Inquiry-Based Lessons from Illinois Agriculture in the Classroom

"Involve me and I understand."

AG E^5

About This Booklet

This booklet combines the basic principles of Inquiry Based Learning with Illinois Agriculture in the Classroom's Ag Mags. The Ag Mags provide the entry point to further explore a topic or idea through an inquiry approach. The lessons in this booklet feature the following Ag Mags: Apple, Soil, Pork, Dairy, Pumpkin, Corn, Beef, and Pizza. These Ag Mags are available from your county's Agricultural Literacy Coordinator. Some of the lessons use other AITC activities in the inquiry process. These activities are available at www.agintheclassroom.org

Three activities in the booklet help students build skills that are necessary in the inquiry process. These activities are referred to as "Skill Builders." The remaining lessons focus on the 5 E's of the inquiry process: engage, explore, explain, extend, and evaluate. In these lessons, students develop their own answers to specific questions. For these lessons, there are two direction sheets. The first one describes what the student does during the inquiry process and the second details what the teacher does. These lessons are just a starting point. Each lesson will be different, because your students will be involved!

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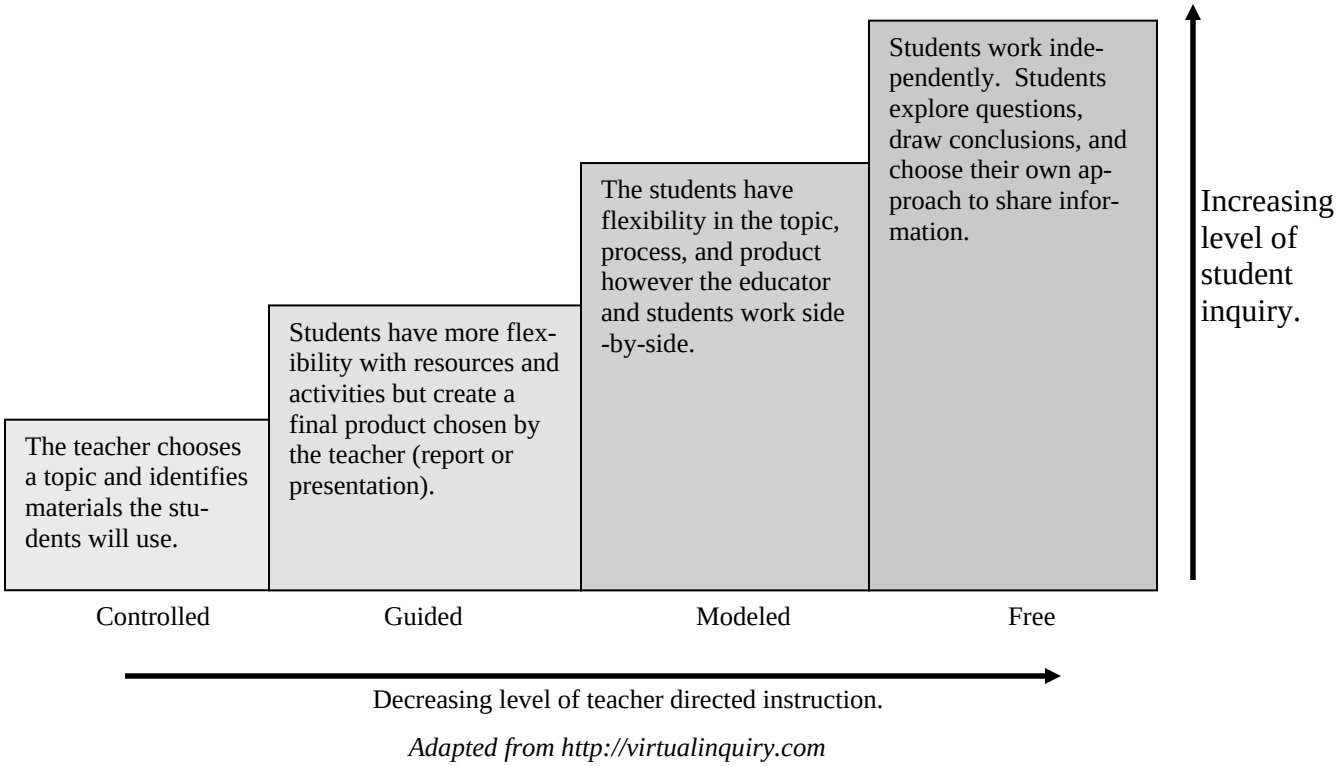
What Is Inquiry-Based Learning?

Inquiry instruction involves asking questions about the natural world and finding answers to those questions. Students either ask their own questions or are posed a question by the teacher. When asking their own questions, students explore topics that they wish to learn about. When posed a question, students explore a topic the teacher wants them to learn about. Regardless of the approach, inquiry learning requires that students take an active role in answering the question. This role can include designing and conducting experiments, making observations, and building models.

Inquiry stretches beyond learning facts and concepts and allows students to discover the processes involved in establishing facts and concepts. In turn, students develop observation, documentation, and critical thinking skills. Exploration during inquiry engages students' skills across multiple disciplines. As well, inquiry instruction allows students across a variety of skill levels to work together. "Involve me and I understand." With inquiry instruction, students are actively involved in their pursuit of knowledge.

The Four Levels of Student Inquiry

Always consider the experiences and skills of your students when selecting inquiry activities.



Adapted from http://virtualinquiry.com

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With inquiry-based learning, your students gain in-depth skills of Engagement, Exploration, Explanation, Extension, and Evaluation. The chart below gives a detailed look at how to get started at any level with the 5 E's.

Chart adapted from Industry Initiatives for Science and Math Education, http://iisme.5ecommunity.org/index.php?area_id=569

5 E's	Suggested Activity	What the Teacher Does	What the Student Does
Engage Encounter The Topic	• Reading • Free Write • KWL Chart • Brainstorm/ Concept Web • Control Experiment	• Generates curiosity. • Raises questions. • Elicits responses that uncover what the students know or think about the concept/topic.	• Asks questions such as, Why did this happen? What do I already know about this? What can I find out about this? • Shows interest in the topic.
Explore Active Involvement	• Perform an investigation • Read Authentic Resources to Collect Information • Solve a Problem • Construct a Model	• Encourages students to work together without direct instruction from the teacher. • Observes and listens to students as they interact. • Asks probing questions to redirect the students' investigations when necessary. • Provides time for students to puzzle through problems.	• Thinks freely but within the limits of the activity. • Tests predictions and hypotheses. • Forms new predictions and hypotheses. • Tries alternatives and discusses them with others. • Records observations and ideas.
Explain Communicate Discoveries	• Student Analysis & Explanation • Supporting Ideas with Evidence • Structured Questioning • Reading and Discussion • Teacher Explanation • Thinking Skill Activities: compare, classify, error analysis	• Encourages students to explain concepts and definitions in their own words. • Asks for justification in their own words. • Formally provides definitions, explanations, and new labels. • Uses students' previous experiences as basis for explaining concepts.	• Explains possible solutions or answers. • Listens to others' explanations. • Questions others' explanations. • Listens to and tries to comprehend explanations the teacher offers. • Uses recorded observations in explanations.
Extend Make Connections and Apply Understanding	• Problem Solving • Decision Making • Experimental Inquiry • Think Skill Activities; compare, classify, apply	• Expects students to use definitions and explanations provided previously. • Encourages students to apply or extend the concepts and skills in new situations. • Reminds students of alternative explanations. • Refers students to existing data and evidence and asks, What do you already know? Why do think…? • Strategies from Explore apply here also.	• Applies new labels, definitions, explanations, and skills in new, but similar situations. • Uses previous information to ask questions, propose solutions, make decisions, and design other or further experiments. • Draws reasonable conclusions from evidence. • Records observations and explanations. • Checks for understanding among peers.
Evaluate Assess Understanding	• Develop a Scoring Tool or Rubric • Test • Performance Assessment • Produce a Product • Journal Entry • Portfolio	• Observes the students as they apply new concepts and skills. • Assesses students' knowledge and/or skills • Looks for evidence that the students have changed their thinking or behaviors. • Allows students to assess their own learning and group-process skills. • Asks open-ended questions, such as: Why do you think…? What evidence do you have? What do you know about...? How would you explain…?	• Answers open-ended questions by using observations, evidence and previously accepted explanations. • Demonstrates an understanding or knowledge of the concept or skill. • Evaluates his or her own progress and knowledge. • Asks related questions that would encourage future investigations.

