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# Manure Occurs: Managing Nutrients in Livestock Manure

Grades 6-8

Science, Math

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## Objectives

Students use the scientific method to test for the presence of nutrients in garden soil, manure and a mixture of the two. Students will use a table to determine which of three farm animals produces the greatest amount of manure.

## Vocabulary

**feces**- bodily waste discharged through the anus

**macronutrient**- a chemical element (such as nitrogen, phosphorus, or potassium) that is needed in relatively large amounts for optimum plant health and growth

**manure**- animal excrement mixed with other substances put on or into the soil to fertilize

**micronutrient**- a chemical element (such as iron, zinc, or manganese) that is needed in smaller amounts for optimum plant health and growth

**runoff**- water from rain or snow that flows over the surface of the ground and finally into streams, rivers, ponds, lakes, or other bodies of water

## Background

In addition to meat, livestock and poultry operations produce another valuable commodity—**manure**. animal manure can be a valuable fertilizer when properly used on field crops. Besides providing **macronutrients** and **micronutrients** to the soil, manure supplies organic matter to improve the soil's physical and chemical properties. It also increases infiltration of water, keeps nutrients in the soil, helps hold the soil in place, and promotes growth of beneficial organisms.

What we normally consider livestock manure is actually a mixture of **feces**, urine, soil, bedding material, and wash water. Its characteristics depend upon the type of animal being raised, its diet and bedding, the manure handling system, and even the climate. The nutrients in manure, such as nitrogen and phosphorus, occur in both organic and inorganic forms, though organic nutrients must first be converted or mineralized to inorganic forms before plants can use them. This conversion process is carried out by micro-organisms in the soil.



## **Manure Occurs: Managing Nutrients in Livestock Manure (continued)**

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Application on cropland is the most common and efficient method of handling livestock manure. However, without proper management, manure application over a period of years can cause a build-up of nutrients and salts in the soil. Excess manure can contaminate groundwater when soluble nitrate and salts leach through the soil. **Runoff** from manure covered land can carry phosphorus, nitrogen, organic sediments, and pathogens to surface water bodies. As the runoff decomposes in surface water, it absorbs oxygen and can cause fish to suffocate.

Good nutrient management involves manure application rates that are based on the actual nutrient content of the manure and the specific requirements of the crops being grown. Nutrient content in manure can vary, so regular testing of soil and manure is important for maintaining a proper balance.

### **Additional Reading**

Ditchfield, Christin, *Water* (True Books; Natural Resources), Children's, 2003.

Lindbo, David, *SOIL! Get the Inside Scoop*, American Society of Agronomy, 2008.

Stille, Darlene R., *Soil: Digging into Earth's Vital Resource*, Compass Point, 2005.

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# Manure Occurs: Managing Nutrients in Livestock Manure

Grades 6-8

Teacher Resources

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## **Activity 1 (Science): Excrement Experiment, 3-4 50-minute class periods**

### **Procedures**

- Read and discuss lesson background.
- Students will design and perform their own experiments to test the influence of manure on nitrogen, phosphorus, and potassium in soil.
- Possible tests may include
  - Place samples outdoors and expose them to the air.
  - Leave samples uncovered indoors.
  - Keep samples covered.
  - Place samples in the refrigerator.
  - Place samples in the oven.
  - Test the difference between store-bought bagged manure and fresh manure acquired from a horse farm or other animal operation.
  - Test manure from different animals.
- Use a home soil test kit, such as the Rapitest Soil Test Kit, to test the amount of nitrogen, phosphorus, and potassium in soil.
- Have students report their experiments and findings to the class.

## **Activity 2 (Math): Manure Math, 1 50-minute class period**

### **Procedures**

- Ask students which livestock species they think produces the greatest amount of feces per body weight. (The correct answer is chickens)
- Pass out the student worksheet.

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# Manure Occurs: Managing Nutrients in Livestock Manure

Grades 6-8  
Standards



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## Oklahoma Academic Standards



### Activity 1: Excrement Experiment

MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing human impact on the environment

### Activity 2: Manure Math

- 6.N.1.4 Determine equivalencies among fractions, decimals, and percents. Select among these representations to solve problems
- 6.D.1.1 Calculate the mean, median, and mode for a set of real-world data.

