



**STEM ACTIVITY:**  
**Life Cycle of Energy in Aviation**

Grades 5–8

[www.nasa.gov](http://www.nasa.gov)

# LIFE CYCLE OF ENERGY IN AVIATION

## SUMMARY

Students will undergo a series of research and documentation to ultimately create a two-tiered energy source life cycle to get a better understanding that one source of energy relies on other energy sources. Students will research to help NASA find ways to lower emissions and make flight more sustainable.

## OBJECTIVES

Students will:

- Define energy and energy sources.
- Research and identify energy sources' waste, emissions, and environmental impacts.
- Create an example of an energy source lifecycle here on Earth.
- Define Sustainable Energy and identify how NASA is using clean energy in various aeronautics missions.

## SAFETY NOTE

Students should be aware of their surroundings and carefully move throughout the room when viewing other teams' work.

**Grade Level: 5–8**

**Materials Needed:**

- Computer/Research tools
- Writing Utensils
- Science notebook or paper
- Posterboard (optional)
- Markers/colored pencils (optional)

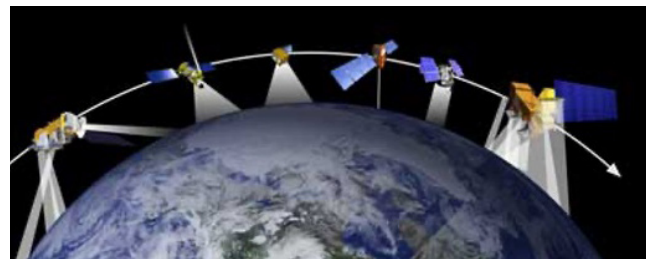
**Time required: 1 hour 10 minutes**

# BACKGROUND

In November 2021, the United States released its [Aviation Climate Action Plan](#) and committed to reaching net-zero greenhouse gas emissions from the U.S. aviation sector by 2050. NASA is helping in the attainment of this net-zero greenhouse gas emissions by making aviation more sustainable.

## First, what is a greenhouse gas?

Greenhouse gases are gases in Earth's atmosphere that trap heat. They get their name from greenhouses. A greenhouse is full of windows that let in sunlight. That sunlight creates warmth. The big trick of a greenhouse is that it doesn't let that warmth escape. On Earth, greenhouse gases let sunlight pass through the atmosphere, but they prevent the heat that the sunlight brings from leaving the atmosphere. The main greenhouse gases are Water vapor, Carbon dioxide, Methane, Ozone, Nitrous oxide, and Chlorofluorocarbons. To learn more details about these greenhouse gases, visit this [Climate Kids link](#). Overall, greenhouse gases are a good thing. Without them, our planet would be too cold, and life as we know it would not exist. But there can be too much of a good thing. Scientists are worried that human activities are adding too much of these gases to the atmosphere.



*Instruments on these satellites are collecting information and sending it back to NASA scientists.*

How do scientist know all of this?

Did you know that NASA has more than a dozen satellites studying Earth? Many of these satellites carry several science instruments and study more than one question. The information these satellites gather will help climate scientists understand Earth as a very complex system or machine.

## Second, what is Sustainable Aviation and how is this attainable?

Sustainable aviation is a multi-disciplinary field that seeks solutions to improve the environmental and societal impacts of air transportation. It aims to reduce aviation's contribution to climate change through new practices and radical innovation.

There are three main ways to make aviation sustainable, efficient aircraft technology, sustainable aviation fuel (SAF), and through operations and infrastructure. Let's dive a little deeper into each.

**Efficient aircraft technology:** needing less energy to fly means either using less fuel or, for electric aircraft, less power that must be sourced elsewhere. This means lower lifecycle emissions for the entire time an aircraft is in use. NASA works toward this through a combination of computational modeling, material and aircraft component developmental testing, wind tunnel testing, and flight testing.



*NASA's partnership with Boeing to produce and test a full-scale sustainable flight demonstrator will help lead to future commercial airliners that are more fuel efficient, with benefits to the environment, the commercial aviation industry, and to passengers worldwide.*

*Credit: Boeing*

Sustainable aviation fuel (SAF) doesn't release new CO2 into the environment. Additionally, it's been shown to reduce contrails that can trap heat in the Earth's atmosphere. NASA works toward this by a combination of computational modeling, emissions and combustion laboratory testing, and flight testing.