Using the 5 E's to Explore SOIL

Engage: Get the students involved. Give each student a cup of soil and a magnifying glass. Let them observe the soil and start to make a list of soil characteristics. Ask questions such as: Why do we have soil? What is soil used for? Why is it important to plants? What or who else uses soil and why? Divide students into groups and begin a controlled experiment using the *Soil Sammy activity* found in the Soil Ag Mag. After three days, students examine their grass seed and write their observations. After 7 days, students reexamine their grass seed. Have students describe what happens in germination. Ask students to describe any problems they encountered and possible solutions to these problems.

Explore: Students should start to pose questions that lead to open-ended experiments. Questions should relate to conditions or factors that may influence the germination of seeds. For this example, we will decide if soil is needed for a seed to germinate. Students should choose a factor or treatment and see how it affects the germination of grass seed. Some factors could include but are not limited to: use no soil, use sand, use ground coffee beans, use shredded paper, etc. What ever treatment is used, the group must supply it. Once a group has decided on a treatment, they must design an experiment to answer their question. A sample question might be "Will my grass seed grow in sand?" students then should design an experiment to answer such questions as: How many seeds will we use? How will we know if the seeds germinate? How much fluid will we use?

Students will make predictions, perform experiments, and record observations.

Explain: Students will explain what they investigated, how they conducted their experiment, and what they found. Ask students if they encountered any problems.

Extend: After initial experiments are concluded and questions are answered, students can again choose a problem and conduct an experiment. Possible extension activities include:

- Students can retest any treatments from another's group initial experiment.
- Students can investigate their initial treatment and ask questions why it did or did not work.
- Students can choose a different treatment that may have some of the same elements as the first initial treatment.
- Students can find the percent of germination for the grass seed in the control group to the grass seed in the treatment group. To calculate this, students would need to count the number of grass seeds in both the control and treatment experiment. As the grass sprouts, students conclude how many seeds actually germinated. Then they find the percentage of germination for each experiment and compare the two.

Once students are done completing their final experiment, they need to explain their findings according to what they have learned about soil.

Evaluate: In all five steps, evaluation and feedback are necessary to ensure students involvement and understanding of the activity. Evaluating students throughout the process allows a teacher to adjust their level of involvement in any of the 5 E's. There are many different options to evaluate students. A set or series of closure questions can be offered to students. This allows the teacher to evaluate and reflect on the activity.

Activity adapted from article in the Electronic Journal of Science Education by Peter Rillero.

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Skill Builder: Get To Know Your Apple

Introduce Inquiry into Your Classroom

Adapted from an activity from the Center for Inquiry Based Learning

Activity Summary: Each student is given an apple and is asked to study it carefully. All the apples are placed in a bag and mixed up. Students are then asked to find their own apples.

Objective: Students will improve their observation and documentation skills.

Procedure:

1. Provide each student with an apple. The apples should be similar in appearance and should not have obvious blemishes or dents.
2. Distribute the apples to the students. Instruct students to handle them with care.
3. Ask students to sketch their apples and describe them in writing. *Do not* tell students that they have to find their apples later.
4. After a few minutes, put all the apples in a box or a large bag. Add a few extras, mix them, up, and pour the apples onto the floor.
5. Ask students to find their own apple. It is likely that discussions will occur between students who are trying to claim the same apple. The only evidence students have will be their notes and sketches.
6. Collect the apples again.
7. Have students pass their written work to another student. These students must now find the apples on the basis of this written work along. No discussion allowed. Students will probably discover that they do not have enough information.
8. For discussion, ask students what problems they encountered. What other information do they need?
9. Repeat this activity. Students will probably be more thorough in their observation and documentation.

Discussion:

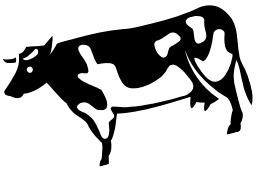
1. What did it feel like not to find your apple?
2. What did it feel like to rely on someone else's notes? Was there enough information?
3. Why is observation important?
4. What does a description need to include?
5. Why is a detailed description important?

Evaluate:

- Compare the student's first set of notes to his/her second set of notes. Did the student describe the apple in more detail?
- Pair students up. Have each student write a description of their partner. Read the descriptions aloud and guess who it is as a class.

Extend:

- Pair students up and give them an apple to describe. Have each student describe the apple independently. Then, have them compare their descriptions.
- Read the Apple Ag Mag and discuss the different varieties of apples. Show students different varieties of apples. Ask students to research and write a detailed description for a certain variety of apple.



Skill Builder: I'M A MOO-STERY!

Original Idea adapted from Inquiry Based Learning Using Everyday Objects by Amy Edmonds Alvarado and Patricia R. Herr

Activity Summary: Students will explore artifacts used in the dairy industry and write a first person narrative on the history of an object.

Objective: Students will improve their observation skills and learn how to use these observations to develop a hypothesis. As well, students will use observations, questions, and hypothesis to describe the history of objects from a first-person perspective.

Procedure:

1. Divide students into groups of three or four.
2. Give each group one of the photographs. *The photographs are located in the back of this booklet.*
3. Provide a recording sheet on which students will record their hypothesis and answers. Have one recording sheet per object. This sheet can stay with the object instead of traveling with the group, so that groups can view previous groups ideas.
4. Inform students that they need to tell the story of each object. Therefore, they must examine each picture carefully. Instruct the group to select one person to be the recorder who writes down everyone's observations. The recorder should write the observations on a blank sheet of paper.
5. As the students write their observations, float between groups and ask guiding questions.
6. After recording the brainstorming information, the group should record their hypothesis and answers on the recording sheet.
7. Once the students have recorded their information, have them switch to another object. Inform students that they can look at other groups' observations, but cannot come up with the same hypothesis. *Their idea about what the object is must be original.* Have students repeat this process for every photograph.
8. When students arrive at the last photograph, give them these directions: You need to write a descriptive history for this object. Read through each group's description. You can use these descriptions if you want. It is okay to combine ideas or add ideas from your group. Write the history from the first person perspective, such as "I am a _____ and I was used for _____."
9. Have each group share their story with the class and then reveal what the object is.

