PURDUE EXTENSION

Livestock-Maker Science Experiments

Makerspaces are zones of self-directed learning. Their hands-on character, coupled with the tools and raw materials that support invention, provide the ultimate workshop for the tinkerer and the perfect educational space for individuals who learn best by doing. There are no set instructions, just materials to have fun, invent and create something new while learning about Science! This Livestock-Maker packet is meant to introduce the Maker Movement to the livestock project areas while also highlighting the idea that youth need to make discoveries on their own.

Included in this packet are 6 lesson plans would be perfect to use as the basis for a STEM in Livestock SPARK Club as it provides educational content to meet the 6-hour requirement. This is a great way to engage non-traditional audiences that are interested in animals but do not have access to live animals. But they are also great to use with traditional animal youth in 4-H club meetings and livestock workshops individually or as a series. In each lesson, the leader is encouraged to not give too much instructions or directions. The goal is for youth to make discoveries for themselves without being told the right answer or the right way to accomplish a certain task. Their idea might fail the first time, and that is okay. They learn through these failures how to improve their ideas and make it better the next time. Think of this as the Trial and Error method. Additionally, do not feel constrained by the species used as the example in each lesson. Feel free to tailor each activity to fit the species of interest of the targeted audience.

Livestock-Maker lessons include:

- Animal By-Products
- Animal Roundup
- Hay Storage Facility
- Livestock Working Facility
- Preventing Disease
- Transporting Corn

Have fun incorporating more STEM related topics in your 4-H Livestock Programming!

Livestock-Makers Science Experiment: Animal By-Products

Scenario:
There are many by-products of animal production that many people would consider to be wastes. These products are not really wastes, they are resources that have a use somewhere else. This includes manure (fertilizer, feed for chickens), by-product feeds (corn gluten feed, soybean hulls, cottonseed hulls) and animal organs/bones/hooves (medicine, soap, camera film). All of these by-products are an important part of the livestock industry and even everyday life.

Supplies: (These materials are suggestions, almost anything could be used.)

- **Empty Plastic Bottles**
- **Paper Towel and Toilet Paper Tubes**
- **Disposable Pie Tins**
- **Newspapers and Magazines**
- **Empty Egg Cartons**
- **Glue**
- **Masking and Scotch Tape**
- **Scissors**

Expected Time: 30 minutes

What to Do:

1. Split the youth into groups of 3-4 and explain that they will be creating new uses for these by-products. Allow the youth time to discuss the items with each other, including what the items were initially intended for and how they think they can use these materials for another use.
2. Give youth approximately 20-25 minutes to experiment with creating new uses and products for the recycled materials. *(Very little instruction is given by the instructor during this time. The goal is for participants to work together and be creative using their own skills and background knowledge.)*
3. Give each group time to share how they created their new products and how they can be used in the future.

Reflect:

1. How did your group work together to create your new product?
2. Did you have difficulties getting your group to agree on a new product or use for your materials?
3. What do inventors need to do in order to create a product that will be used by consumers?
4. What did you learn about the process of inventing a new product?

Apply:
Are you surprised that there are animal products in camera film? What about chewing gum? The famous saying "One Person's Trash is Another Person's Treasure" can be very true. Think about times in your life when you have thrown something away. *How could you have used the product in a different way? What other products can you think of that are reused or recycled for a different purpose? How does using these animal by-products affect a farmer's production costs?*

PURDUE EXTENSION | LOCAL FACES COUNTLESS CONNECTIONS

Livestock-Makers Science Experiment: Animal Round-up

Scenario:
Animals see their surroundings much different than people. For example, cattle have an almost 300-degree field of vision. Because of this, they have poor depth perception (will not walk over a shadow). It is important to understand their point of balance (shoulder) and flight zone (personal space) to move cattle in a stress-free way. Narrow alleys, solid panels and avoiding loud noises, sudden movements and sharp turns are also important.

Supplies: (These materials are suggestions, almost anything could be used.)

- **HEXBUG Nano Robots** (https://www.hexbug.com/nano/hexbug-nano-nitro-five-pack.html)
- **Cardboard**
- **Paper Straws**
- **PVC Pipe**
- **Craft Sticks**
- **Index Cards**
- **Tape**
- **Scissors**

Expected Time: 30 – 45 minutes

What to Do:

1. Split the youth into groups of 3-4 and explain to them that they will be designing a system to get weaned calves from a pasture to the barn with 3-4 HEXBUGS as the calves. The distance from pasture to the designated barn area should be at least 2 feet. Allow youth time to discuss cattle movement and what they know about it, then they should sketch out their plan.
2. Give youth approximately 20-25 minutes to design their system. *(Very little instruction is given by the instructor during this time. The goal is for participants to work together and be creative using their own skills and background knowledge.)*
3. After the design session, it is time for the competition! Each group will explain their design, and then turn the calves loose. Record the number of calves and the time it takes for the calves to reach the barn. The group with the most calves in the barn in the least time will be declared the winner.

