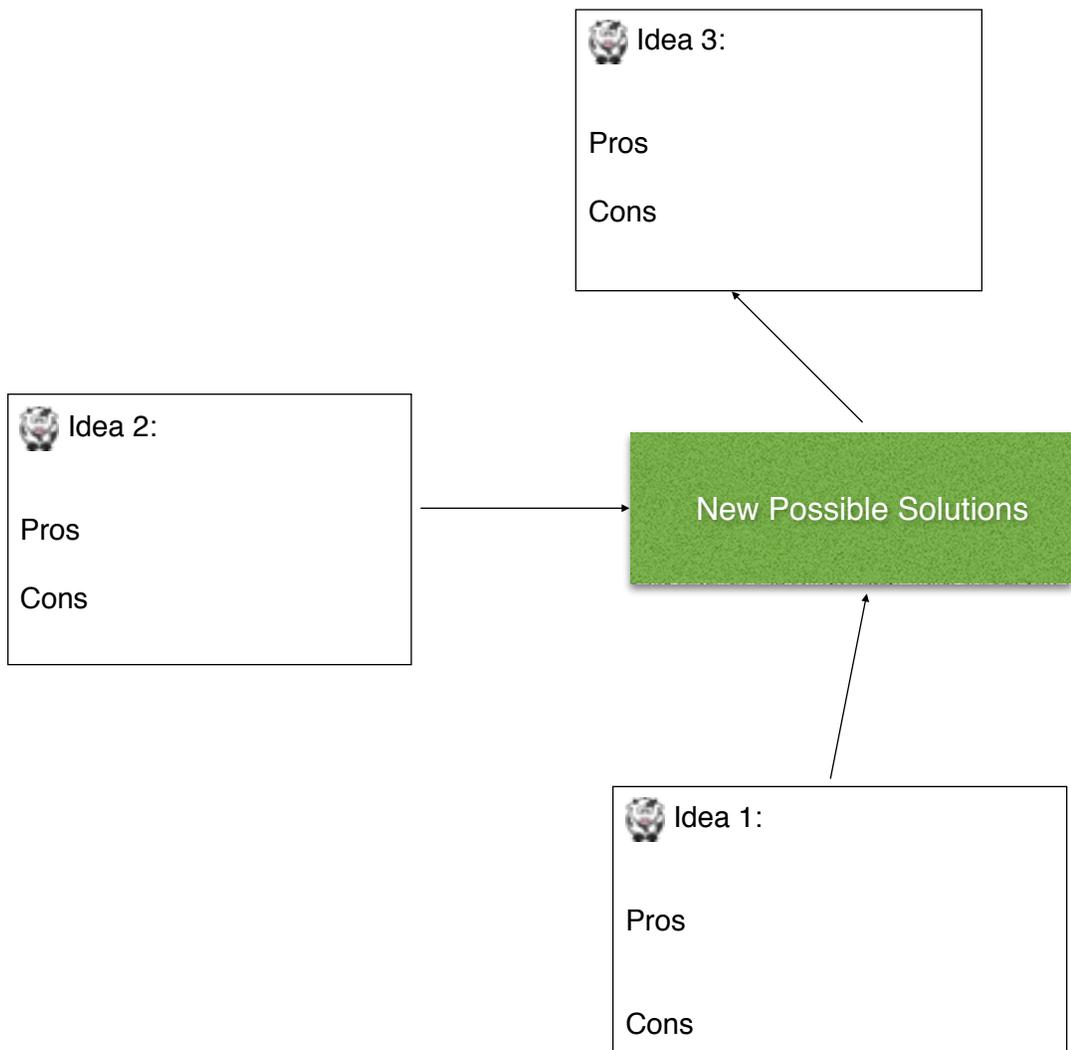
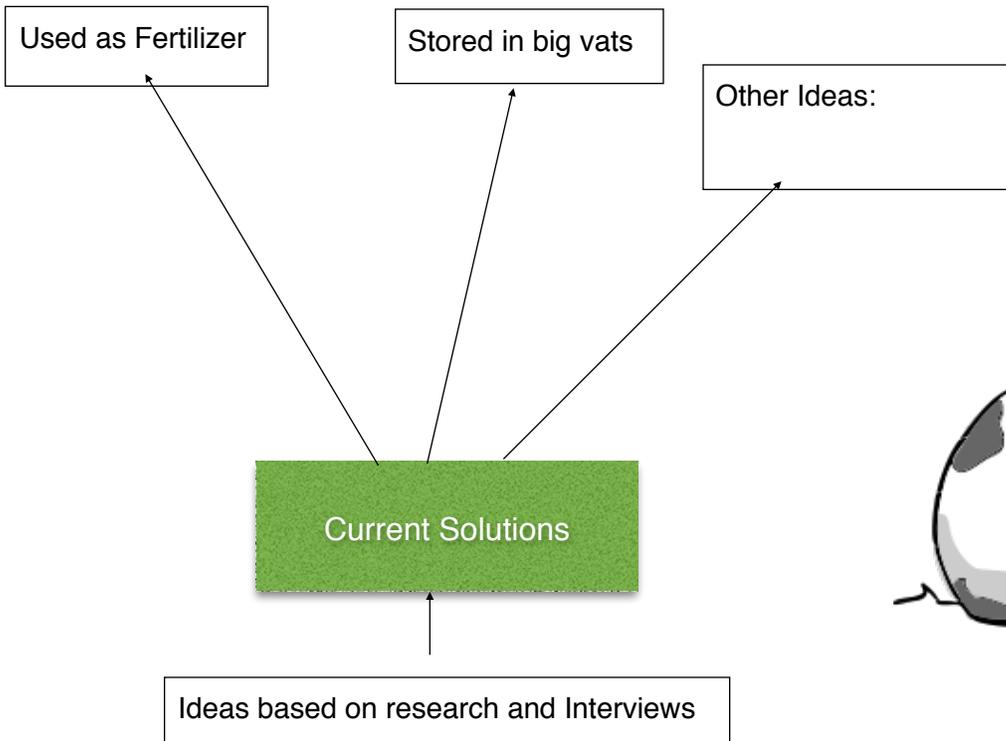
This interview can be done on site, on line, email, FaceTime, etc.