Discussion Questions:

1. Did your personal experiences influence you during this process? If so, how?
2. Did the opinions of your group members influence you during this process? If so, how?
3. How would your hypothesis about each item have changed if you had the actual object instead of the picture?
4. What is an artifact? What do they tell us about a culture?
5. Why do you think we are unfamiliar with these items?

Evaluation:

1. Read through each group's personal history. Evaluate the use of the first-person perspective and the use of descriptive details.

Extend:

- Have students read authentic accounts of butter making and other artifacts at: http://webexhibits.org/butter/index.html
- Read the Dairy Ag Mag. Compare and contrast dairy production in the past compared to the present. How has it changed? Why has it changed?

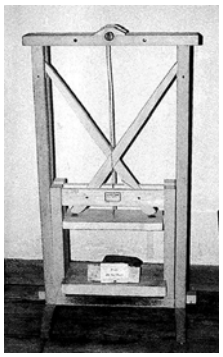
I'M A MOO-STERY!

Background Information for Objects

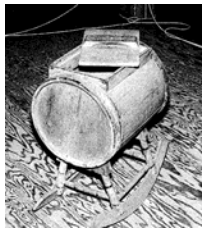
Object One: This object is a milk tester. It was used to test the fat content of milk and cream. It was produced by Dr. S.M. Babcock in 1890. These small hand-cranked devices were commonly found on dairy farms. Farmers used it to compare the butter fat content of milk from each cow.

Object Two: This object is a cream separator. Invented in 1890 by C.G.P. Delavai this machine was used to separate cream from milk. The machine eliminated doing this task by hand or transporting whole milk to the creamery.

Object Three: This object is a butter paddle. After the cream was churned, the butter was put in a large bowl. This tool was used to separate the butter from the buttermilk and to form the butter into a solid form.



Object Four: This object is a self-acting cheese press. One step in the cheese making is to press the cheese curds and drain the liquid out. This press uses the weight of the cheese to press the moisture out of it. This type of cheese press was commonly used in smaller dairies.



Object Five: This object is a foot operated butter churn. Hands-free, this type of churn allowed you to do something else! Butter churns separated the butter milk and butter. The primary purpose of having dairy cows was to provide a family with milk and butter. Farm production of butter started in 1791.

Object Six: This object is an 8 gallon milk can. Until the adoption of farm bulk tanks and tanker trunks in the 1940s and 50s, milk was stored cooled and transported in cans. Milk cans came in 5, 8, and 10 gallon sizes. Sturges & Burn Manufacturing Company of Chicago, Illinois was a large manufacturer of milk cans

Object:

Group 1:
What is this object?
Who might have used it?
What was it used for?
How do you know?
Is it still used today? Why or why not?

Group 2:
What is this object?
Who might have used it?
What was it used for?
How do you know?
Is it still used today? Why or why not?

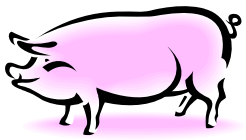
Group 3:
What is this object?
Who might have used it?
What was it used for?
How do you know?
Is it still used today? Why or why not?

Group 4:
What is this object?
Who might have used it?
What was it used for?
How do you know?
Is it still used today? Why or why not?

Group 5:
What is this object?
Who might have used it?
What was it used for?
How do you know?
Is it still used today? Why or why not?

Group 6 Personal History:

Skill Builder: Picking Up Where It Left Off...



Activity Summary: Students will read hypothetical situations about Illinois Pork Producers and decide what should happen next. They will then develop their own creative way to present their response.

Objective: Students will improve their critical thinking skills. Through group work, students will have to reach a consensus through discussion and deliberation. The students' creative response will improve students' writing skills and or presentation skills. This will differ based on what the students create.

Procedure:

1. Have students read the Pork Mag Ag and highlight the key ideas about pork production.
2. Divide students into groups of three or four and pass out the Picking Up Where It Left Off worksheet.
3. Have students read through each situation and discuss what would happen next. It is the students' job to continue the hypothetical situation.
4. Float between students and ask: What do you think would happen next? How should the producer respond? Does the Ag Mag give you more information?
5. Once the students are finished, explain that in their groups they are going to develop a creative way to present what will happen next in one of the hypothetical situations.
6. Brainstorm ideas as a class. Possible ideas might include: play or skit, story, newspaper article, news broadcast, bulletin board, or radio announcement. The sky is the limit. *But, let the students brainstorm!*
7. Provide students with in-class time to work on their project. During this time, float between groups and ask guiding questions. Help each group reach a consensus.
8. Once the projects are complete, have each group present their response to the class. Possible questions to ask during this presentation: Why did you choose to do this? Why might this happen? What factors led you to make this decision?

Discussion Questions:

<u>For Each Situation</u>

1. Why did you choose to respond in this way?
2. How else could you have responded in this situation?

<u>Overall</u>

1. Describe what it was like to work in your groups.
2. How did your group reach a consensus?
3. What factors influence a pork producer's decision making?
4. What factors influence your decision making?

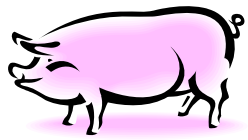
Evaluation:

- Develop a rubric to evaluate the project. For example, if a group selects a newspaper article, is it written in a newspaper format? Did the group use proper sentence construction? In terms of content, there is no right or wrong answer. Instead, evaluate whether or not the students thoroughly explained what would happen next and provided rationale.

Extend:

- Have groups develop their own hypothetical situation on an agricultural topic from the producer or farmer perspective. Give each group a different situation to respond to. This group needs to explain why they chose this response. Then, have the group who created the hypothetical situation explain why this situation is relevant to a producer or farmer.

Skill Builder: Picking Up Where It Left Off...



Read these hypothetical situations. In your group, brainstorm possible ideas about what will happen next in each situation.

Then, your group will select a situation and develop a creative way to continue the hypothetical situation.

Producer Sam buys his soybean meal from the local grain elevator for $7.82 per bushel. He uses these soybeans to feed over 650 hogs on his farm. Today, the price of soybeans skyrocketed to over $15.00 a bushel.

The weather forecast is calling for extreme weather with temperatures bottoming out at 15 degrees below zero. When Producer Cory goes out to do chores in the finishing barn, the electricity goes out due to extreme winds. Producer Cory owns a hog farm in DeKalb County with over 150 hogs.

Producer Tony owns a farrow to finish hog farm in Southern Illinois. The current retail price of pork is $3.20 per pound. Producer Tony is ready to sell the hogs to market. The retail price drops to $1.00 per pound.

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What causes a seed to germinate?

5 E's	Suggested Activity
Engage Encounter The Topic	• Read the Soybean Ag Mag. • Read Oh Say Can You Seed? by Bonnie Worth. • Read p.6-12 in Raymond Bial's The Super Soybean. • Complete the Bean Book activity. • Watch seed germination clip available at: www.ncsu.edu/project/agronauts/mission2_4.htm. • Visual aids (posters) • See the Beanie Baby activity without explanation.
Explore Active Involvement	• Develop hypothesis of seed germination. • Conduct Beanie Baby Activity. • Record observations. • Test prediction of seed germination. • Find percentage of seed germination.
Explain Communicate Discoveries	• Analyze findings. • Draw conclusions about seed germination. • Develop definition of seed germination. • Compare findings with other classmates.
Extend Make Connections and Apply Understanding	• Modify Beanie Baby experiment by changing variables (temperature, water, light, seeds, media, etc.). • Record findings. • Compare findings with those of the control group. • Find percentage of seed germination from experimental group and compare to control group. • Draw conclusions about seed germination. • Explain findings.
Evaluate Assess Understanding	• Explain seed germination using research and data from experiments by answering questions (ie. How would you explain seed germination? Why do you think your control experiment had a higher percentage of seed germination than your experimental group?). • Make seed germination visual aid/model. • Organize findings into a final lab report.

