Livestock Unit, Packet 2.1

First & Last Name: _____ Period/Hour:_____

NOTE: Packets are due after completing Part 5. Check each page to be sure all blanks are completed.

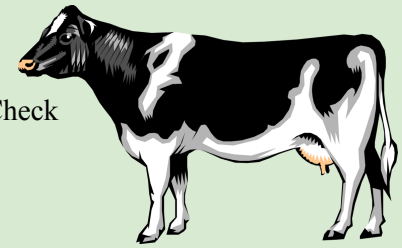
Driving Question: How do animals efficiently convert feed into products?

Anchoring Phenomenon: In this unit, we will be exploring how we can optimize livestock performance - in other words, how can we get livestock to convert as much of their feed into usable products like meat, milk, and eggs?

Deeper Questions

1. How does feed become animal products?
2. Why might two animals use similar feed differently?
3. What does feed contain that animals need for growth & production?

Schedule



Part 1: Introduction
- Three Claims, Data Dive, Data Check

Part 2: Core Ideas
- Core Ideas, Driving Questions, & Lesson Check

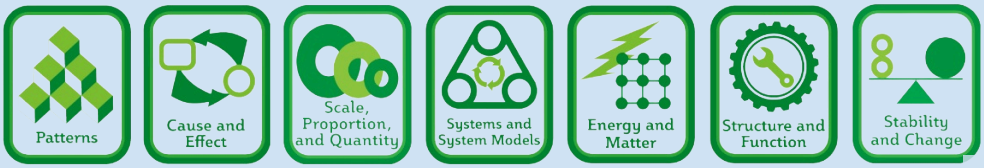
Part 3: Investigation
- Calculating Feed Efficiency

Part 4: Review & Assessment
- Ranking Your Readiness
- Review, Formative Assessment, & Mastery Check

Part 5: Career Connections
- Livestock Evaluation

AFNR Standards: AS.01.02. Assess and select animal production methods for use in animal systems based upon their effectiveness and impacts. AS.02.01. Demonstrate management techniques that ensure animal welfare. AS.03.01. Analyze the nutritional needs of animals. AS.03.02 Analyze feed rations and assess if they meet the nutritional needs of animals.AS.03.03 Utilize industry tools to make animal nutrition decisions.

NGSS Standards (*PEs* & *CCCs are summarized below. SEPs are noted throughout the packet*). HS-LS1-2. How bodily systems interact in multicellular organisms. HS-LS1-6. How carbon, hydrogen, and oxygen from sugar molecules form amino acids and/or other molecules. HS-LS1-7. How bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.



Semester Schedule

1. Crops Unit
1.1: How can we improve crop productivity?
1.2: How can we explain crop growth using atoms?
1.3: How do we design plant experiments?

2. Livestock Unit
2.1: How do animals convert feed into products?
2.2: How do animals acquire nutrients from their feed?
2.3: How can we use anatomy for management decisions?

3. Genetics Unit
3.1: How can we predict genetic inheritance?
3.2: How do genetic outcomes vary in more complex cases?
3.3: How do we design genetic experiments?

4. Biotech Unit
4.1: How can DNA be modified to enhance species?
4.2 How do we design biotech experiments?

5. Sustainability Unit
5.1: What determines if food production is sustainable?
5.2: What methods improve sustainability in agriculture?
5.3: How do we design sustainability experiments?

These materials were partly developed with assistance from artificial intelligence.

Resource Links: Class Website; Core Ideas Reading; Practice Mastery Check;

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Part 1: Intro – Optimizing Livestock Production (2.1.1)

Overview: In this activity, you will begin by discussing your initial ideas about how animal growth relates to their diets and their cells. You will then analyze data and work in teams to develop initial explanations.

Initial Ideas - *Record your ideas separately (e.g., on a white board or scratch paper).*
SEP: Engaging in Argument from Evidence; Asking Questions & Defining Problems

1. Students are learning about livestock production in their agriculture courses. They wonder how the bodies of cattle use the feed they consume. **Do you agree or disagree with each student's claim**?
    a. Nina: Most of the feed an animal eats becomes meat, milk, eggs, or another useful product.
    b. Daryll: If two animals eat the same amount of feed, they should gain the same amount of weight.
    c. Oscar: Animals that grow faster are always more efficient at converting feed to animal products.
2. **Work in your small groups to discuss your ideas.** How are your ideas similar or different? Decide as a group whether each statement is correct (and why). Be prepared to present your ideas.