1. Farmer's Name:

Notes (methods, problems, ideas):

2. Farmer's Name:

Notes (methods, problems, ideas):



# Research

1. Choose the best idea and come up with an experiment to gather some data to figure out if your idea is worth trying

For example: Tests ways to dispose of the excess waste from the anaerobic digester. Figure out ways to distribute among other businesses and calculate how much distribution would cost. Or figure to a way to use different types of waist more effectively in the digester. What would be the best proportion of waist from restaurants, fat, manure, etc? How pH changes with the various types of waist and how those changes affect the anaerobic bacteria efficiency or growth?

2. Determine what is the problem you are interested in solving.

The problem to be solve is \_\_\_\_\_

3. State a testable possible solution or hypothesis based on your background research/knowledge

Hypothesis: \_\_\_\_\_

4. What are the controls and variable(s) in your experiment

Control(s):

Variable(s):

5. Explain in detail how your experiment will be conducted. Remember to use scientific method and instructions that specify amounts (in g, Kg, cm,M, etc), specific brands used for materials. Also, be specific with the amounts of time use for the experiment and if you timed reactions in sec, min., hrs, days). Be detailed and precise. Remember to repeat the same experiment at least three times and aggregate (average) the data.

6. What data are you going to collect? Create a data table before you start the experiment. (include measurements in metric system).

7. Write observations that include quantitative and qualitative data/information.

8. Results: Explain what the data shows. Use the T table shown here to organize your thoughts.

Observation	Evidence
Example:More lipids helps anaerobic digestion	Example:There is 10% increase in methane production when lipids increased

9. Conclusions: Is your hypothesis correct? what data specifically indicates or proves your conclusions. Use your background information to help with this analysis.

Does your data support your hypothesis. Prove it by citing valid data from your experiment!

# Create

Armed with your idea, research and experimentation create a sketch, drawing or 3D picture of your new waste disposal method. Make sure to label all the parts, suggest materials to be used and do the cost analysis.

**Sketch with labels**