Seed Germination Lesson Organizer

5 E's	What the Teacher Does
In Advance Prepare Materials for the Lesson	1. Three days in advance, prepare a Beanie Baby. 2. Gather materials for Beanie Baby Activity: soybeans, Soil Moist, small Ziploc bags, and yarn. Also gather possible materials for students who may want to alter media, seeds, temperature, and light during the Extend stage. 3. Photocopy the soybean worksheets.
Engage Encounter The Topic	1. Provide students with different ways to explore the topic of seed germination. Allow students to select their own approach. Float between students and ask questions as they learn more about seed germination. 2. Introduce the concept of germination. Show students germinating soybeans. As a class, record observations of the germinating soybeans. Ask them: What causes a seed to germinate? Explain that it will be their job to discover the answer. 3. Show students the Beanie Baby activity. Explain the steps involved, but *do not provide an explanation about seed germination*.
Explore Active Involvement	1. Divide students into groups of three. Each student in the group should complete the Beanie Baby activity. This will provide them with a larger control group. 2. Prompt students to write a hypothesis about seed germination by asking questions such as: What prediction can you make about what causes a seed to germinate? How can you write that in an if/then statement? Is this statement testable? How could you test it? 3. Provide suggestions or guidance as students conduct the Beanie Baby activity. 4. Read through students' observations as they record them. Encourage them to use specific, detailed descriptions. 5. Help students how to calculate the percentage of seed germination. *They will need to count how many seeds germinated and then divide this amount by the total amount of seeds.*
Explain Communicate Discoveries	1. Help students summarize conclusions about the Beanie Baby activity by asking guiding questions such as: What did you learn about seed germination? How do you know? What evidence from your observations can you use to support your conclusion? 2. Allow students to share their definitions of seed germination.
Extend Make Connections and Apply Understanding	1. Before students design their experiments, discuss control groups and experimental groups. *Control group: The experiment is done as is. No variables are changed .* *Experimental group: One variable is changed in the experiment to see what happens.* 2. Ask students: What is the purpose of a control group? What is the purpose of the experimental group? 3. Explain that the Beanie Baby activity is the control group and that the students will develop the experimental group. Encourage them to list the variables that could be changed. Have students share their ideas as a class. 4. Approve the students' experimental designs. Offer any suggestions or feedback. 5. Help students compare the results from the control group to the experimental group. Ask: What do you already know about seed germination? Did you learn anything new about seed germination from the experimental group? If so, what?
Evaluate Assess Understanding	*Choose any of the following for an assessment:* • Have students explain seed germination using research and data from experiments by answering questions: How would you explain seed germination? Why do you think your control experiment had a higher percentage of seed germination than your experimental group? • Make a seed germination visual display/visual model. • Organize findings into a final lab report.

What causes a seed to germinate?

Hypothesis:

Procedure

Step 1: Place a 1/2 teaspoon of Crystal Soil into the bag.
Step 2: Add one tablespoon of water.
Step 3: Gently push in three soybeans.
Step 4: Seal your bag.
Step 5: Punch a hole in the top your bag, above the zipper seal. Insert the yarn to make a necklace.
Step 6: Use the yarn to hang the Beanie Baby in the room or wear it around your neck.
Step 7: Check your Beanie Baby several times a day to watch the process of germination. Your observations will occur over the course of three days. Your group needs to select time intervals to observe the germination (every half hour, every hour, etc).
Step 8: Record observations and chart growth. It may be helpful to draw pictures of each stage on a separate sheet of paper.

Time and Day of Observation	Observations

Time and Day of Observation	Observations

Briefly summarize the results of this experiment. Include the percent of seeds that germinated.

What conclusions can you make about seed germination?

Write your own definition of seed germination.

What causes a seed to germinate?

What variables could be changed in the Beanie Baby activity?

In your lab notebook, design an experiment changing one of these variables. Include the following in your experimental design:

- Hypothesis: Develop a hypothesis. Make a prediction about how altering the variable will effect seed germination. Also, predict how many soybeans will germinate in the experimental group.
- Procedure: List the steps from start to finish. Explain things in detail so that someone else could easily do your experiment.
- A list of materials needed to complete the experiment.
- Develop a way to record your findings (chart, journal log, etc).

After your group's design has been approved, conduct your experiment. During your experiment, make notes on anything that should be altered from the original design.

In the box below, briefly summarize the results of your experiment. Find the percent of seeds that germinated.

CONTROL VS. EXPERIMENTAL GROUP

Compare the percent of seed germination from the control group to that of the experimental group. Describe your findings.

What conclusions can you make about seed germination?

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Why is Illinois a good place to grow pumpkins?

5 E's	Suggested Activity
Engage Encounter The Topic	• Read the Pumpkin Ag Mag. • Read Pumpkins by Jacqueline Farmer. • Pictures of pumpkin growth cycle and production. • Create a KWL Chart on pumpkin growth. • Complete the Pumpkin Charm or Pumpkin Chain activities without explanation.
Explore Active Involvement	• Develop hypothesis of pumpkin growth. • Develop plan to research pumpkin growth.. • Research and record information on pumpkin growth. • Create own model of pumpkin growth cycle using available materials.
Explain Communicate Discoveries	• Present and describe model to class. • Draw conclusions about pumpkin growth cycle. • Make any modifications to model of pumpkin growth cycle based on class discussion.
Extend Make Connections and Apply Understanding	• Develop plan to research pumpkin production in Illinois to answer the question: Why is Illinois a good place to grow pumpkins? • Read authentic resources on the topic to collect information. Encourage students to look for information based on their model of the pumpkin growth cycle (soil, water, temperature, seasons, etc.). • Record information. • Make any modifications to model of pumpkin growth cycle to best represent new findings. • Draw conclusions on pumpkin production in Illinois
Evaluate Assess Understanding	• Describe the model of pumpkin growth cycle to explain why Illinois is a good place to grow a pumpkin. This description could be in written format or through an in-class presentation. • Explain Illinois pumpkin production using research and model by answering questions. • Organize findings into portfolio or lab report.