Data Dive - *Read the directions below.* *SEP: Analyzing & Interpreting Data. Data Source: PSU*

The data below show four different feeding rations (*diets*) for steers (*castrated cattle raised for meat*). Values reflect dry weights. First look for patterns & trends in this data before answering questions. (*Note: the individual amounts of corn, soybeans, etc. fed reflects the late ration, not the overall average values*).

Ration	Days Fed	Total lbs. fed	Lbs fed/ day	Lbs gained per day	Cost per day per head	Corn (lbs/head)	Soybeans (lbs/head)	Corn Silage (lbs/head)	Hay (lbs/ head)	Calcium (lbs/head)	Vit/Min Suppl't (lbs/head)
Ration 1	304	5,486	18.0	2.7	$1.90	16.3	0.59	0	7.22	0.22	0.25
Ration 2	269	4,848	18.0	3.0	$1.96	20.2	1.54	0	2.41	0.33	0.25
Ration 3	278	5,010	18.0	2.9	$1.31	12.2	2.13	25.14	0	0.28	0.25
Ration 4	266	4,798	18.0	3.1	$1.58	17.2	2.01	12.57	0	0.33	0.25

1. **Begin by individually attempting to make sense of this data**. What trends or patterns do you notice? How does this relate to any prior knowledge or experience that you have?
2. **Next, work in your teams to discuss your ideas**. Where do you agree? Where do you disagree?
3. **What are two conclusions that would be supported by this data?** How are these conclusions supported by this data? What specifically suggests that your claims are accurate?
4. Each animal is fed an average of 18 lbs. per day but only gains about 3 lbs. A typical steer produces ~8 lbs. of manure daily. **What is happening to the remaining mass of consumed feed?**
5. **Does this data support or refute any of the initial claims (see above)?** If so, explain.
6. **Which of these four rations would *you* utilize?** Defend your stance with evidence & reasoning.

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Discussion - *Record your ideas in the spaces below.* *SEP: Asking Questions & Defining Problems.*

As a class, discuss your ideas about this data. What are the ideas that most agreed on? Where did your ideas differ as a class? Record your ideas in the spaces below.

We generally agree that…	***We disagreed or were unsure if…***

Initial Explanations - *Record your ideas in the spaces below.* *SEP: Constructing explanations*

How do animals convert feed into products such as meat, milk, wool, and eggs, and what determines how efficiently they do it? Write down an initial explanation in the space below. Don't worry if you aren't completely sure about this. You will come back and revise this explanation as you gain more information during this unit.

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Part 2: Core Ideas - Livestock Nutrition (2.1.2)

Overview: In this activity, you will use this reading to explore ideas about this packet's driving questions. You will then complete a lesson check (you can use your written notes).

Driving Questions - *Record your ideas separately (e.g., on a white board or scratch paper).*	
1. What does livestock feed provide to an animal's cells to enable growth & production? 2. What are cells, and how do their activities affect animal growth and production? 3. What types of feed components are fed to livestock and what nutrients do they provide that enables growth & production? 4. How do nutrients move from food to the cells during digestion? What happens to anything that isn't digested and/or absorbed? 5. What are macronutrients and what roles & functions does each provide? 6. What are micronutrients and what roles & functions does each provide? 7. What is a ration, and what makes a ration balanced? What would occur if a ration were *unbalanced*?	8. Why do an animal's nutrient needs change with age, health, activity, and production stage? How does this affect its ration? 9. What happens to feed nutrients that are not used for production? How does this affect feed efficiency? 10. Develop a conceptual model showing what happens to matter and energy as feed moves through an animal. Include: feed, digestion, absorption, maintenance, growth, production, feces & urine, and heat. 11. What are production and feed efficiency? How are they similar and different, and why do they matter to a farmer or rancher? 12. What factors affect feed efficiency, and how can farmers use information about feed efficiency to make management decisions?

