Lesson Number: MS.AST.2.5

# Research in Agriculture

***Middle School Food and Agricultural Literacy Curriculum***

## Precepts

B. Relationships

B4. Eliminate barriers in building relationships.

## National Standards

CS.11.01.01.c. Demonstrate procedures and a conceptual understanding of scientific investigation.

AS.03.01.05.b. Explain the health risks of zoonotic diseases to humans and their historical significance and future implications.

BS.03.01.01.a. Explain biological, social, agronomic and economic reasons for genetic modification of eukaryotes.

BS.03.03.08.c. Evaluate the technologies used to create biofuels from biomass.

PS.03.03.03.b. Describe types of pesticide controls and formulations.

PST.05.03.01.b. Explain and evaluate concepts and principals of geospatial technologies.

NL-ENG.K-12.12 – Applying Language Skills

NS.5-8.1 – Science as Inquiry

NS.5-8.3 – Life Science

NS.5-8.5 – Science and Technology

NS.5-8.6 – Science in Personal and Social Perspectives

## Student Learning Objectives

As a result of this **unit** the students will…

Discuss agricultural research.

As a result of this **lesson** the students will …

Identify one way the scientific method is used in agriculture research.

## Content Outline

**I. Identify one way the scientific method is used in agriculture research.**

A. Discuss the results of using the scientific method for the following:

## Time

Instruction time for this lesson: 90 minutes.

## Resources

Biofuel. (n.d.) Retrieved November 2, 2009, from Wikipedia: http://en.wikipedia.org/wiki/Biofuel — Dana, Peter H. (1994). The Geographer's Craft Project, Global Positioning System Overview. Retrieved November 2, 2009, from The Department of Geography, The University of Colorado at Boulder. Website: http://www.colorado.edu/geography/gcraft/notes/gps/gps_f.html — Medical Discoveries. (2007). Genetic Engineering. Retrieved November 2, 2009, from Website: http://www.discoveriesinmedicine.com/Enz-Ho/Genetic-Engineering.html — National FFA Organization. (2009). LifeKnowledge Online. Retrieved July 9, 2009, from http://agedlearning.org — National FFA Organization. (2003). LifeKnowledge Precepts and Signs of Success. — United States Environmental Protection Agency. (2009). Pesticides. Retrieved November 2, 2009 from About Pesticdes. Website: http://www.epa.gov/opp00001/about/ — Using GPS, Precision Agriculture Making Big Impact on Farms. (2007) Retrieved November 2, 2009, from Associated Content: Bible Doc Website: http://www.associatedcontent.com/article/303675/using_gps_precision_agriculture_making.html — U.S. Food and Drug Administration, Vaccines, Blood and Biologics. (2009). Xenotransplantation. Retrieved November 2, 2009, from United States Department of Health and Human Services Website: http://www.fda.gov/BiologicsBloodVaccines/Xenotransplantation/default.htm — The Scientific Method. (2005). Retrieved November 2, 2009, from Make it Solar: http://www.makeitsolar.com/images/chartmethod002.jpg

## Tools, Equipment, and Supplies

Overhead projector/transparencies
Ziploc Bags
MS.AST.2.5.AS.A – Print out two pages and cut each word into letters
MS.AST.2.5.TM.A – Cut apart by section
MS.AST.2.5.TM.B – one per teacher
MS.AST.2.5.TM.C – one per teacher
MS.AST.2.5.TM.D – one per teacher
MS.AST.2.5.TM.E – one per teacher
MS.AST.2.5.ASSESS.A – one per student

## Key Terms

***Flowchart***

1. Xenotransplantation
2. Gene splicing
3. Pesticides
4. Biofuel
5. Global positioning system

B. Develop a flowchart for the scientific theory

1. Components of the Scientific Method in Alphabetical Order:
   a. Analyze the results
   b. Choose your topic
   c. Design the experiment
   d. Develop a hypothesis
   e. Formulate conclusions
   f. Identify a problem
   g. Research the problem
   h. Test the hypothesis

## Interest Approach

Welcome students to your class. Students will engage in a group introductory activity that asks them to organize a bag of letters into a word. This word is a result of agriculture scientists using the scientific method. Utilize **MS.AST.2.5.AS.A** and cut up each word into letters, placing each cut up word in a bag and handing out one bag to each group.

