Agricultural Lesson Plan

LESSON PLAN :	CROP SCIENCE

Lesson Title:	AGRICULTURAL LAND USE		
Grades:	7-8 ADV	Lesson Duration:	3- 60 minute lessons

Lesson Objectives:

Students explore the impact of fertilizer on algae growth, soil erosion, and agricultural soil and water conservation practices.

Standards:

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

MS-LS2-E-3 Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Materials / Equipment:

Activity 1:

- Algae Experiment Planning Sheet (https://naitc-api.usu.edu/media/uploads/2015/12/29/Algae_Experimental_Planning_Sheet.pdf)
- Algal culture, such as Oscillatoria, Chlorella, or mixed algae, 2 ML per student group
- Distilled Water
- Liquid Plant Fertilizer
- Masking tape and markers
- Transfer pipettes
- Test Tubes and a test tube rack, enough for groups of students
- Plastic wrap (for the tops of the test tubes)

Activity 2:

- Land Management Presentation (https://naitc-api.usu.edu/media/uploads/2015/12/29/Agricultural_Land_Use_Presentation.pdf)
- Projection equipment
- Three plastic 1L or 2L soda bottles, cut in half length-wise, empty and clean
- Soil
- Additional leaf and forage material for creating natural soil conditions
- A chunk of sod, sized to fit within the plastic bottle demonstration area
- Clear plastic cups or glass beakers to measure water runoff

- Water, at least 100 mL

Activity 3:

- Conservation Practice Research Guide (https://naitc-api.usu.edu/media/uploads/2015/12/29/Conservation_Practice_Research_Guide.pdf)
- Internet access for each student, or group of students

Activity 4:

- Land Management Plan worksheet (https://naitc-api.usu.edu/media/uploads/2015/12/29/Land_Management_Plan.pdf)
- Internet access for each student, or group of students

Vocabulary

algal bloom: a rapid increase in the population of algae in a given area of water, which often causes the water to look green

erosion: the process of removing topsoil from one area and depositing it in another through the action of wind or water

fertilizer: material added to soil to increase soil fertility and crop yield; can be organic (such as manure or compost) or inorganic

plowing: the act of turning over the top layer of soil to prepare for planting which brings nutrients to the soil surface and buries old plant litter; performed with a tractor and plow

tilling: preparing soil for planting by breaking up clumps of soil to provide an even bed for seeds; performed with a tractor and tilling implement

topsoil: the top layer of soil, where most nutrients are available for plants

Summary of Tasks / Actions:

Background Agricultural Connections

Modern agriculture methods play an important role in our society. Agricultural producers utilize the latest research in crop genetics and land management as well as animal production methods to produce a safe and abundant food supply. In addition, agricultural plants and animals provide fuel, clothing, shelter and thousands of other products we use every day. This lesson challenges students to explore the role of synthetic fertilizers, modern agricultural machinery, and soil and water conservation techniques.

Most agricultural fertilizers contain nitrogen, phosphorous, and potassium, which are commonly limiting nutrients for plants. Fertilizers vary in the concentration of these nutrients; farmers choose which formulation to use based on the soil content of their fields and what they are growing. Fertilizers provide for more vigorous plant growth, which can improve crop yields and help prevent soil erosion. Modern plowing and tilling implements, pulled by tractors, allow farmers to prepare large fields for planting by turning over soil and providing an even seed bed.

These farming methods can have environmental impacts. Land that is tilled and left bare (for example, over the winter) is more susceptible to erosion by wind or water. Topsoil that is washed or blown away can take decades to naturally replace. Excess nutrients applied to the soil can reach waterways through runoff and the groundwater. Nutrient input from agricultural land in the Midwest is thought to contribute to the dead zone in the Gulf of Mexico. In Activity 1 of this lesson, students design an experiment to test the effect of fertilizer on algae growth. In Activity 2, students see a demonstration of water erosion in bare soil.

Farmers are land stewards who can reduce and reverse the impact of agriculture on the environment by using farming practices that conserve resources. In Activity 3, students research the following conservation practices:

- Crop Rotation: The practice of growing different types of crops on the same plot of land in sequential growing seasons. Different crops use different amounts of nutrients. If the same crop is planted continuously, the soil will become depleted of some nutrients more than others, increasing fertilizer use. For example, some crops use a lot of nitrogen, while others are able to return nitrogen to the soil. A common rotation is to plant corn one year and soybeans the next year, since soybeans are legumes, which return nitrogen to the soil.

- Cover Cropping: Cover cropping helps reduce erosion. Instead of leaving bare soil when the main crop is harvested, farmers plant an additional crop and leave it in the field over the winter. For example, a farmer might harvest corn and then plant rye to cover the field.