Use the space below to record notes:

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Part 3: Calculating Feed Efficiency (2.1.3)

Pre-Investigation Questions - *Work as a group to prepare verbal responses for these questions. When you think you are all ready to provide responses, raise your hand. Your instructor will listen to your explanations, provide feedback, and determine if you are ready to move on to the investigation.*
SEP: Developing & Using Models

1. How do macro- and micronutrients differ? What roles & functions does each provide?
2. How does digestion enable an animal's cells to acquire nutrients from its food?
3. What is a ration, and what makes a ration balanced?
4. How are production and feed efficiency different?

This activity was completed _____ (*instructor signature*)

Overview: In this investigation, we are trying to quantify how different animals convert feed into useful products such as meat.

Hypothesis - *Discuss your ideas and record your predictions in the spaces below.*
SEP: Planning and Carrying Out Investigations

1. Summarize what most determines whether an animal efficiently converts its feed into products such as meat, milk, eggs, or wool.

   _____

   _____

2. Why would one animal produce these products more efficiently than another? Summarize the factors that affect this outcome:

   _____

   _____

Directions - *Carefully read the directions below before beginning. Record info where prompted.*

1. ☐ Analyze the data in the table on the next page. This data compares five breeds of chickens used for meat (called *broilers*). This data shows how much feed they consumed, their final weight, and the amount of meat that they produced (carcass weight) on average. *Data Source: Univ. of Maine*
2. ☐ Use this data to calculate which breed was most efficient at using its feed to produce meat in order to make an informed choice as to which would be most efficient for a farm to use.
3. ☐ Show all work during your calculations and be prepared to discuss your findings.

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	Cornish Cross	Red Freedom Ranger	Black Freedom Ranger	Imperial Red	Imperial Stripe
No. of Birds	28	28	28	28	28
Lifetime Feed Intake (lbs)	14.6	16.5	13.7	16.1	17
Live Weight (lbs)	5.4	5.5	5.15	5.54	5.24
Carcass Weight (lbs)	4.1	3.8	3.5	3.8	3.5
Dressing,%	75	69	68	68	67
Days to Processing Weight	46	60	61	60	62

Formulas Source: uky.edu

1. Begin by calculating **average daily gain (ADG)**. This refers to the amount of weight an animal gains on average each day. This is calculated by dividing total weight gained (*live weight*) by days on feed (*days to processing*). Report your values in the blanks on the left. Show your work on the right.

   Cornish Cross ADG: _____

   Red Freedom Ranger ADG: _____

   Black Freedom Ranger ADG: _____

   Imperial Red ADG: _____

   Imperial Stripe ADG: _____

2. Next, calculate **Feed Conversion Ratio (FCR)**. This is the amount of feed fed per pound of live weight gained (because their hatching weight is so small, we will treat it as if it is zero). This tells us how efficiently an animal converted its feed into body weight. This is calculated by dividing lifetime feed intake by live weight. Show your work on the right. *Hint: lower FCR values = more efficient animals.*

   Cornish Cross FCR: _____

   Red Freedom Ranger FCR: _____

   Black Freedom Ranger FCR: _____

   Imperial Red FCR: _____

   Imperial Stripe FCR: _____

3. Next, calculate **$FCR_{carcass}$**. This refers to the amount of feed fed per pound of meat produced. This tells us how efficiently an animal converted its feed into meat. This is calculated by dividing lifetime feed intake by carcass weight. Report your values in the blanks on the left. Show your work on the right.

   Cornish Cross FCR: _____

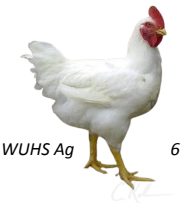
   Red Freedom Ranger FCR: _____

   Black Freedom Ranger FCR: _____

   Imperial Red FCR: _____

   Imperial Stripe FCR: _____

Image source



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Discussion Questions

1. From greatest to least, rank each of the breeds for each of the following considerations. You can abbreviate each breed's name (Cornish Cross = CC, Red Freedom Ranger = RFR, Black Freedom Ranger = BFR, Imperial Red = IR, Imperial Stripe = IS)

   Meat Production: _____
   Hint: carcass weight refers to the amount of meat produced

   ADG: _____

   FCR: _____

   $FCR_{carcass}$: _____

2. Why might a farmer need to consider more than one measure when evaluating an animal's performance?

   _____

   _____

   _____

3. A) How does "*days to processing weight"* differ between the breed with the highest FCR and the breed with the lowest FCR? B) How might this affect their efficiency and profitability?