Reflect:

1. Did the number of turns in your system impact the time it took for the calves to make it to the barn?
2. Did you have to add anything to your design to keep the calves contained?
3. What worked the best at keeping the calves moving forward?
4. Why do you think farmers put up fences on their farms?

Apply:
Have you ever moved a group of calves? Was it difficult? Did you learn anything in this activity that will help you do it better in the future? Robots and computer systems are commonly used on farms. Did you know that robots are being used to milk dairy cows? *In what ways do you think robots and computer systems can be used in the future of animal agriculture? Is it possible to use robots to round-up animals?*

PURDUE EXTENSION | LOCAL FACES COUNTLESS CONNECTIONS

Facilitator Note: This activity can easily be modified to include examples of goats, sheep, swine, llamas, horses, dogs and cats.

Livestock-Makers Science Experiment:
Hay Storage Facility

Scenario:
Hay is the predominant winter feed for beef cattle, sheep and goats. Losses due to weather damage can range from 10-30% for hay not stored in a barn. Storing hay in a barn can significantly decrease the production costs for livestock producers. Important considerations for hay barns include complete protection from the weather, minimizing access to pests, storage capacity and a firm foundation.

Supplies: (These materials are suggestions, almost anything could be used.)

- **Cotton Swabs**
- **Paper Plates**
- **Straws**
- **Index Cards**
- **Craft Sticks**
- **Masking Tape**

Expected Time: 30 minutes

What to Do:

1. Explain to the youth that they will be designing a hay barn that will hold as much hay as possible, minimizes losses due to weather/pests and has a firm foundation. Allow youth time to discuss hay barns and what they know about them, then they should sketch out their plan.
2. Split the youth into groups of 3-4 of various age and ability levels and explain the various materials they can use to build a structure.
3. Give youth approximately 20-25 minutes to build a hay barn using the materials on hand. *(Very little instruction is given by the instructor during this time. The goal is for participants to work together and be creative using their own skills and background knowledge.)*
4. At the end of the design session, it is time for the competition! Each group will explain their hay barn design. You should apply a little pressure to the top with your to make sure it will has a firm foundation. The biggest barn that does not collapse will be declared the winner.

Reflect:

1. How did your group work together to create your barn?
2. Did you have difficulties getting your barn to stand up?
3. What does a building need in order to stand? (a firm foundation)

Apply:
What did you know about hay barns before this activity? What did you learn about hay barns and buildings in general through this activity? Even though buildings can look very different, they can have very similar purposes and the good ones have a firm foundation. As you go out into the world, take the time to look at the buildings around you. *How long do you think it takes to plan and build a hay barn in real life?*

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Livestock-Makers Science Experiment: Livestock Working Facility

Scenario:
Proper animal restraint is one of the most important parts of the humane care of animals. Large animals like beef and dairy cattle, require a working facility consisting of panels and gates that form holding pens and alleyways that allow for the low stress movement through the facility. Important considerations include solid panels, narrow alleyways to prevent turning around and gates that work to funnel the animals from the holding pens to the alleyway.

Supplies:

- **3D Printing Pens**
  - Recommended Pens: Intelligent 3D Pen, Amazing Pagreberya V3 3D Drawing Pen for Kids
- **3D Printing Pen Filament**
- **Cardboard or plastic sheets**

Expected Time: 30 – 45 minutes

What to Do:

1. Explain to the youth that they will be designing a livestock working facility that should include at least 1 holding pen, an alleyway and a head gate. Allow youth time to discuss livestock working facilities and what they know about them, then they should sketch out their plan.
2. Split the youth into groups of 3-4. Give youth approximately 20-25 minutes to experiment with the 3D Printing Pens. They can complete their designs on the cardboard or plastic sheets. The designs easily peel off of most surfaces in a few seconds after hardening. *(Very little instruction is given by the instructor during this time. The goal is for participants to experiment with the pens and make discoveries on their own.)*
3. Give each group time to share about their livestock working facility.
4. **Variation on the Experiment:** If you do not have access to 3D Printing Pens, you can replicate this experiment by having children create 3D objects using a variety of materials.

Reflect:

1. What is the biggest difference between using a 3D Printing Pen and a regular pen?
2. Was it difficult to get the pen to work as you were creating your design?
3. What did this experiment teach you about using patience and perseverance?