Operations and infrastructure, by using less energy on the ground or by choice of flight paths also reduce fuel burned and save money. NASA works toward this by a combination of computational modeling, simulations, and testing in the field.

## INSTRUCTIONS

Watch [NASA is Reinventing Aviation](#)

- Discuss and record your answer for: Why is NASA reinventing aviation?
- Write these key vocabulary words "Energy", "Energy Sources", "Sustainability", and "Clean Energy" on your paper and draw pictures or list words that come to mind when thinking of these words and how they are interconnected.
- After a few minutes share with the team and compare what you have on your papers. Come up with a common definition and connection for the words.

### **Let's find out if there is one energy source that is the best.**

- As a group, take a sheet of paper and divide it in half lengthwise.
- On the top of the left column title, "Items".
- In that column, use the next minute to list all of the items you can think of that use energy.
- On the top of the right column title, "Energy Sources"
- In that column, use the next minute to make a list of energy sources.
- Next, draw a line from each item to the energy source it can use. Remember, one item can use more than one energy source, and one energy source can be used by more than one item.

Watch [Expanding NASA Aeronautics Research for Sustainable Aviation](#)

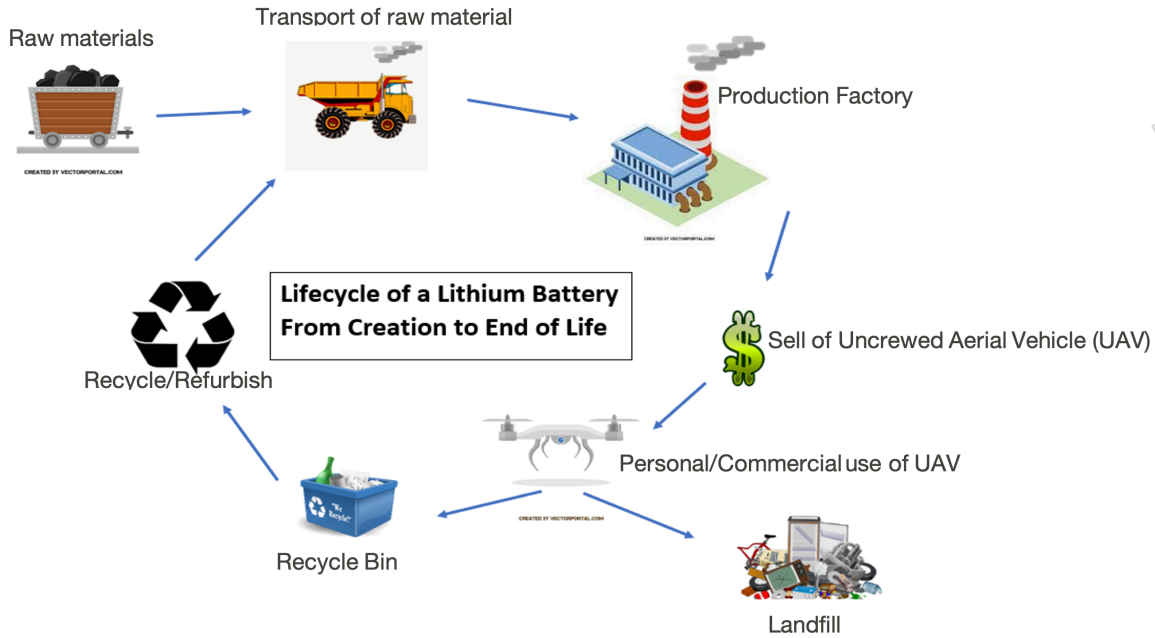
NASA is working toward reducing aviation energy use and emissions. Check the links below to learn more about NASA's transformative concepts to meet those challenges.

List the energy sources again under the “Energy Source” column, then research and find what the waste product, emissions, or environmental impact, benefits and drawbacks are for that energy source. If you need more space, add an extra sheet of paper.