   _____

   _____

   _____

4. Based on the data, which breed would you choose for a farm focused on efficient meat production? Defend your choice with evidence and reasoning.

   _____

   _____

   _____

5. Suggest how this experiment could be made more valid and/or reliable and defend with reasoning.

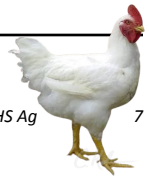
   _____

   _____

6. In this experiment, all birds were raised under similar conditions. What are two factors besides management that can affect production & efficiency? Justify your ideas with reasoning.

   _____

   _____



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Part 4: Review & Assessment (2.1.4)

Step 1: Review each Driving Question. Circle any questions that are still unclear to you.
Step 2: Identify and discuss any remaining confusion with your instructor.
Step 3: Complete the Formative Assessment (last page). Compare responses as a class.
Step 4: Individually complete a Mastery Check. If needed, your instructor will provide further support.

Part 5: Livestock Evaluation (2.1.5)

Overview: In this investigation, you'll use visual clues to identify which livestock are likely to best convert feed into muscle for meat. These skills help farmers make more informed decisions. (Image Sources: *Top*; *Middle*; *Bottom*)

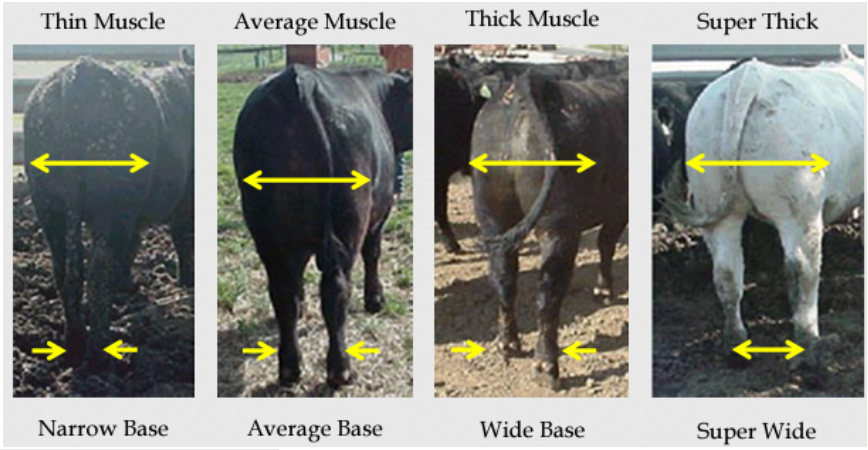
Background: Farmers & ranchers rely on livestock that efficiently turn feed into meat. They use visual cues to decide which animals to buy, breed, and sell to ensure they keep only productive and profitable animals.

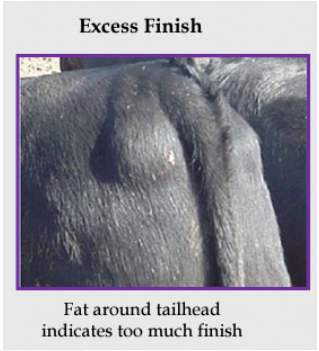
For cattle, the ideal market steer has muscular hindquarters and a thick loin, which provides valuable cuts like tenderloin, sirloin, and ribeye. It should also have moderate fat, a long body, strong legs, and a level topline ending in a straight, long rump. More details & examples can be found here.

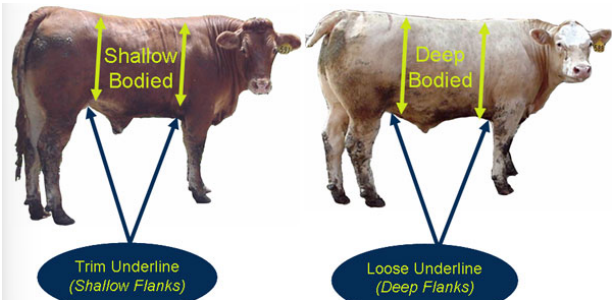
How To Evaluate Livestock. When evaluating livestock, check the animal from the ground up and back to front:

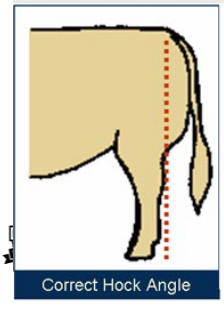
1. **Muscle**: Look for thick muscles, broad shoulders, a wide muscled back, thick legs, and a deep chest.
2. **Fat Cover (finish)**: Some fat over the ribs (only enough to still see the ribs) and a full *brisket*, but no fat buildup near the tail.
3. **Body Structure**: Strong, straight legs and a long, wide back to support its weight.