AG E^5

Pumpkins Production in Illinois Lesson Organizer

5 E's	What the Teacher Does
In Advance Prepare Materials for the Lesson	1. Gather materials for students to make a model of the pumpkin growth cycle. Include items such as: green paper, yellow paper, orange paper, yellow string, pumpkin seeds, craft sand, beads, pipe cleaners, paper plates, etc. 2. Gather possible reference materials about pumpkin growth. Include books, magazines, the Pumpkin Ag Mag, pictures, and charts. 3. Photocopy the pumpkin worksheets.
Engage Encounter The Topic	1. Provide students with different ways to explore the topic of pumpkin growth. Float between students and ask questions as they explore. 2. Show students the Pumpkin Charm or Pumpkin Chain activity without explanation. 3. Complete a KWL chart on the question: What does a pumpkin need to grow?
Explore Active Involvement	1. Explain to students that before they can answer why Illinois is a good place to grow pumpkins, they need to learn more about pumpkin growth. 2. Ask students: What does a pumpkin need to grow? Instruct students to write a hypothesis of pumpkin growth. 3. Float between students as they write their hypotheses. Ask them: What predictions can you make about what a pumpkin needs to grow? How can you write that in an if/then statement? 4. Explain to students that they will not be conducting an experiment. Instead, they will be researching pumpkin growth to see if their hypothesis was correct. 5. Float between students as they research and record their information. Ask students: Does this research support your hypothesis? Why or why not? 6. Tell students that based on their research, they are going to create their own model of the pumpkin growth cycle. Give students time to plan and build their models.
Explain Communicate Discoveries	1. Have students present their models to the class. Ask them describe their model and why they included each component. 2. As a class, summarize the important details of pumpkin growth. 3. Allow students to make any corrections to their model based on what they learned during the class presentations.
Extend Make Connections and Apply Understanding	1. Now that students know about pumpkin growth, they are ready to answer the question: Why is Illinois a good place to grow pumpkins? 2. Write the students' predictions on the chalkboard. Then, tell students that they need to find research to answer this question. Handout another copy of the research worksheet for students to record their findings. 3. Float between students as they conduct their research and record their information. Ask students: How does this information fit into your model? 4. Once students have completed their research, give them to time to make any modifications to their model to explain why Illinois is a good place to grow pumpkins. 5. As students are working, ask them: Why are you making this change to your model? How does what you learned support this change? 6. As a class, summarize findings about pumpkin production in Illinois.
Evaluate Assess Understanding	*Choose any of the following for an assessment:* • Have students describe their change model of the pumpkin growth cycle to explain why Illinois is a good place to grow pumpkins. This could be in written format or through an in-class presentation. • Create a rubric to evaluate the student model. • Complete the KWL chart. • Organize findings in a portfolio.

Why is Illinois a good place to grow pumpkins?

What Does a Pumpkin Need to Grow?

Hypothesis:

Develop a Research Plan

Use this chart to plan your research. Keep your hypothesis in mind. You need to find information that supports or does not support your hypothesis.

What do I need to find out?	Where can I find it?

Why is Illinois a good place to grow pumpkins?

Use these charts to record the research. You can choose how to organize your findings (topic, source, etc).

What I Learned	New Questions	Where I Learned It	How Good the Info Is

What I Learned	New Questions	Where I Learned It	How Good the Info Is

What I Learned	New Questions	Where I Learned It	How Good the Info Is

What I Learned	New Questions	Where I Learned It	How Good the Info Is

Why is Illinois a good place to grow pumpkins?

Summarize Your Research:

Does your research support your hypothesis? Why or why not?

DESIGN YOUR PUMPKIN GROWTH CYCLE MODEL

Use this space to plan your model. Brainstorm ideas and then list the items you will need to create your design.

Why is Illinois a good place to grow pumpkins?

Why is Illinois a good place to grow pumpkins?
Hypothesis:

Research why Illinois is a good place to grow pumpkins. Record your research on the Research Worksheet.

Summarize Your Research:

Conclusion: Why is Illinois a good place to grow pumpkins?

ANALYZE YOUR MODEL

Based on your research, what changes can you make to your model to answer the question: why is Illinois a good place to growth a pumpkin? Please include what you will add to your model or take away from your model and why.

AG E^5

What factors cause the price of corn to change every year?

5 E's	Suggested Activity
Engage Encounter The Topic	• Read the Corn Ag Mag. • Read Corn Belt Harvest by Raymond Bial. • Explore how much a bushel of corn is. • Complete the Futures Farming activity available from the Innovations in Agriculture Resource Guide.
Explore Active Involvement	• Develop a hypothesis about changes in corn prices. • Examine the corn prices chart and graph. • Develop predictions of historical events, economic trends, etc. that might have impacted corn prices for these years.
Explain Communicate Discoveries	• Describe overall trends in corn prices using a graph and chart as a reference. • Share the events or trends that might have impacted the price of corn. • Develop a comprehensive list with classmates for each year.
Extend Make Connections and Apply Understanding	• Select a year from the set researched above. • Develop research plan to answer how and why the historical events and economic trends listed for the selected year impact the price of corn. • Read authentic resources on the topic to collect information. • Analyze the historical events and economic trends to determine how and why they impacted the price of corn. • Based on research, add or remove events or trends. • Compare findings with other classmates who researched the same year. • As a class, place the events/trends into categories.
Evaluate Assess Understanding	• Answer critical thinking questions about the Futures Farming activity based on findings from research. • Create a visual display showing factors that influence the price of corn for particular year or in general. • Develop a game or activity designed to show participants the factors that influence the price of corn. • Organize findings into a written report or in-class presentation.

Corn Prices Lesson Organizer

5 E's	What the Teacher Does
In Advance Prepare Materials for the Lesson	1. Gather reference materials for students about Illinois and United States' history. 2. Purchase individual bags of M&Ms; enough for each student to have their own. 3. Photocopy the Futures Farming and corn worksheets.
Engage Encounter The Topic	1. Bring in a bushel basket and show students how much a bushel is. 2. Review the Corn Ag Mag and highlight what a bushel of corn produces. 3. Facilitate the Futures Farming activity with students and complete the discussion questions. Tell students that they are going to explore different events or trends that may impact the price of corn.
Explore Active Involvement	1. Float between students as they complete their worksheet. Review their hypothesis and ask follow-up questions. 2. Ask guiding questions to help students focus on different events or trends that occurred during a specific year. For example, what happened in 1935? How could that have impacted the price of corn?
Explain Communicate Discoveries	1. In a class discussion, help students summarize the overall trends in corn prices. 2. Have each student share their events and trends. Ask them: How would this event/ trend have impacted corn prices? Why? 3. Combine and summarize the students' responses on a large chart.
Extend Make Connections and Apply Understanding	1. Tell students that now they are going to test their predictions. They need to select one year from the chart and research historical events or economic trends during this year that might have impacted the price of corn. *Have the students create the method they will use to record and document their research.* 2. Once students have finished their research, group them according to the year they selected. In groups, have students share their findings. During this time, float between groups and help them summarize their findings. 3. Have each group present their findings to the class. 4. Record the findings in a large chart. 5. As a class, place the events or trends into categories. Allow the students to create and name the categories. Doing this will help them better understand the overall factors that influence price.
Evaluate Assess Understanding	*Choose any of the following for an assessment:* • Answer critical thinking questions about the Futures Farming activity based on findings from research. • Create a visual display showing factors that influence the price of corn for a particular year or in general. • Develop a game or activity designed to show participants the factors that influence the price of corn. • Organize findings into a written report or in-class presentation.

WHAT FACTORS CAUSE THE PRICE OF CORN TO CHANGE EVERY YEAR?

Hypothesis:

This chart shows the average corn price in Illinois from 1935 to 2007 (through September 2007). Using only what you know, brainstorm possible historical events and economic trends that might have impacted these corn prices. Because these are Illinois corn prices, you can use events from Illinois history or national history.

Year	Corn Price	Events or Trends
1935	$.75	
1945	$1.08	
1955	$1.17	
1965	$1.18	
1975	$2.76	
1985	$2.28	
1995	$2.71	
2005	$1.92	
2007 Average Price for September 2007	$3.32	

WHAT FACTORS CAUSE THE PRICE OF CORN TO CHANGE EVERY YEAR?

