Lesson Plan: Fighter Jet

Summary

In this lesson, students learn about the development and function of jet engines, their differences from rockets, and why jets cannot work in space. The class also explores the history of jet proliferation, unusual forms of jet propulsion, and the role of supersonic and hypersonic aircraft such as the Concorde and scramjets.
https://www.youtube.com/live/Wv3PLff-A0c?si=gph5nt0pcxvw3XgD

Objective

Students will understand the history, mechanics, and limitations of jet engines, compare jets to rockets, and analyze how advancements like scramjets may shape the future of global travel.

Standards

- NGSS MS-PS2-2: Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object.
- CCSS.ELA-LITERACY.RST.6-8.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
- C3.D2.His.2.6-8: Classify series of historical events and developments as examples of change and/or continuity.

Materials

- 9 Fun Facts: Fighter Jets
- Worksheet
- Optional: whiteboard, projector, reference images of jets, rockets, and Concorde

Activity

1. Present the 9 Fun Facts to the class.
2. Break the students into small groups and assign each group one fact to illustrate with a diagram or timeline.
3. Have each group share their work, explaining their fact and how it fits into the overall story of jet propulsion.
4. Lead a class discussion comparing jets, rockets, and scramjets, focusing on their limitations and advantages.

Introduction

Begin by asking students what comes to mind when they hear the word “jet.” Discuss how jets transformed travel and warfare in the twentieth century. Transition into the lesson by outlining how jets work, how they differ from rockets, and why some designs like scramjets point toward the future of high-speed travel.

Assessment

- Evaluate group diagrams or timelines for accuracy.
- Observe student participation in discussion to gauge understanding of the distinctions between jets, rockets, and scramjets.
- Collect completed worksheets to assess comprehension of key concepts.

Rubric

Criteria	Excellent (4)	Good (3)	Fair (2)	Poor (1)
Content Understanding	Demonstrates full understanding of jet history, mechanics, and differences	Shows good understanding with minor gaps	Partial understanding, some confusion	Limited or incorrect understanding
Discussion Participation	Actively contributes with accurate information	Participates with mostly accurate information	Limited contribution, some errors	No participation or mostly incorrect
Worksheet Completion	All sections complete with accurate answers	Most sections complete with mostly accurate answers	Some sections incomplete or inaccurate	Worksheet largely incomplete or inaccurate
Technology Connections	Effectively connects Fun Facts to future technology	Makes some connections with minor gaps	Few connections, limited detail	No attempt to connect to future technology

9 Fun Facts

1. **The jet engine was first developed in the 1930s.** Frank Whittle in Britain patented a turbojet design in 1930, while Hans von Ohain in Germany developed a working version soon after. The world's first jet-powered flights included the German Heinkel He 178 in 1939 and Britain's Gloster E.28/39 in 1941, laying the groundwork for the modern jet age.
https://cs.stanford.edu/people/eroberts/courses/ww2/projects/jet-airplanes/planes.html

2. **A jet engine is defined by how it makes thrust.** It pulls in outside air, compresses it, mixes it with fuel, ignites it, and shoots the hot gases out a nozzle to push the plane forward. This separates jets from piston engines and propellers, which move by mechanically turning blades rather than expelling exhaust gases at high speed.
https://skybrary.aero/articles/jet-engine

3. **Jets and rockets work in very different ways.** A jet engine breathes outside air, compresses it, and burns fuel with its oxygen. A rocket, by contrast, carries both fuel and oxidizer on board, which lets it operate where there is no atmosphere at all.
https://howthingsfly.si.edu/ask-an-explainer/what%E2%80%99s-difference-between-jet-engine-and-rocket-engine

4. **Conventional jets cannot work in space.** They fail beyond the atmosphere because there is no air to compress or oxygen to burn. As altitude rises, oxygen levels drop until thrust is impossible, and without air there is no lift for wings or control surfaces either.
https://www.uu.edu/dept/physics/scienceguys/2002Nov.cfm

5. **Jet engines quickly spread worldwide after World War II.** Germany's Me 262 and Britain's Gloster Meteor proved the potential of jets in combat, and nations rushed to copy or adapt the technology. By the 1950s, jets powered not only fighters but also commercial planes, with companies like Boeing and de Havilland bringing the jet engine into everyday civilian travel.
https://www.britannica.com/technology/history-of-flight/The-jet-age

6. **Jet-like propulsion comes in many unusual forms.** Jetpacks and suits use miniature turbines or rockets to lift a single person, while astronaut maneuvering units expel pressurized gas for movement in orbit. Ramjets and scramjets are other variants that rely on forward speed to compress air, showing the wide range of jet designs beyond ordinary aircraft.
https://space.stackexchange.com/questions/7749/how-do-jetpacks-work-in-space

7. **The fastest commercial jet in history was the Concorde.** It cruised at about Mach 2, twice the speed of sound, carrying passengers across the Atlantic in under four hours. Modern subsonic jets, like the Boeing 747-8, reach around Mach 0.85, while business jets like the Bombardier Global 8000 push close to Mach 0.94.
https://www.sciencefocus.com/future-technology/fastest-plane-in-the-world

8. **Concorde was retired in 2003 due to cost and restrictions.** Its engines burned enormous amounts of fuel per passenger, ticket prices were high, and sonic boom rules limited routes to over oceans. A fatal crash in 2000 and a post-9/11 downturn in air travel sealed its fate, making the aircraft no longer commercially viable.
https://airandspace.si.edu/stories/editorial/what-happened-concordes

9. **The next frontier after jets may be scramjets and rockets.** Supersonic projects like Boom's Overture still use turbofan jet engines, but hypersonic designs move into ramjets and scramjets that burn fuel in supersonic airflow. Scramjets have already proven speeds beyond Mach 5, with NASA's X-43A reaching Mach 9.6 in 2004. For global travel, combined-cycle hybrids and even suborbital rocket hops, like those envisioned by SpaceX, may eventually replace jets as the fastest way around the planet.
https://www.nasa.gov/reference/x-43a/

Worksheet

Name: _____ Date: _____

Review

1. Who patented the first turbojet design in 1930?

2. What year did the first jet-powered plane carry people?

Discussion

3. Explain how jets differ from rockets.

4. Why can rockets work in space while jets cannot?

Data Analysis

5. Concorde flew at Mach 2. If Mach 1 is the speed of sound, how many times faster than sound was Concorde?

6. NASA's X-43A reached Mach 9.6. How does that compare to Concorde's Mach 2?

Reflection

7. How did the shift from ocean liners to jets change global business and travel?

8. What possibilities could scramjets or suborbital flights open for the future?