Good morning/afternoon. It's good to see you all made it to class this morning. To start things off, we will be using our organizing skills to identify some of the great outcomes of the scientific method. When I say OPEN, take the Ziploc bags that will be handed out and spread out the items inside onto your table. Each item in the bag is a letter. Our task is to take the letters and organize them into a word or phrase. Each word or phrase is a result of agriculture using the scientific method. See how long it takes to create a word from the letters. We'll have three minutes. What questions do you have? OPEN!

# Summary of Content and Teaching Strategies

**Objective 1:** Identify one way the scientific method is used in agriculture research.

After the three minutes are up, go around the room asking each group what word they created. If the group struggled to create the correct answer, provide them with it by giving each group the information sheet for their scrambled letters (then cut apart pieces of **MS.AST.2.5.TM.A**). Ask each group to do a quick presentation reflecting their outcomes.

Now that we have unscrambled our scientific outcomes, please review the information for that outcome. Be prepared to give a brief overview to the rest of the class about your outcome.

Allow students to review the information and report to the class.

Great job! The amazing discoveries in agriculture are a result of the scientific method. It's important to realize that not everything that agricultural scientists discovered happened in a perfect, straight line. If that's true, how do you think these discoveries were made?

Elicit student responses.

Direct students to consider and think about how the scientific method does not always instantly end in a desired result. Instead, the scientific method helps us to continue to ask questions. It's the process of asking questions that leads scientists to further questions and answers which can ultimately bring about new discoveries. The advancement of humankind is result of the major discoveries of the scientific method.

Utilize the *Go-With-The-Flow-e-Moment®* to explain to students the relationship of lines and shapes of a flowchart. Utilize **MS.AST.2.5.TM.B** for a visual representation.

In this next activity, we are going to create a ***flowchart*** or process diagram showing the step-by-step relationship of how the scientific method works.

Flowcharts are easy-to-understand diagrams showing how steps in a process fit together. It makes them useful tools for communicating how processes work. The act of mapping a process out in flowchart format helps you clarify your understanding of the process, and it helps you think about where the process can be improved.

A flowchart can be used to:

- Build a step-by-step picture of the process for analysis, discussion, or communication.

Find improvement in a process.

Let's look at an example ***flowchart*** that asks the question, "Should I buy it?" and analyze how it is used to help individuals make smart money management decisions.

Display **MS.AST.2.5.TM.C**. Follow the steps with students to identify whether or not a purchase is the right decision toward using their money wisely. Point out the step-by-step process and discuss the purpose of each question asked. After you review the example, lead students into creating their own flowcharts for the following steps of the scientific method:

Now that we've seen how important each step is in making the right decision and ending up with a positive result, let's put our new knowledge to work!

When I say ***FLOWCHART***, our assignment is to create a ***flowchart*** that represents the process between the parts of the scientific method. To remind us of the steps, here they are.

Display **MS.AST.2.5.TM.D**

When you are finished, please sit quietly. We have three minutes. What questions do you have? ***FLOWCHART.***

Great job creating those ***flowcharts***. Now that we are all finished, let's share our ideas with our neighbors. Take one minute and compare the differences of your ***flowchart*** with a neighbor.

Allow students to discuss for a minute, and then proceed. Be sure to move about the room to guide students with ideas for flowcharts if you see students struggling with this activity.

Raise your hand if your interpretation of a flowchart of the scientific method looked very different from that of the person you shared with.

Acknowledge student responses.

How were they different?

Elicit student responses. Student responses may include the direction of the chart, the shapes used, the number of steps, etc. Display **MS.AST.2.5.TM.E** for students to view a commonly used flowchart of the scientific method.

Please raise your hand if you created or viewed a ***flowchart*** that showed a barrier.

If a student raises their hand, ask them what barrier was shown and continue with the discussion. If few students respond, explain how there are barriers that we face when using the scientific method.

Let's look at how there can be barriers in the scientific method.

Utilize the whiteboard to draw a flowchart with barriers as you explain. Examples of scientific method flowcharts are available as transparency masters or just as reference points for you: **MS.AST.2.5.TM.B**.

Observations are made, a question is posed, and a test is done. This process sounds simple, but many times scientists run into barriers. A barrier is a bump in the road or a stopping point that causes your test to not work or end in an undesired result.

Almost every relationship has a barrier along the way, but just because there is a bump in the road doesn't mean that we can't get past it. What barriers does the average person deal with in their lifetime?

