Lesson Plan

Fueling the World, One By-Product at a Time

Created: 03/2022 by the National FFA Organization

Description of Lesson - With National Biodiesel Day on March 18, recognizing how biodiesel and renewable biodiesel are made and making an impact comes into focus.

Student Learning Objectives:

After completing these activities, students will...

1. Describe biodiesel and its production.
2. Describe renewable biodiesel and its production.
3. Compare and contrast biodiesel and renewable biodiesel.
4. Determine careers that support biodiesel and renewable biodiesel production.
5. Construct a statement that students could share with others about biodiesel and renewable diesel.

Suggested Grade Level:

Grade 9-10 (this lesson is written to be able to scale up and down based upon your class)

Suggested Time:

45 minutes (*Time requirements may vary based upon student understanding and class schedule)

Resources/References:

1. Article: https://www.ffa.org/the-feed/fueling-the-world-one-by-product-at-a-time/
2. Website: AgExplorer, AgExplorer.ffa.org
3. Website: Renewable Diesel vs. Biodiesel, CHS, https://www.cooperativeownership.com/around-the-table/renewable-diesel-vs-biodiesel/

Related Resources:

1. Website: Agricultural Technology and Mechanical Systems CDE, https://www.ffa.org/participate/cdes/agricultural-technology/
2. Website: U.S. Department of Energy, https://www.energy.gov/sites/default/files/2014/06/f16/biomass_creatingbiodiesel.pdf

Equipment and Supplies Needed:

1. A copy of the "Fueling the World, One By-Product at a Time" worksheet for each student.
2. Internet access to read the article or print out the article in advance.

Vocabulary:

1. Biodiesel
2. Feedstock
3. Infrastructure
4. Renewable biodiesel
5. Transesterification

Cross-Curricular Connections:

Science	English/Language Arts
Students will learn scientific concepts about how biodiesel and renewable diesel are produced.	Students will construct a statement about biodiesel and renewable diesel.

Virtual Instruction Ideas:

Students can read the article online and complete the activities.

Student Activity Sheets:

Direct access to student activity sheets without lesson plan or answer key for easy upload to a learning management system or printing for classwork.

https://ffa.box.com/s/0a8q5tloz4c41ofv10r6xr1ce12nqhnf (Word)
https://ffa.box.com/s/rhgsxwiz0iv0alybn23cbejngrn4wr5q (Non-Designed)
https://ffa.box.com/s/7rhobxbjsje2ezlksdod5eegac3518d5 (PDF)
https://docs.google.com/document/d/1dOGO71a2nMIi3PMIMPz-d7q4YN11KPA9Bx36zFolMF8/copy (Google)

These Activities Are Aligned to the Following Standards:

FFA Precept

- FFA.PL-A.Action: Assume responsibility and take the necessary steps to achieve the desired results, no matter what the goal or task at hand.
- FFA.PL-C.Vision: Visualize the future and how to get there.
- FFA.PL-F.Continuous Improvement: Accept responsibility for learning and personal growth.
- FFA.PG-I.Professional Growth: Assume responsibility for attaining and improving upon the skills needed for career success.
- FFA.CS-N.Decision Making: Analyze a situation and execute an appropriate course of action.
- FFA.CS-P.Technical/Function Skills in Agriculture: Obtain knowledge and skills needed for a career in agriculture and related industries.

Common Career Technical Core

- AG2 Evaluate the nature and scope of the Agriculture, Food, and Natural Resources Career Cluster and the role of agriculture, food, and natural resources (AFNR) in society and the economy.
- AG5. Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food & Natural Resources career pathways.

AFNR Cluster Skills

- CS.02. Evaluate the nature and scope of the Agriculture, Food, and Natural Resources Career Cluster and the role of agriculture, food, and natural resources (AFNR) in society and the economy.
- CS.05. Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food & Natural Resources career pathways.

Common Core – Reading: Informational Text

- CCSS.ELA-Literacy.RI.9-10.3 Analyze how the author unfolds an analysis or series of ideas or events, including the order in which the points are made, how they are introduced and developed, and the connections that are drawn between them.
- CCSS.ELA-Literacy.RI.9-10.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the cumulative impact of specific word choices on meaning and tone (e.g., how the language of a court opinion differs from that of a newspaper).