Describe the overall trend in corn prices from 1935 to 2007.

Conclusion

What is inflation? How could it impact corn prices?

What factors impact the price of corn?

Do these same factors impact the cost of your favorite snack food? Why or why not?

AG E^5

Amazing Grazing: What are the formula; for the perimeter and area of a rectangle?

5 E's	Suggested Activity
Engage Encounter The Topic	• Read the Beef Ag Mag • Read Amazing Grazing by Cris Peterson. • Write a definition for pasture. • Complete the graph paper exercise. • Create definition for perimeter and area.
Explore Active Involvement	• Read "The Amazing Grazing Problem." • Using the materials provided, develop procedures for finding the perimeter and area. • Write down the steps the group used to find the perimeter and area. • Develop formulas for the perimeter and area of a rectangle.
Explain Communicate Discoveries	• Explain the steps the group used to find the perimeter and area. • Describe the formula for the perimeter and area. • Compare findings with other classmates. • Make any changes to perimeter and area formulas.
Extend Make Connections and Apply Understanding	• Solve perimeter and area problem using additional information from the Illinois Beef Producer. • Compare answers with other classmates. • Make any changes to perimeter and area formulas. Also make any changes to the steps created in the Explore section. • Write letter to Illinois Beef Producer with the following information: the perimeter and area of the pasture, the steps used to find the answer, and the perimeter and area formulas.
Evaluate Assess Understanding	• Create a display explaining the formula for the perimeter and area of a rectangle. • Using a ruler or yardstick, find the perimeter and area of everyday objects. Use formula developed above. • Complete a performance assessment.

Amazing Grazing Lesson Organizer

5 E's	What the Teacher Does
In Advance Prepare Materials for the Lesson	1. Prepare 10-12 large sheets of paper. The length and width of the paper may vary, but needs to be numbers divisible 2. For example, cut 11 X 17 paper to the dimension of 10 X 16. This sheet of paper represents the producer's pasture. 2. Prepare 10-12 card stock squares to the dimension of 2 X 2. These squares will act as the measuring tool for the larger sheet of paper. 3. Photocopy the worksheets and cut the messages from an Illinois Beef Producer into two parts.
Engage Encounter The Topic	1. Before starting the Graph Paper Exercise, divide students into groups of three. 2. Float between groups as they complete the exercise. 3. Ask guiding questions, such as: Is there anything we can count to find the perimeter/area? Do we count the corner squares once or twice? 4. Review students' definitions of perimeter and area. Ask questions to help students develop the correct definition. *Perimeter: The total length around the object* *Area: The amount of space inside the figure*
Explore Active Involvement	1. Provide students with the paper prepared above. Also, give students the first message from an Illinois Beef Producer. 2. Float between groups as they complete the first part of the Amazing Grazing problem. If students struggle, review the concepts introduced in the exercise and help them apply these concepts. 3. Check students' understanding by asking them what steps they used to find the perimeter and area. 4. Have students explain their formula. If needed, ask questions to guide them in the right direction.
Explain Communicate Discoveries	1. Pair up each group with another group. Ask the groups to compare their findings and complete the "Connect with Your Classmates" section. 2. Float between the groups as they explain their answers to one another. Help each group reach a consensus. 3. Have the groups report the steps and formula they used to find the perimeter and area to the whole class.
Extend Make Connections and Apply Understanding	1. Have students return to their original group. 2. Provide each group with the second message. 3. Float between groups as they use this new information to find the perimeter and area. Encourage students to use the formulas they created. 4. After the groups have finished, review the guidelines for the letter to the Illinois Beef Producer. 5. Make computer resources and art materials available to students.
Evaluate Assess Understanding	*Choose any of the following for an assessment:* • Evaluate the students' letters to the Illinois Beef Producer based on the criteria listed on the worksheet. • Have students create a display explaining the formula for the perimeter and area of a rectangle. • Using a ruler, ask students to find the perimeter and area of everyday objects. • Create a performance assessment.

The Amazing Grazing Problem

Message from an Illinois Beef Producer

Dear Students,

Hello from JoDaviess County! My county is a leading beef cattle producing county in Illinois. There are 1,470,000 cattle and calves on Illinois farms.

Currently, I have 30 cattle and 8 calves on my farm. The beef cattle raised on my farm graze on pasture. This is where I need your help! I need to figure out the perimeter and area of the pasture.

I enclosed two items for you to use. The first is a white piece of paper. This represents my pasture. The second item is a brightly colored square. Each side of the square is 2 inches long. This square is the only measuring instrument you can use. These two items will be all that you need to find the perimeter and area of my pasture. Of course, nothing will be to scale. I will send specific information later on!

Thanks for your help. I look forward to hearing from you soon!

Sincerely,

An Illinois Beef Producer

Message from an Illinois Beef Producer

Dear Students,

Hello again! I hope you are well on your way to solving my Amazing Grazing problem. I wanted to send you more information about my pasture. It is about 1500 feet wide and 5500 feet long, which is close to 189 acres. Land is often measured in acres. Use these figures to find the actual perimeter and area of my pasture.

In your letter back to me, please report the following:

- The steps you took to find the perimeter and area.
- The formula you created for the perimeter and area.
- The perimeter and area of my pasture.

Thanks,

An Illinois Beef Producer

The Amazing Grazing Problem

After reading the Beef Ag Mag and Amazing Grazing, develop a definition of the word "pasture" and write it on the lines below:

_____

_____

_____

_____

Graph Paper Exercise

1. Draw two rectangles on a piece of graph paper.
2. Label the first rectangle "perimeter" and shade the first row of boxes along each side of the rectangle. These shaded boxes represent the perimeter of the rectangle.
3. Brainstorm ways to represent the perimeter as a number and then write the number on your graph paper.
4. Label the second rectangle "area" and shade in the entire rectangle. These shaded boxes represent the area of the rectangle.
5. Brainstorm ways to represent the area as a number and then write the number on your graph paper.

Definition of Perimeter and Area

Look at the shaded areas on your graph paper. In your own words, write a definition of perimeter and area.

perimeter: _____

_____

_____

_____

area: _____

_____

_____

_____

The Amazing Grazing Problem: Part One

1. Read the first message from the Illinois Beef Producer.
2. Use the materials provided to find the perimeter and area of the pasture.
3. Be sure to write down the steps your group used to find the perimeter and area.
4. Develop formulas for the perimeter and area of a rectangle.
5. STOP! After your group has finished this step, you will explain the steps you used to find the perimeter and area as well as the formula you developed to another group.

The Amazing Grazing Problem

Record the steps your group used to find the perimeter and area in the spaces provided below.

The Steps Used to Find the Perimeter:

The Steps Used to Find the Area:

CONNECT WITH YOUR CLASSMATES

Compare your steps and formulas with another group. After doing so, does your group need to make any changes to their formula? If so, write them in the space provided and then explain why your group is making this change.

FORMULA FOR THE PERIMETER OF A RECTANGLE:

Reason: _____

FORMULA FOR THE AREA OF A RECTANGLE:

Reason: _____

The Amazing Grazing Problem

The Amazing Grazing Problem: Part Two

1. Read the second message from the Illinois Beef Producer.
2. Find the perimeter and area of the pasture using the actual figures and the formula your group developed. Be sure to show your work.