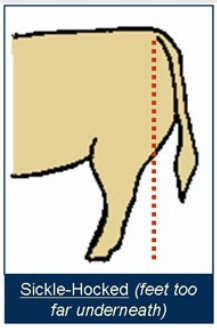
Check your skills w/ sample classes & hogs

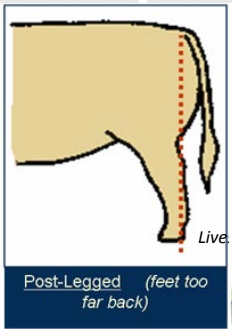


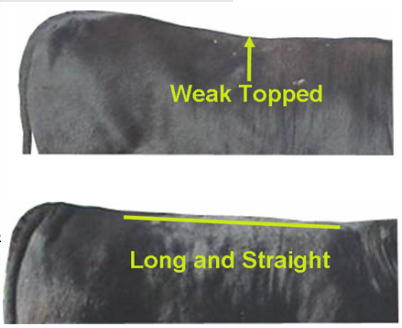












Packet 2.1 Formative Assessment (2.1.4)

Name: _____Hour____Date:_____Score:_____

Directions: Your instructor may allow you to work in assigned groups. If so, have a different person write each response while others assist. If you are stuck, refer to your work in this packet and the resources linked on pg. 1.

Background: This data compares two different diets fed to dairy heifers (immature female cattle). The *Concentrate* diet feeds more grains, while the *Forage* diet feeds more roughage. Use this data to answer the following questions.

Ingredient, (% of DM)	Concent.	Forage
Grass Hay	12.82	3.04
Alfalfa Hay	1.97	34.99
Corn Silage	9.41	36.23
Ground Corn	56.96	14.73
Soybean Meal	6.96	3.93
Cottonseed Hulls	4.91	2.02
Distillers Grains	2.3	2.59
Urea	0.93	0.05
Mineral Mix	3.74	2.42
Item		
Initial Body wt (lbs)	572	585
Final Body wt (lbs)	1274	1289
DMI, pounds/d	10.6	11.4

1. Provide an example of each of the following from this table:

   Roughage: _____

   Concentrate: _____

   Protein Feeds: _____

   Energy Feeds: _____

   Micronutrients: _____

2. Summarize the role or function this nutrient plays in cells. Then provide an example of a feed component that would provide each macronutrient.

   Carbohydrates: Role or function _____

   _____. Feed component source: _____

   Fats: Role or function _____

   _____. Feed component source: _____

   Proteins: Role or function _____

   _____. Feed component source: _____

3. Briefly summarize how digestion enables nutrients to be moved from feed to the animal's cells:

   _____

   _____

   _____

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4. This data shows the average DMI (dry matter intake) per day. This indicates the amount of feed consumed per day on average over a 365 day period. Using this information, complete this table. Show your work below.

	Concent.	Forage
Total Body Weight Gained:	_____	_____
Feed Consumed:	_____	_____
FCR (feed fed ÷ wt gained) *Hint: lower FCR values = more efficient animals*	_____	_____

Show work:

Ingredient, (% of DM)	Concent.	Forage
Grass Hay	12.82	3.04
Alfalfa Hay	1.97	34.99
Corn Silage	9.41	36.23
Ground Corn	56.96	14.73
Soybean Meal	6.96	3.93
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Urea	0.93	0.05
Mineral Mix	3.74	2.42
Item		
Initial Body wt (lbs)	572	585
Final Body wt (lbs)	1274	1289
DMI, pounds/d	10.6	11.4

5. Based on the info in the previous question, which diet is more likely to be more profitable? Explain:

6. Is the diet that resulted in the greatest average weight gain also the same diet that was most efficient? In your explanation, describe how production differs from efficiency. Conclude by explaining why this is important for a farmer or rancher to consider.

7. What determines if a ration is balanced? Is it possible for a ration to be balanced for one group of animals but be unbalanced for another group of animals? Explain.

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