Common Core – Writing

- CCSS.ELA-Literacy.W.9-10.2 Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

Common Core – Science & Technical Subjects

- CCSS.ELA-Literacy.RST.9.10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.

Common Core – Literacy in Science & Technical Subjects: Writing

- CCSS.ELA-Literacy.WHST.9.10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

AFNR Career Ready Practices

- CRP.02. Apply appropriate academic and technical skills. Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive.
- CRP.04. Communicate clearly, effectively, and with reason. Career-ready individuals communicate thoughts, ideas and action plans with clarity, whether using written, verbal and/or visual methods.
- CRP.05. Consider the environmental, social and economic impact of decisions. Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organizations and the environment.
- CRP.08. Utilize critical thinking to make sense of problems and persevere in solving them. Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem.

Partnership for 21st Century Skills

- Critical Thinking and Problem Solving
- Global Awareness
- Initiative and Self-direction
- Leadership and Responsibility
- Think Creatively

Lesson Plan:

1. **Bellringer:** If you had soybeans, leftover cooking oil or leftover fat from meat, what would you do with it? Why?

2. **Introduction:** On March 18, the calendar will mark National Biodiesel Day. Biodiesel and renewable diesel are quickly becoming a staple and major need for how society powers many engines across the globe. Finding sustainable uses for our waste and more green ways to power our lives is critical to ensuring our planet's health and the organisms that exit and rely on its resources. Today, we will scratch the surface on what biodiesel and renewable diesel are and why they are important.

3. **Activity:** Each student needs a copy of the worksheet "Fueling the World, One By-Product at a Time."
    a. **Part 1:** Have students read the article "Fueling the World, One By-Product at a Time" and complete the questions from the article. The article can be found at https://www.ffa.org/the-feed/fueling-the-world-one-by-product-at-a-time/.
    b. **Part 2:** Next, students are going to use the resources below to compare and contrast biodiesel and renewable diesel in the production, use, etc. of the resource. Students need to include a minimum of five points in each column.
        i. CHS: Renewable Diesel vs. Biodiesel, https://www.cooperativeownership.com/around-the-table/renewable-diesel-vs-biodiesel/
    c. **Part 3:** Now, students are going to think about the careers that play a role in the biodiesel and renewable diesel fields of science by going to AgExplorer and identifying three careers that would directly involve biodiesel and biodiesel production. Students will also describe how that career fits in this segment of the industry. Lastly, students will construct a 3-5 sentence statement that they could share with someone unfamiliar with biodiesel and renewable diesel. Students should consider everything they have learned about production and use.

4. **Optional – Extended Learning Opportunities (Not factored into time requirement):**
    a. Have students make biodiesel in class with new and used vegetable oil. Check out this resource from the U.S. Department of Energy for step-by-step instructions: https://www.energy.gov/sites/default/files/2014/06/f16/biomass_creatingbiodiesel.pdf

5. **Exit Ticket:** What role do you think biodiesel and renewable diesel will have in our future economy? Give specific examples.

Name: _____

Fueling the World, One By-Product at a Time

Aligned to the following standards:
FFA.PL-A; FFA.PL-C; FFA.PL-F; FFA.PG-I; FFA.CS-N; FFA.CS-P; AG2; AG5; CS.02; CS.05; CCSS.ELA.RI.9-10.3; CCSS.ELA.RI.9-10.4; CCSS.ELA.W.9-10.2; CCSS.ELA.RST.9.10.4; CCSS.ELA.WHST.9.10.4; CRP.02; CRP.04; CRP.05; CRP.08

Part 1

Directions:

Read the article "Fueling the World, One By-Product at a Time" and complete the following activities. The article can be found at https://www.ffa.org/the-feed/fueling-the-world-one-by-product-at-a-time/.

In your own words, why is biodiesel so important to the world?

How does biodiesel directly impact you?

How many gallons of biodiesel were produced in 2021?

a. 100 gallons
b. 3 million gallons
c. 1 billion gallons
d. 3 billion gallons
e. 4 billion gallons

Which of the following is not a benefit of biodiesel, according to the article?

a. Fewer sick days
b. Reduced cancer risk
c. Fewer asthmatic symptoms
d. Lower rate of premature deaths
e. Fewer joint issues

The use of biodiesel reduces greenhouse gases by what percentage?

a. 75 %
b. 85%
c. 95 pounds
d. 85 particles

What are the three major sources of fats and oils for biodiesel use?