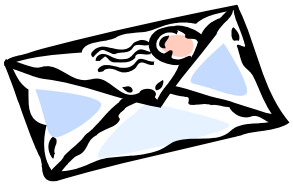
PERIMETER OF PASTURE:

AREA OF PASTURE:

AN AMAZING GRAZING LETTER

Write a letter back to the Illinois Beef Producer. Summarize your findings from this activity. Include the information the producer requested in the second letter: Use the back of this paper or attach a separate piece of paper if necessary.

- The steps your group took to the find the perimeter and area
- The formula your group created for the perimeter and area
- The perimeter and area of the producer's pasture.
- Pictures or diagrams to better explain your findings.



Dear Illinois Beef Producer,

AG E^5

What's the Pi in my pizza pie?

Adapted from activity by the National Clearinghouse for English Language Acquisition and Language Instruction Educational Programs

5 E's	Suggested Activity
Engage Encounter The Topic	• Read the Pizza Ag Mag • Read Extra Cheese, Please! Mozzarella's Journey from Cow to Pizza by Cris Peterson. • Discuss the terms center point, circumference, radius, and diameter. • Cut out the pizza from the Pizza Ag Mag. • Label the center point, circumference, radius and diameter on the pizza • Develop and write definitions for each term.
Explore Active Involvement	• Measure the radius and diameter. Measure to the nearest centimeter. • Develop a rule or formula for finding the diameter and radius. • Brainstorm ways to find the circumference of the pizza. • Measure the circumference. Measure to the nearest centimeter.
Explain Communicate Discoveries	• Compare measurements with other students. • Demonstrate findings using the pizza cut-out. • Describe the relationship between radius and diameter.
Extend Make Connections and Apply Understanding	• Divide the circumference of the pizza by its diameter and round to the nearest 100th. • Do this for three other pizzas using the provided measurements. • Describe the mathematical relationship between circumference and diameter (Circumference is always a little more than three times the diameter). • Listen to teacher description of Pi and understand that Pi is about 3.14. • Look at calculator to see the Pi button and the value of Pi. Discuss with classmates and teacher why Pi continues on and on. • Develop formula to show how Pi can be used to find the circumference of a circle. • Use the formula to find the circumference of the circle. • Compare the measured circumference to the calculated circumference. Explain why these numbers might be different.
Evaluate Assess Understanding	• Find the diameter, radius, and circumference of everyday objects. Examples include: jar lid, coin, Frisbee. • Write or draw the steps for finding the circumference of a circle. • Complete problems using circumference formula.

AG E^5

Pizza Lesson Organizer

5 E's	What the Teacher Does
In Advance Prepare Materials for the Lesson	1. Photocopy pizza worksheets. 2. Set up the overhead projector and prepare an overhead transparency. The transparency should include: center point, circumference, radius, and diameter. 3. Gather string, yarn, and other possible materials for students to measure the circumference.
Engage Encounter The Topic	1. Display the prepared overhead transparency. 2. Discuss the terms center point, circumference, radius, and diameter with students. 3. Instruct to students to cut out the large pizza from the center of the Pizza Ag Mag. Then, ask them to fold it in half to find the center. 4. As students label their pizzas with each term and write their definitions, float between students to ensure their understanding. If students are struggling, refer them to the example on the overhead transparency.
Explore Active Involvement	1. Check students' understanding of radius and diameter and make sure they have the correct measurements. 2. Ask students to explain the formula they created to find the diameter. 3. Help students brainstorm ways to measure the circumference. Ask guiding questions: How could we measure the distance around the circle? What kinds of tools could we use for that? *Yarn and a ruler is a great solution, but let students create their own.*
Explain Communicate Discoveries	1. As a whole class, have students share their measurements. 2. Encourage students to explain their findings using the pizza cut-out. 3. Ask students: What is the relationship between the radius and diameter? 4. Test the students' diameter formula, provide them with a number for the radius and ask them to determine the diameter.
Extend Make Connections and Apply Understanding	1. In a class discussion, ask: What did you find when you divided the circumference by the diameter? What is the relationship between the two? How can we describe this relationship mathematically? 2. Introduce the concept of Pi. Explain to students that pi represents the ratio of a circle's circumference to its diameter. Therefore, the circumference of a circle will always be a little more than three times the diameter, or Pi. 3. Show students the value of pi and explain that this number continues on and on with no repeating patterns. 4. Help students find the pi button on their calculators. 5. Help students create a formula to find the circumference of the circle using Pi. 6. As a class, compare the measured circumference to the calculated circumference. Ask students: Why are these numbers different?
Evaluate Assess Understanding	*Choose any of the following for an assessment::* • Find the diameter, radius, and circumference of everyday objects. Examples include: jar lid, coin, Frisbee. • Write or draw the steps for finding the circumference of a circle. • Complete problems using circumference formula.

What's the Pi in my pizza pie?

DEFINITIONS

Center point:

Radius:

Diameter:

Circumference:

FIND THE RADIUS AND DIAMETER

1. Measure the radius and diameter. Measure to the nearest centimeter.
2. Label each with their measurement and write them in the boxes below.

RADIUS OF THE PIZZA	DIAMETER OF THE PIZZA

What is the relationship between the radius and diameter of a circle?

Create a formula for finding the diameter of a circle.

What's the Pi in my pizza pie?

FIND THE CIRCUMFERENCE

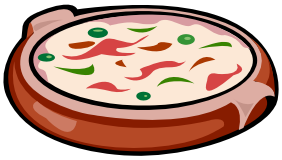
1. Brainstorm ways to measure the pizza's circumference.
2. Using one of these methods, measure the circumference and write it in the space below. Measure to the nearest centimeter.

CIRCUMFERENCE OF THE PIZZA

FINDING THE Pi

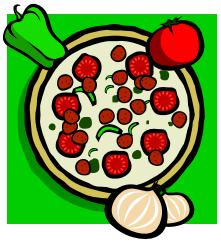
Divide the circumference of the pizza by the diameter.

For each of the following pizzas, divide the circumference by the diameter. Write the result in the space provided.



diameter: 40 cm
circumference: 126 cm

diameter: 14 cm
circumference: 144 cm



diameter: 66 cm
circumference: 208 cm

Compare the diameter to the circumference.
What is the relationship between the diameter and circumference of a circle?

What's the Pi in my pizza pie?

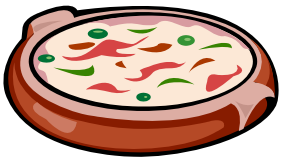
CIRCUMFERENCE FORMULA

After learning about Pi, create a formula using Pi to find the circumference of a circle.

FIND THE Pi in your PIZZA PIE!

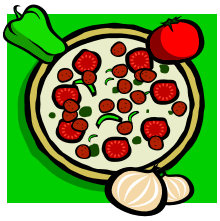
Use your circumference formula to find the actual circumference of the pizza. Be sure to show all of your work.