- Conservation Tillage: Soil preparation that leaves crop residue from the previous year's crop on the field. For example, corn stalks may be left on the field after harvest and soybeans planted directly into the corn residue the next spring. Keeping the soil covered in this manner reduces erosion and runoff

- Habitat Preservation: An area of a farm that is reserved in or returned to its pre-cultivation state, such as a grassland or wetland. These areas provide food and shelter for wildlife and prevent erosion and runoff, and provide an alternative to farming marginal land.

- Contour Farming: In hilly areas, rows of crops are planted perpendicular to the slope rather than parallel to the slope, following the contour of the land. This slows runoff from the land, allowing water to infiltrate the soil and reducing erosion.

- Buffer Stripping: An area of vegetation, often grass, planted at the edge of a field next to a body of water such as a lake or river. Filter strips help protect water quality by trapping and filtering sediment, nutrients, and other pollutants in runoff.

Most farmers employ several of these methods, and many farmers are innovating and doing on-farm research to make the best sustainable choices for their land.

Interest Approach – Engagement

1. Find historical photos or videos from the Dust Bowl. Introduce them to this disaster in our nation's history.

• Examples of short videos include Black Blizzard or Dust Bowl- A 1950's Documentary.

2. Prompt students to share their thoughts about the impact that these events had on our natural resources, specifically soil and water. Facilitate a discussion that leads students to discuss their thoughts about how farmers can negatively and positively impact the quality of these resources.

3. Summarize the discussion and introduce the lesson informing students they will be learning about conservation practices used in agriculture to preserve the soil and allow farmers to continue to provide our food and fiber for years to come.

Procedures

Activity 1: How does fertilizer affect algae growth?

Teacher Note: Four days before you plan to teach the lesson, have students set up algal cultures. They will plan and conduct a simple experiment to test the effect of fertilizer on algae growth using the Algae Experimental Planning Sheet.

1. Ask students if they have heard of fertilizer and why it is used. They may be familiar with lawn or agricultural fertilizer and may answer that it helps plants grow.

2. Pass out the Algae Experimental Planning Sheet. Have each lab group predict what the effect of fertilizer will be, and sketch out a basic experimental procedure (students should not worry about amounts of algae at this point). After students have planned their experiments, review the following procedure to make sure all students have set up an appropriate experiment.

a. Obtain two test tubes. Label one "Control" and one "Fertilizer."

b. Use a clean transfer pipette to add 20 drops of algal culture to each test tube.

c. Add 4 drops of fertilizer to the "Fertilizer" tube.

d. Cover the tubes with plastic wrap. Poke holes in the plastic to allow for air exchange.

e. Place the beakers in a sunny window or under fluorescent light for 4 days. Have students record their observations each day.

3. Discuss the results of the algae experiment as a class. Students should notice that the test tubes containing fertilizer were greener than the control tubes, indicating faster algae growth with fertilizer. Ask students to share why they think this is. Students should come away with an understanding that the fertilizer contains nutrients (N, P, K) that enable the algae to grow faster.

Activity 2: What are the environmental impacts of agriculture?

Before you begin this activity, set up the erosion demonstration (see Step 3).

1. Ask students to brainstorm ways that agriculture impacts the environment. Possible ideas include:

- natural resources (soil, water, air quality)
- animal habitat
- biodiversity
- conserve land
- energy/fossil fuel use
- waste

2. Show the image of the tractors plowing and tilling (Slide #1 in Land Management Presentation). Explain that plowing turns over the first layer of soil (about 12 inches) and that tilling further breaks up the soil to make an even surface for planting.

3. Ask students what effect they believe plowing and tilling has on erosion, the removal of soil by wind or water. Demonstrate erosion in three different conditions: bare soil, soil with some cover, and soil with plants in it.

a. Collect three plastic bottles of equal size (1-L or 2-L). Lay the bottles flat and cut an oval shape around the top to create a “boat.” Make sure that the sides of your boat are higher than the mouth of the bottle.

b. Fill two of the bottles with soil. Cover the soil in one of these bottles with leaf and plant matter. Place the sod in the third bottle.

c. Set up the three bottles so students can see them. Elevate the far ends of the bottles so that water will drain out of them. Place a clear cup or beaker beneath the mouth of each bottle.

d. Ask students to predict which soil sample will have the most erosion, or the most sediment in the runoff.

e. Pour an equal amount of water (~100 mL) onto the soil or plant matter in each bottle “boat” and evaluate the results by looking at the color of the runoff.Show the image of soil layers (Slide #2 in Land Management Presentation). The top layer is called topsoil, and it is where the nutrients and water that plants need to grow are stored. Topsoil is formed over hundreds of years by the breaking down of rock or soil parent material, and therefore cannot easily be replaced when it is eroded.

