Dairy Digester Scavenger Hunt and Observations

Grades 8-12

As you virtually travel through SMUD's dairy digester tour at **smud.org/DairyDigester**, please click on all of the additional information and video link buttons and don't forget you can always press the back arrow to review a topic or hit the pause button to have time to make an observation or write it down.

Take the time as you visit the dairy digester to answer questions and write down observations. You may have to do additional research to answer the Bonus questions.

Are you ready to find out how SMUD, MAAS Energy and New Hope Dairy are working on creating a clean, carbon free future?

Let's get mooving!

What is California's number #1 agricultural product? _____

How much does the dairy industry contribute every year to California's economy? _____

Approximately how many cows live in Sacramento county? _____

Each dairy cow produces _____ tons of poop a year. How many pounds of poop does that equate to every day? _____

What has cow poop traditionally been used for in the past? What is the downside to this use?

_____

What is the harmful, greenhouse gas which is associated with cow poop? _____

Cows make up about _____ of this gas's emissions in California.

This video shows that through partnerships between SMUD, _____ and _____ we can capture methane to fight global warming and meet SMUD's zero carbon goals by 2030.

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Life at New Hope Dairy

What is the name of the dairy farmer? _____

From which country did the dairy family emigrate? _____

Bonus - Who are some of the other immigrant groups who started dairy farms in the state of California?

What time of day does work start on the family farm? _____ Can you ever take a day off at a dairy farm? _____

What are the **three** main operations which happen on the dairy farm?

1.

2.

3.

How is the type of feed given to a cow categorized? Why is this important?

How many pounds of feed does a dairy cow eat each day _____ in order to produce _____ gallons of milk. How many gallons of milk does each cow produce each year? _____

Name **four** types of feed typically given to dairy cows.

1.

2.

3.

4.

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Why does alfalfa and other grasses require for fermentation?

Bonus - Diagram this process with a chemical equation sketch.
Draw a simple diagram of a free stall barn. How are the cows positioned? Where is their feed? Where does their manure go? What's the most interesting thing you learned about the cow's life in the free style barn?

How many times a day is a cow milked?

In a few words, describe the milking process that you observed.

Why is it important to disinfect the cow's udders prior to milking?

What are some of the methods used to keep the cows happy?

The dairy digester process

The dairy farmer partners with Maas Energy who installed a digester to make electricity for SMUD customers.
Every dairy cow makes about how many pounds of manure every year? _____
Bonus – Can you figure out how many pounds of poop a cow produces every day?

As the manure breaks down it produces what kind of gas which is harmful to the environment as a greenhouse gas. _____

What are the **four** major steps to turning cow waste into renewable power?

1.

2.

3.

4.

What are **two** ways in which cows produce methane gas?

1.

2.

Define methane.

Bonus – Sketch the methane molecule.

Why is methane a harmful greenhouse gas?

What is the system called which takes the manure down to the central pit?

What organism is actually releasing the methane gas in the poop?

Collecting poop

What is the system called which collects the poop into a central area?

Approximately, how many times a day is the poop collected?

How can you tell visually that methane gas is being released?

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In a collection pit, the manure starts breaking down. What is the organism which eats the poop and actually causes the really bad smell?

There isn't very much oxygen in the poop mixture so the methane is being released without oxygen. What is this process called?

Bonus - Sketch this process with the chemical structure.

Separator

Name some of the solids which need to be removed from the liquid waste.

How are the solids removed?

How are any remaining bacteria killed in the solids which are removed? How are the final solids useful?

Covered lagoon

The liquids are moved from the separator into the covered lagoon.

Describe the lagoon.

Approximately, how many days does it take for the microorganisms to break down the manure to release methane?

Why does the trap over the lagoon bubble up?

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What kind of energy is the methane considered while it stored under the tarp? Potential or kinetic?

What is your most interesting observation of the covered lagoon?

The engine

How is the methane created by the dairy digester different from ordinary methane?

What needs to be removed from the biogas?

What is the last step to get the gas ready for burning?

Like any other engine, the burning gas pumps the pistons, spinning an alternator to create _____.

Does the engine produce emissions? What are they?

How is the production of emissions and release into the atmosphere mitigated?

Bonus - How much of SMUD's energy mix is derived from biogas?

Recall some observations of dairy farmer, Arlin Van Groningen.

Recall some observations of MAAS Energy expert, Doug Bryant.

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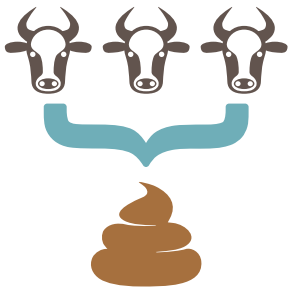
Career path

What are some of the career paths mentioned on the video either mentioned by Arlin or Bryant or interpreted from your observations of the transformation of cow manure to energy? Think of all the steps and processes and who is needed to support this energy production. Challenge yourself to discover 30 jobs.



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If you enjoyed your learning experience of transforming cow poop to energy, you may enjoy these videos:

Digital resources

How to turn poop into power.
https://www.youtube.com/watch?v=iAZdg969mww

How to make energy from cow poop – by kids
https://www.calacademy.org/educators/renewable-energy-powered-by-poop

How about other kinds of poo?
https://www.youtube.com/watch?v=yh-67zu-kx4

The chemistry and problem of methane – BBC
https://www.science.org.au/curious/earth-environment/methane

Anerobic vs. aerobic and fermentation
https://www.youtube.com/watch?v=YbdkbCU20_M

What about pig poop?
https://www.youtube.com/watch?v=iAZdg969mww

Going beyond poop – how to turn trash into cash
https://www.youtube.com/watch?v=8GQIrTTXyg4

Biogas – Helping a village reduce waste, disease, and turn indoor pollution into electricity
https://www.youtube.com/watch?v=Ey8nEPqhkhE

How to make your own microbiocidal fuel cell
https://www.labroots.com/trending/earth-and-the-environment/6010/methane-electricity-bacteria

MAAS Energy Works
https://www.maasenergy.com/

Using waste in a circular economy
https://www.youtube.com/watch?v=hEFqcqOWSWw If

Methane – the Chemical
https://energyeducation.ca/encyclopedia/Methane

Explore Clean Energy Careers
https://www.energy.gov/eere/education/explore-clean-energy-careers-0

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