Find the actual circumference for the pizzas below.



diameter: 40 cm
circumference: 126 cm

diameter: 14 cm
circumference: 144 cm

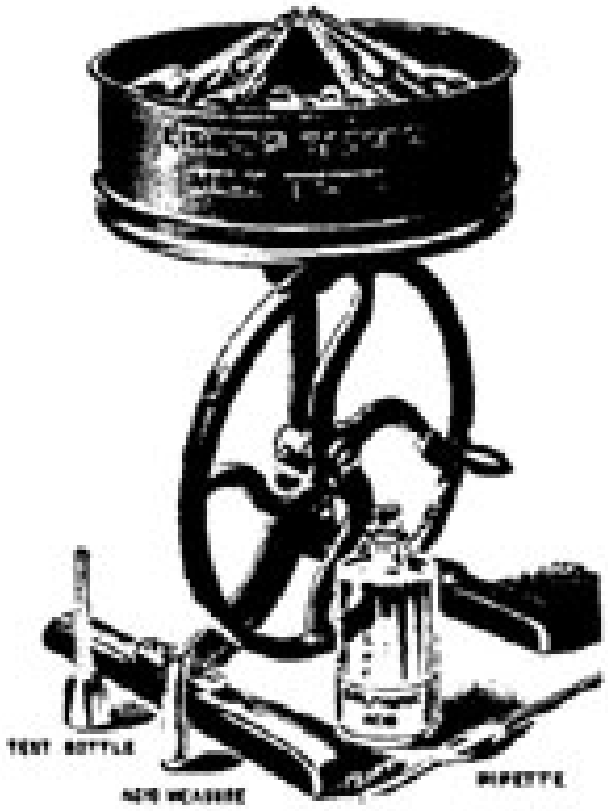


diameter: 66 cm
circumference: 208 cm

Compare the measured circumferences to the calculated circumferences. Describe your findings on the lines below.

OBJECT ONE

Photo from: www.flexi.net.au



OBJECT TWO

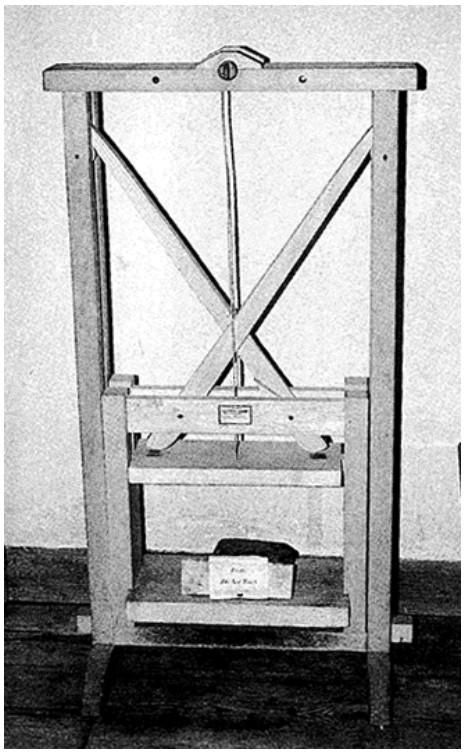
Photo from: http://pilgrim.ceredigion.gov

OBJECT THREE

Photo from: http://pilgrim.ceredigion.gov

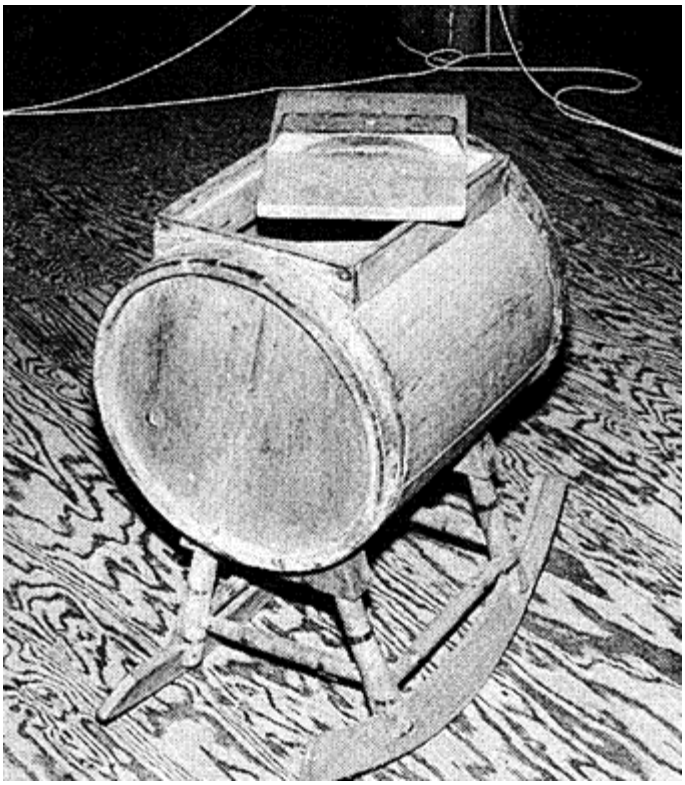
OBJECT FOUR

Photo from: www.nofa.org/thf/fall99/afe.php Photo by Jack Kittredge



OBJECT FIVE

Photo from: www.nofa.org/thf/fall99/afe.php Photo by Jack Kittredge



OBJECT SIX

Photo from: www.museum.siu.edu

AG E^5

Illinois Learning Standards and Assessment Framework

Activity	Illinois Learning Standards	Illinois Assessment Framework
Using the 5 E's to Explore Soil	11.A.2a; 11.A.2b; 11.A.2d; 12.A.2a	11.4.01; 11.4.02; 11.4.03; 11.4.04; 12.4.04
Skill Builder: Get to Know Your Apple	11.A.2b; 13.A.2c	11.4.02; 13.4.03
Skill Builder: It's a MOO-STERY	3.C.2a; 11.A.2a; 11.A.2b; 13.B.2b; 16.A.2c	3.5.17; 3.5.18; 11.4.02; 11.4.03; 13.4.11
Skill Builder: Picking Up Where It Left Off	1.C.2a; 1.C.2b *Written Project:* 3.A.2; 3.B.2b; 3.C.2a *Presentation:* 4.B.2a; 5.C.2a; 5.C.2b	1.5.08; 1.5.11 *Written Project:* 3.5.01; 3.5.06; 3.5.15; 3.5.17; 3.5.18; 3.5.25; 3.5.28
What causes a seed to germinate?	6.C.2a; 11.A.2a; 11.A.2b; 11.A.2d; 11.A.2e; 12.A.2a	6.5.12; 11.4.01; 11.4.02; 11.4.04; 12.4.05
Why is Illinois a good place to grow pumpkins?	1.C.2a; 1.C.2d; 5.A.2a; 5.A.2b; 5.B.2a; 5.C.2b; 11.A.2a; 11.A.2d; 11.B.2b; 11.B.2c; 12.A.2b; 17.A.2b	1.5.11; 1.5.15; 11.4.01; 11.4.02; 11.4.03; 11.4.04; 11.4.06; 12.4.04
What factors cause the price of corn to change every year?	5.A.2a; 5.A.2b; 5.C.2b; 10.A.2c; 15.A.2a; 15.B.2a; 15.B.2b; 15.C.2a; 15.C.2b; 16.A.2ac	10.5.01
What are the formulas for the perimeter and area of rectangle?	6.C.3a; 7.A.3b; 7.C.3b	6.6.12; 7.6.02; 7.6.06
What's the Pi in my pizza pie?	7.A.3b; 7.C.3b; 9.A.3c	7.8.01; 7.8.02; 9.8.04

Illinois AGRICULTURE in the Classroom℠

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