Energy Source	Waste product, emissions, or environmental impact	Benefits	Drawbacks

Some energy sources may be looking more sustainable than others. One energy source cannot function as the only energy source. Different products require different sources of energy. In fact, one energy source may even rely on another. For example, to mine the raw materials for a lithium polymer battery, you will need heavy machinery that runs on diesel fuel. Therefore, the lithium polymer battery’s life cycle includes items that depend on diesel fuel.

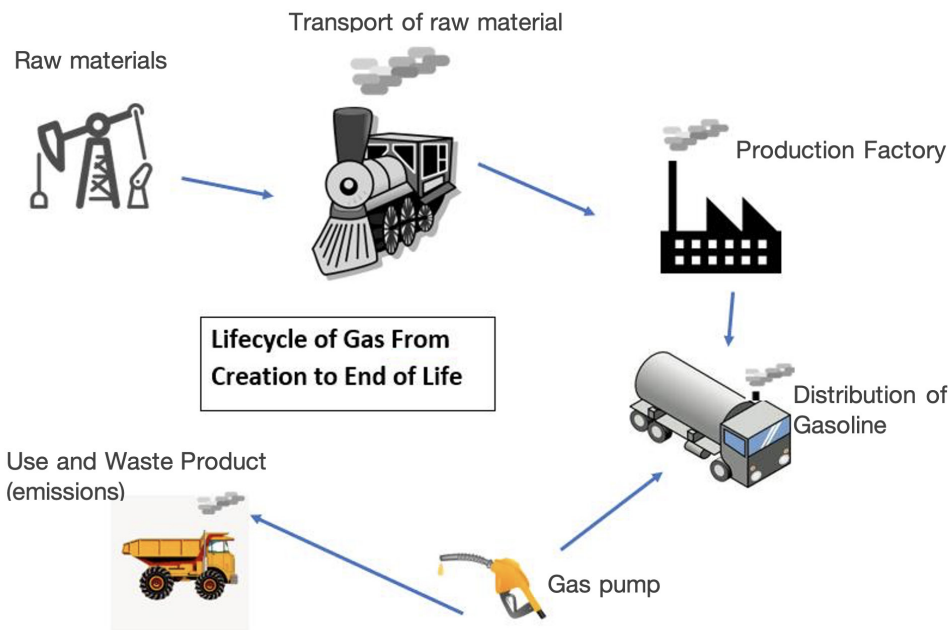
Here is an example of the Lithium polymer battery life cycle.



Example

Now choose an energy source other than a lithium polymer battery and show its lifecycle from creation to end-of-life.

Looking at the lifecycle that was just created, choose a phase that uses a different source of energy. Now make a lifecycle of an energy source that your first energy source relies on. For example, The Lithium battery relies on the truck for transportation to the manufacturer. The truck runs on gas so the second-tiered lifecycle would be gas.



Example

Think about the life cycles of other energy forms such as jet fuel. What would this life cycle look like? After researching, sketch out the life cycle of jet fuel.

### Essential Questions:

- List different modes of transportation along with their typical energy source. Then find and list an alternate energy source that could make them more sustainable.
- Is there one energy source that is better for an aircraft? Why or why not?
- How can aviation focus on conserving energy and becoming more sustainable?
- Could aviation function without fossil fuels in the next five years? Why or why not?
- How is sustainable energy beneficial?

## DIFFERENTIATION AND GOING FURTHER

- Provide students with a limited number of energy sources from which to choose.
- Provide students with images representative of the life cycle stages for the energy source choices given to them. Have students sort through the graphics to put together a complete life cycle.

### Extension

- Have students research energy consumption in their community and what their community is doing to reduce energy consumption. Students can present their findings in a brief presentation.
- Have students research common ways they can help their families reduce energy consumption based on their current lifestyle. Have students present their findings in a brief presentation.

## STANDARDS

### Next Generation Science Standards

#### Disciplinary Core Ideas

- MS-LS2-3 Ecosystems: Interactions, Energy, and Dynamics
- MS-ESS3-3 Earth and Human Activity
- MS-ESS3.C Human Impacts on Earth Systems
- MS-ESS3-4 Earth and Human Activity

#### Crosscutting Concepts

- Cause and Effect
- Science Addresses Questions About the Natural and Material World
- Energy and Matter

#### Science and Engineering Practices

- Developing and using models

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