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# Manure Occurs: Managing Nutrients in Livestock Manure

## Activity 1: Excrement Experiment



Name: \_\_\_\_\_ Date: \_\_\_\_\_

Class/Hour/Teacher: \_\_\_\_\_

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### The Scientific Method

Directions: You are to design your own experiment to test the influence of manure on the amount of nitrogen, phosphorus, and potassium in the soil. Follow the steps of the scientific method.

**Question:** What question are you trying to answer with your experiment?

**Hypothesis:** What do you think will happen in the experiment?

**Experiment:** Describe what you will do in the experiment.

## **Manure Occurs: Activity 1 (continued)**

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**Record:** Write down what happened in your experiment.

**Analyze:** What does your results tell you?

**Conclusions:** Was your hypothesis correct? Why or why not?

# Manure Occurs: Managing Nutrients in Livestock Manure

## Activity 2: Manure Math



Name: \_\_\_\_\_ Date: \_\_\_\_\_

Class/Hour/Teacher: \_\_\_\_\_

1. Complete the table by calculating the total nitrogen excreted per animal per year as a percentage of its body weight. The first one has been done as an example.

Animal	Weight (lb)	Total Nitrogen (lb/yr)	Percentage of Body Weight Excreted as Nitrogen
Dairy Cow	1400	210	$210/1400=.15$ $.15 \times 100 = 15\%$
Beef Calf	500	62	
Beef Cow	100	124	
Horse	1000	99	
Nursery Pig	35	5.7	
Finishing Pig	200	33	
Sow	275	23	
Boar	350	28	
Sheep Feeder	100	16	
Laying Hen	4	1.05	
Broiler	2	0.85	

Source: “nutrient Value of fresh Livestock manure,” Washington State University, <http://gardening.wsu.edu/stewardship/compost/manure/manure3.htm>

## Manure Occurs: Activity 2 (Continued)

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Once you have the table completed, compare your answers with another students' before moving on to the next page.

2. For the animal weights...
  - a. What is the mean? \_\_\_\_\_
  
  - b. What is the median? \_\_\_\_\_
  
  - c. What is the mode? \_\_\_\_\_
  
3. For the total nitrogen in the manure per year...
  - a. What is the mean? \_\_\_\_\_
  
  - b. What is the median? \_\_\_\_\_
  
  - c. What is the mode? \_\_\_\_\_
  
4. For the percentages...
  - a. What is the mean? \_\_\_\_\_
  
  - b. What is the median? \_\_\_\_\_
  
  - c. What is the mode? \_\_\_\_\_



# Manure Occurs: Managing Nutrients in Livestock Manure

## Exercise 2: Manure Math **Answers**



Name: \_\_\_\_\_ Date: \_\_\_\_\_

Class/Hour/Teacher: \_\_\_\_\_

1. Complete the table by calculating the total nitrogen excreted per animal per year as a percentage of its body weight. The first one has been done as an example.

Animal	Weight (lb)	Total Nitrogen (lb/yr)	Percentage of Body Weight Excreted as Nitrogen
Dairy Cow	1400	210	$210/1400=.15$ $.15 \times 100 = 15\%$
Beef Calf	500	62	<b>12.4 %</b>
Beef Cow	100	124	<b>12.4 %</b>
Horse	1000	99	<b>9.9 %</b>
Nursery Pig	35	5.7	<b>16.29 %</b>
Finishing Pig	200	33	<b>16.5 %</b>
Sow	275	23	<b>8.36 %</b>
Boar	350	28	<b>8 %</b>
Sheep Feeder	100	16	<b>16 %</b>
Laying Hen	4	1.05	<b>26.25 %</b>
Broiler	2	0.85	<b>42.5 %</b>

Source: "nutrient Value of fresh Livestock manure," Washington State University, <http://gardening.wsu.edu/stewardship/compost/manure/manure3.htm>

## Manure Occurs: Activity 2 **Answers** (continued)

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Once you have the table completed, compare your answers with another students' before moving on to the next page.

2. For the animal weights...
  - a. What is the mean?  
**442.36**
  - b. What is the median?  
**275**
  - c. What is the mode?  
**1000**
3. For the total nitrogen in the manure per year...
  - a. What is the mean?  
**54.78**
  - b. What is the median?  
**28**
  - c. What is the mode?  
**none**
4. For the percentages...
  - a. What is the mean?  
**16.69**
  - b. What is the median?  
**15**
  - c. What is the mode?  
**12.4**