Apply:
What did you know about livestock working facilities before this activity? What did you learn through this activity? 3D Printers are being used to help move the world forward in a variety of ways. Did you know 3D Printers are currently being used to replicate organs for the human body and for prototyping in the auto industry? *In what ways do you think 3D Printers can be used in the future of animal agriculture? Is it possible to 3D print a livestock working facility?*

PURDUE EXTENSION | LOCAL FACES COUNTLESS CONNECTIONS

Livestock-Makers Science Experiment: Preventing Disease

Scenario:
Vaccines are one of the main ways that farmers prevent disease in their livestock. They expose an animal to a form of a disease that causes the animal to build immunity to a certain disease. Generally, this results in reducing the severity of a disease or decreasing the percentage of the herd that gets sick. Many vaccines (and other medications) require storage in a refrigerator to remain effective and also have expiration dates.

Supplies:

- **Cardboard Box** (smaller, shoebox size; one per group)
- **Wax Paper**
- **Aluminum Foil**
- **Masking Tape**
- **Newspaper**
- **Rubber Bands**
- **Ice Cubes** (2 per group)

Expected Time: 30 – 45 minutes

What to Do:

1. Split the youth into groups of 3-4 and explain to them that they will be designing a refrigerator to store vaccines. Give each group a cardboard box and the remaining supplies (except the ice cubes). You can decide if you want to give each group an unlimited amount of supplies or a set amount of supplies.
2. Give youth approximately 20-30 minutes to design their own refrigerator. The goal is for their ice cube to melt slower than a control ice cube outside of the box. *(Very little instruction is given by the instructor during this time. The goal is for participants to work together and be creative using their own skills and background knowledge.)*
3. After the design session, it is time for the competition! Each group will explain their design, and then place one cube in their refrigerator and one outside of the container (control ice cube). After 90 seconds, remove the ice cube from the refrigerator and measure the difference in melting between it and the control ice cube. If the 2 ice cubes are similar (same loss of water), the refrigerator did not work well. The group with the least amount of water loss (melting) will be declared the winner.
4. For more "scientific results", try weighing or measuring the volume of each ice cube prior to testing it. Measure it again after testing to find the true amount of water/mass lost compared to the control.

Reflect:

1. What materials did you use? Were there any that you did not use? Why?
2. Which materials worked best? Which worked the least? Why?
3. Which design worked the best? What is it about that design that seemed to make the difference?

Apply:
Have you ever given a vaccine to an animal? If so, did you check the expiration date? Do you know if it was properly stored? *How would you check to makes sure a refrigerator is working properly? What other animal products have special storage requirements?*

PURDUE EXTENSION | LOCAL FACES COUNTLESS CONNECTIONS

Source: PBS ZOOM Activities "Keep-A-Cube"
www.pbskids.org/zoom/activities/sci/keepacube.html

Livestock-Makers Science Experiment: Transporting Corn

Scenario:
Many agricultural products are transported by water to marketplaces all over the world. This might include transporting grain on a river from one state to another, or exporting meat across an ocean to another country. The goal is to transport the products as efficiently as possible.

Supplies:

- **Aluminum Foil (be sure to give each group the same amount)**
- **Tape**
- **Scissors**
- **Several Pennies (to represent "corn")**
- **Bucket of Water**
- **Other materials that can be used for building a boat**

Expected Time: 30 – 40 minutes

What to Do:

1. Explain to the youth that they will be designing a boat that will need to be sturdy enough to transport corn down the river to be used in a neighboring state (pennies represent corn). It is important to transport as much as possible to keep transportation costs low, while also not over-loading the boat.
2. Split the youth into groups of 3-4. Give the groups approximately 15-20 minutes to design a boat that will float on water and transport as much corn as possible. The goal of the competition is to design a boat that will hold the most corn without sinking the boat. *Give very little instruction during this time. Encourage youth to experiment with the boats and test out how much cargo it can hold.*
3. At the end of the design session, it is time for the competition! Each group will explain their boat design and then count the number of pennies (amount of corn) that their boat can hold without sinking.
4. The group whose boat can hold the most pennies was able to transport the most corn and will be declared the winner of the challenge.

Reflect:

1. Think about the boat that held the most pennies. What was the shape of that boat?
2. Do you think the shape of the boat makes a difference in how many pennies it can hold?

Apply:
Ask the group why you need to know the correct amount of corn to have on the boat. *How do you know when you have the correct amount? What is wrong with having too little corn? What might happen if there is too much corn?* Depending on the age of the youth, consider teaching them about volume, buoyancy and density.

Additional Resource for Teaching Volume, Buoyancy, and Density: http://www.sciencebuddies.org/ (How Much Weight Can Your Boat Float?)

PURDUE EXTENSION | LOCAL FACES COUNTLESS CONNECTIONS