Student responses may include financial struggles, family ties, career obstacles, etc.

Very good. Barriers are not desirable but we can overcome them. In science, there are constantly barriers in the relationships between problems and solutions. However, with hard work and dedication, we have been able to overcome some of the greatest barriers in the world. You can do the same thing in your life.

## Review/Summary

Review how the scientific method is used by having them participate in a Karaoke e-Moment. Split students into small groups and have them rewrite the words to the song "Jingle Bells."

Let's review today's lesson in a creative way. When I say PRACTICE, write the words to a song using the steps of the scientific method. To start, list the steps of the scientific method on a piece of paper. Then rewrite the words to the song "Jingle Bells" using your list of steps. When finished we will share our songs with the class. We will have 15 minutes to complete this task in groups of three. What questions do you have? PRACTICE.

Excellent job today. Each of us did a great job participating in our activities. Today we showed ourselves how well we understand the scientific method and how it is used in agriculture. Next time we meet we'll apply what we've learned and see firsthand agriculture research at its best!

## Application

***Extended Classroom Activity:***

Work with your local farm machinery business to bring in a high-tech piece of equipment that demonstrates the progression of agriculture through research or create advertisements for such technology,

***FFA Activity:***

Introduce students to the agriscience CDE and what opportunities there are for students interested in this topic.

***SAE Activity:***

Students could pursue an exploratory SAE project investigating an agriculture question and create an agriscience project.

## Evaluation

MS.AST.2.5.ASSESS.A

## Answers to Evaluation

1. B
2. D
3. D
4. B
5. D

# Agriculture Results of the Scientific Method

1. XENOTRANSPLANTATION

2. GENE SPLICING

3. PESTICIDES

4. BIOFUEL

5. GLOBAL POSITIONING SYSTEM

Teacher Directions: Cut apart by section and provide to each group as they finish unscrambling their scientific outcomes.

## XENOTRANSPLANTATION

**Xenotransplantation is the transplantation of living cells and tissues from one species such as a pig to another, that of a human. The development of this process via the scientific method has been driven by the increasing demand for human organs, far exceeding the supply available. Currently 10 patients will die in the United States due to a lack of organs available. Xenotransplantation has been the answer to this problem as a result of the scientific method, but also carries with it some concerns. Zoonotic disease, disease passed on from animal to human, raises concerns about the safety of transplantation along with the lack of knowledge readily available from the minimal medical usage of this process.**

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## GENE SPLICING

**Genetic engineering is the human altering of the genetic material of living cells to make them capable of producing new substances or performing new functions. Genetic engineering allows scientists to identify specific genes, remove them, and clone (duplicate) them, and use them in another part of the same organism or in an entirely different one. Genetic engineering promises a revolution in agriculture. It is now possible to produce plants that will survive freezing temperatures, take longer to ripen, convert atmospheric nitrogen to a form they can use, manufacture their own resistance to pests, and so on. By 1988 scientists had tested more than two dozen kinds of plants engineered to have special properties such as these. Domestic animals have been genetically "engineered" in an inexact way through breeding programs to create more meaty animals, etc., but with genetic engineering, these desirable traits could be guaranteed for each new generation of animal. Another example is corn. Cells of corn plant can be changed by genetic engineering to create a plant that will yield more ears of corn altering it to grow taller instead of wider, therefore increasing the amount of food produced per acre. This result of the agriculture research through the scientific method is decreasing the food supply issues in our world.**

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## PESTICIDES

**A pesticide is any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant. Though often misunderstood to refer only to insecticides, the term pesticide also applies to herbicides, fungicides, and various other substances used to control pests. Research on pesticides began when an overabundance of living organisms that that were not wanted or caused damage to crops, humans, or other animals became a problem. Research has resulted in many types of pesticides through investigation by the scientific method. From biological remedies such as pheromones, to chemical uses such as round-up, pesticides manage pest damage to crops and animals along with extended uses as household cleaners and rodent control.**