4. Ask students, “What is fertilizer and why is it used?” Explain that farmers use fertilizers to increase the nitrogen, phosphorous, and potassium available to their plants. (Slide #3 in Land Management Presentation). Refer back to the results of the algae experiment in Activity 1.

5. Ask students how fertilizer use by farmers and homeowners could cause more algae to grow in lakes and rivers. Show the image of the largest sources of nitrogen to streams (Slide #4 in Land Management Presentation). Ask students to identify the Mississippi river and tributaries. Point out the cropland and manure as sources of nitrogen and that the Midwest contributes the most, as shown in dark blue (Slide #5 in Land Management Presentation).

6. Show the image of the algae bloom (Slide #5 in Land Management Presentation). Ask students how the excess algae affect the aquatic ecosystem. Students may believe that the excess algae provide more food for other marine organisms. However, when the algae die, they are decomposed at the bottom of the ocean or lake. Decomposers use up the dissolved oxygen, resulting in a hypoxic zone. The salt and temperature gradient prevents surface oxygenated water from mixing with the hypoxic water. While older fish can usually swim to safer waters, young fish, shellfish, mussels, and crabs may be killed due to lack of oxygen.

Activity 3: How do farmers reduce the environmental impacts of agriculture?

1. Divide students into groups and assign each group one of the following conservation practices:

- Crop rotation
- Filter strip
- Cover cropping

- Contour farming
- Conservation tillage
- Habitat preservation
- Any other conservation techniques that interest students

2. Have student groups research their conservation practice to answer the questions on the Conservation Practice Research Guide. The USDA Natural Resources Conservation Service Conservation Practices website is a good resource.

3. Have students develop a poster to illustrate the practice and how it benefits the environment and share this information with the class. As each group presents their poster, the rest of the class should take notes on the major environmental benefits and uses of each conservation practice for use in Activity 4.

Activity 4: What is your land management plan?

1. Have students apply the information they learned from the class presentations to a new situation. Students will imagine that they have inherited a parcel of farmland in Minnesota (or your local area, if outside of this particular state).

2. Ask students what kind of information they would like to know about their new land. The Land Management Plan sheet gives information about the new farmland, including a map of the land and existing structures. Based on this information, students will each suggest at least two conservation practices they would choose to employ on their new farm. Students must justify their choices by writing a paragraph, stating how they expect each practice to benefit the farm and the environment, and indicate on the map the area where they would use each practice.

Concept Elaboration and Evaluation

After conducting these activities, review and summarize the following key concepts:

 The agriculture industry uses and maintains natural resources such as soil and water in order to grow and produce crops and animals that provide our food, fiber, and fuel.

 There are many examples of conservation practices designed to decrease soil erosion, maintain water quality, and preserve soil quality.

 Using sound and sustainable farming practices is important to preserve our ability to provide food for a growing population and to decrease the chance of another disaster like the Dust Bowl.

Follow up /References

https://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=82

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LESSON PLAN :	CROP SCIENCE

Lesson Title:	SEED SAVING		
Grades:	5-12	Lesson Duration:	

Lesson Objectives:

-Students generate examples of ways that seeds are prevalent in their diets.

-Through harvesting and cleaning seeds, students create a living product that can be shared to create community connections and offer food security.

Standards:

Materials / Equipment:

Variety of seeds

Summary of Tasks / Actions:

Vocabulary:

K-4: Seed Library

5-HS: Open Pollinated, Hybrid, GMO

Start a list on the whiteboard with one of these questions (5 min):

- When is the last time you ate a seed? What kinds of seeds do we eat? (Sunflower seed, poppy seed, pumpkin seed…but what about oatmeal, or anything made of wheat flour or corn?)

- How is a seed like a book? (Can travel around the world, protects what's inside, the contents are valuable – the genetic information to make a new plant – and might look different than the outside, colorful ideas that are hidden inside the suitcase can eventually blossom)

Based on the conversation, explain that we're going to explore some seeds in the garden together and that they can save some if they'd like. If you'd like to give some seeds to Queen City Seed Library for your neighbors to "check out" and use, make an envelope, label, and place in a box.

Choose a seed, clean it, and label/decorate an envelope (10 minutes)

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In the Seed Saving Garden, ask students to choose a plant they're curious about. Ask students how that plant came to be there. Explain that a seed was planted, germinated, flowered, was pollinated, and now we can save the seeds.

Follow up /References

Abbey Palmer, MSU North Farm