(1)

(2)

(3)

Name: _____

Part 2

Directions:

Using the chart below, compare and contrast biodiesel and renewable diesel in the production, use, etc. Include a minimum of five points in each column.

- CHS: Renewable Diesel vs. Biodiesel, https://www.cooperativeownership.com/around-the-table/renewable-diesel-vs-biodiesel/

Biodiesel	Similarities	Renewable Diesel
1.	1.	1.
2.	2.	2.
3.	3.	3.
4.	4.	4.
5.	5.	5.

- Would it be easy to introduce renewable diesel into our current systems? Why/why not?

Part 3

Directions:

Using AgExplorer, identify three careers that would directly involve biodiesel and biodiesel production.

1. _____: How does this career fit?
2. _____: How does this career fit?
3. _____: How does this career fit?

- Construct a 3-5 sentence statement that you could share with someone unfamiliar with biodiesel and renewable diesel. Be sure to consider everything you have learned about production and use.

Name: _____

KEY: Fueling the World, One By-Product at a Time

Aligned to the following standards:
FFA.PL-A; FFA.PL-C; FFA.PL-F; FFA.PG-I; FFA.CS-N; FFA.CS-P; AG2; AG5; CS.02; CS.05; CCSS.ELA.RI.9-10.3; CCSS.ELA.RI.9-10.4; CCSS.ELA.W.9-10.2; CCSS.ELA.RST.9.10.4; CCSS.ELA.WHST.9.10.4; CRP.02; CRP.04; CRP.05; CRP.08

Part 1

Directions:

Read the *New Horizons* article "Fueling the World, One By-Product at a Time" and complete the following activities. The article can be found at https://www.ffa.org/the-feed/fueling-the-world-one-by-product-at-a-time/.

In your own words, why is biodiesel so important to the world?
Answers will vary.

How does biodiesel directly impact you?
Answers will vary.

How many gallons of biodiesel were produced in 2021?

a. 100 gallons
b. 3 million gallons
c. 1 billion gallons
d. 3 billion gallons
e. 4 billion gallons

Which of the following is not a benefit of biodiesel, according to the article?

a. Fewer sick days
b. Reduced cancer risk
c. Fewer asthmatic symptoms
d. Lower rate of premature deaths
e. Fewer joint issues

The use of biodiesel reduces greenhouse gases by what percentage?

a. 75 %
b. 85%
c. 95 pounds
d. 85 particles

What are the three major sources of fats and oils for biodiesel use?

(1) Soybeans

(2) Rendered animal fats

(2) Used cooking oils

Name: _____

Part 2

Directions:

Using the chart below, compare and contrast biodiesel and renewable diesel in the production, use, etc.. Include a minimum of five points in each column.

- CHS: Renewable Diesel vs. Biodiesel, https://www.cooperativeownership.com/around-the-table/renewable-diesel-vs-biodiesel/

Biodiesel	Similarities	Renewable Diesel
1. Answers will vary. Example responses include: transesterification, requires different storage and handling in cold temperatures, etc.	1. Answers will vary. Example responses include: Both high-quality fuels, use the same feedstocks, meet requirements for renewable fuels standards, meet requirements for low-carbon fuel standards program, meet specifications for American Society for Testing Materials (ASTM), etc.	1. Answers will vary. Example responses include: use existing production structures, produced through hydrotreating process, naturally high cetane, expensive, etc.
2.	2.	2.
3.	3.	3.
4.	4.	4.
5.	5.	5.

- Would it be easy to introduce renewable diesel into our current systems? Why/why not?
  Answers will vary.

Part 3

Directions:

Using AgExplorer, identify three careers that would directly involve biodiesel and biodiesel production.
Answers will vary.

1. _____: How does this career fit?
2. _____: How does this career fit?
3. _____: How does this career fit?

- Construct a 3-5 sentence statement that you could share with someone unfamiliar with biodiesel and renewable diesel. Be sure to consider everything you have learned about production and use. In 2-3 sentences, describe your thoughts on biodiesel. Include thoughts on the production process and use in the economy.

Answers will vary.