## BIOFUEL

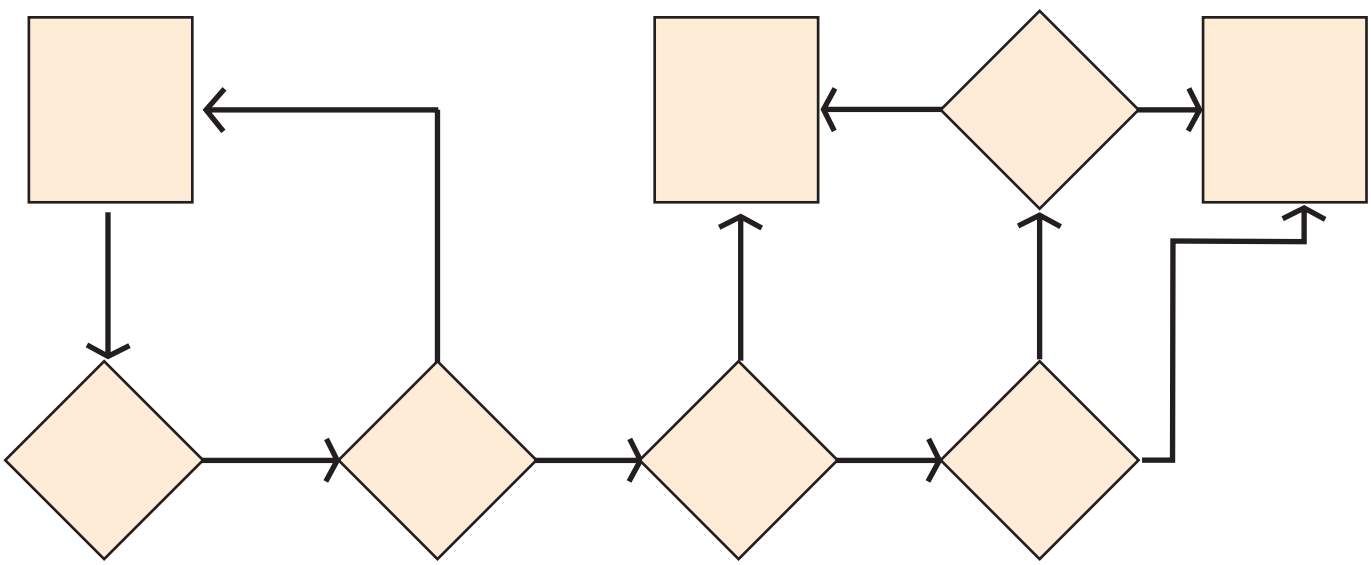
**Biofuel is a liquid fuel derived from biologic things, commonly plants. Biofuel research came about due to oil price spikes and the need for increased energy security. Biofuel comes in two different packages; bioethanol and biodiesel. Bioethanol is an alcohol made by fermenting the sugar components of plant materials, and it is made mostly from sugar and starch crops. With advanced technology being developed, cellulosic biomass, such as trees and grasses, are also used as feedstocks for ethanol production. Bioethanol is widely used in Brazil, where 100% of the gas stations sell it and all gas contains 25% bioethanol. Biodiesel is made from vegetable oils, animal fat, or recycled greases. Biodiesel can be used as a fuel for vehicles in its pure form, but is usually used as a diesel additive. Biodiesel is produced from oils or fats using transesterification and is the most common biofuel in Europe. Biofuels provided 1.8% of the world's transport fuel in 2008 and investment into biofuels production capacity exceeded $4 billion worldwide in 2007 and is still growing.**

## GLOBAL POSITIONING SYSTEM

**Global positioning systems (GPS) were funded and developed by the U.S. Department of Defense, created for majority usage by the United States military. GPS systems are the creation of specially coded satellites using signals worldwide to identify position, velocity, and time. GPS is commonly thought of as a means to assist in navigation for a driver to get from one place to another. In today's world of agriculture, it is the leading mechanism for precision agriculture. Crop planting is now being done by farmers using a combination of GPS and an auto-guide system to plant crops precisely. GPS can make it possible for a farmer to plant grain within an inch of where he wants the seed to go. To optimize the use of fertilizer and seed, a strip of fertilizer can be laid down using the GPS and auto-guide systems, and seed will be planted in that fertilizer strip. The combination can prevent the waste of fertilizer and optimize the growing of the seed. The precision system prevents the overlapping of rows and reduces unnecessary trips across the field.**

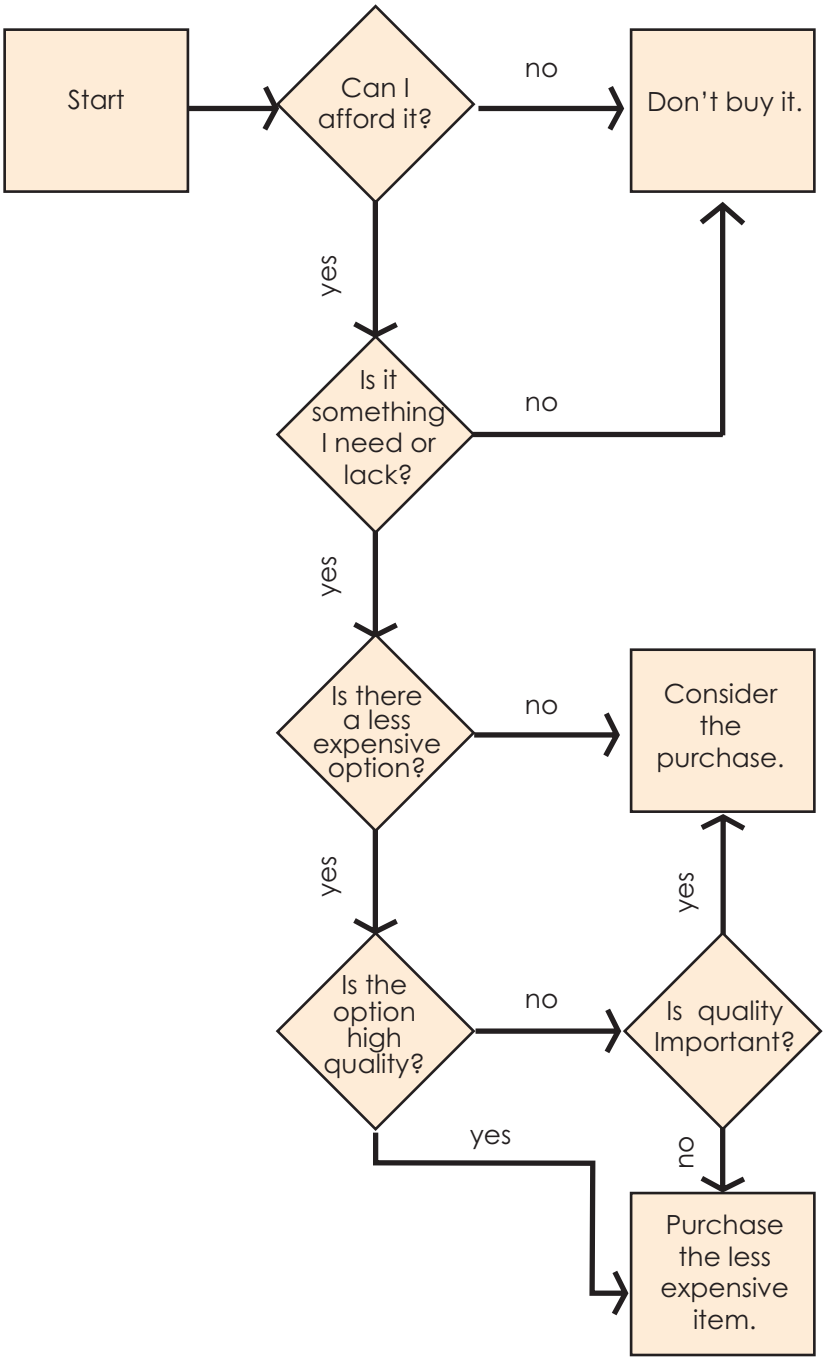
# Flowchart Example

**A. A flowchart** is a relationship that you create between lines and shapes that explain a process.



# "Should I buy it?"

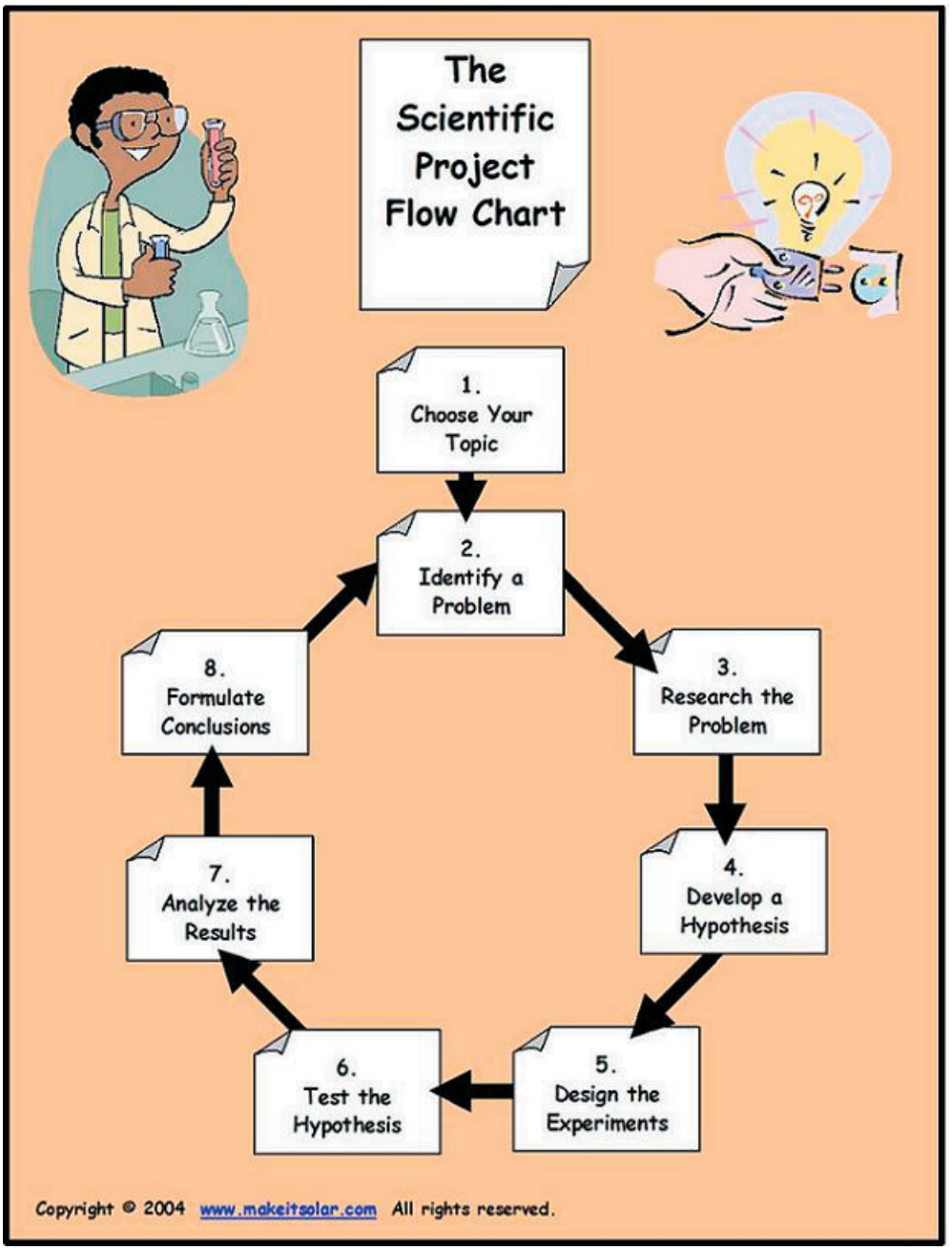
## Flowchart



# Components of the Scientific Method in Alphabetical Order:

- Analyze the results
- Choose your topic
- Design the experiment
- Develop a hypothesis
- Formulate conclusions
- Identify a problem
- Research the problem
- Test the hypothesis

# Scientific Method Flowchart



# Multiple Choice

**Name**_____

Directions: circle the correct answer.

1. **Which answer best represents the results discovered through the scientific method that uses different species internal organs as replacement for humans?**
   a. Transesterification
   b. Xenotransplantation
   c. Gene splicing
   d. Representation

2. **Which answer best represents the word pesticide?**
   a. Insecticide
   b. Herbicide
   c. Fungicide
   d. All of the above

3. **Which of the following answers is not a purpose of gene splicing?**
   a. Alter or duplicate genes to make new substances
   b. Produce plants that can fight freezing temperature
   c. Create more crop yield on the same amount of land
   d. Force farmers to farm more environmentally safe

4. **As a result of the scientific method used by the agriculture scientist, biofuel is a new fuel created from what means?**
   a. Oil
   b. Biological matter
   c. Gasoline
   d. Chemicals

5. **Which of the following examples is an impact made upon agriculture from the research completed about global positioning systems?**
   a. Farms all use GPS, so they are more uniform
   b. Farmers don't have to work as much as they used to
   c. Farming isn't as hard because of the new technology
   d. Farmers can grow food faster and more efficiently