GRADE LEVEL: 3-8 | TIME REQUIREMENT: 1-2 CLASS PERIODS

INNOVATION AND PROBLEM SOLVING

1 READING

INTRODUCTION

The following is a short essay that presents a framework for understanding how innovation happens. Using examples from WWII innovations to introduce an Adopt-Adapt-Apply framework, the essay asks students to think of how they could use examples of WWII innovations to solve today's problems using this framework.

The Adopt-Adapt-Apply framework is used throughout the curriculum and is simple enough to explain and understand even if you use later parts of the book without this essay. However, this essay provides a model of how the WWII stories will be introduced and used throughout the curriculum.

OBJECTIVE

In the beginning of the year, you can use this essay and its prompts to begin a discussion about problem-solving, innovation, and STEM careers. The essay can serve as a framework for any other activities you choose to do from the curriculum. You can supplement the reading and discussion by showing the linked video on the Real World Science curriculum webpage.

STANDARDS

NGSS DCI ETS1.B
Developing Possible Solutions

NGSS DCI ETS2.B
Influence of Engineering, Technology, and Science on Society and the Natural World

NGSS SEP
Asking Questions and Defining Problems and Constructing Explanations and Designing Solutions

NGSS CCC
Systems and System Models

PERFORMANCE EXPECTATIONS

3-5-ETS1-2
Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

MS-ETS1-2
Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

ADDITIONAL RESOURCES

To learn more about problem solving and the ideas behind the Adopt-Adapt-Apply framework, try these books:

+ *Where Good Ideas Come From* by Steven Johnson, Riverhead Books
+ *Eureka* by Gavin Weightman, Yale University Press

Glider pilot in front of WACO CG4 Glider, May 1944.
(Image: The National WWII Museum, 2014.005.051.)

READING

ADOPT-ADAPT-APPLY

When the United States entered World War II in December 1941, success was not guaranteed. In the Japanese attack on Pearl Harbor, the event that led to the United States entering the war, about 3,500 military servicemen were killed or wounded, and more than a dozen ships and hundreds of aircraft were heavily damaged or destroyed. In just one morning, our already small military suffered a great loss. At that time, the German and Japanese militaries were 10 times as large as ours. Each of those nations had been spending years preparing for war, while the United States had hardly invested in its military since World War I.

At the same time, Great Britain, the biggest ally of the United States, was under siege and being targeted by frequent air attacks. Tens of thousands had died in cities and industrial areas as result of German bombing. The Atlantic Ocean was patrolled by German U-boats that terrorized shipping and passenger lines. France had fallen, with much of it under German occupation. Japan had conquered large parts of China and Southeast Asia and controlled the natural resources there, as well as the shipping lanes of the western Pacific.

And yet the United States and its allies won.

The people of the United States rallied to the war effort, enlisted in the military, grew Victory Gardens, recycled materials, and took jobs in factories. In the industrial sector, our nation's leaders turned to **Science, Technology, Engineering, and Mathematics (STEM)** professionals to solve big problems and help us win the war. The STEM innovations of World War II can be grouped into three categories:

ADOPT

Some existing civilian and military technologies were used for new military and war production purposes with little change.

ADAPT

Some existing technologies were modified to be used for new military and war production purposes.

APPLY

Some recent advances in our understanding of how the world works were put to use in new military technologies.

When you look at WWII innovations, you can use these categories to explain how things were developed. You can also use them to think of how innovation occurs today.

- **Is something made from new information (apply)?**
- **Is it lightly modified for a new purpose (adopt)?**
- **Is it changed to match a new necessity (adapt)?**

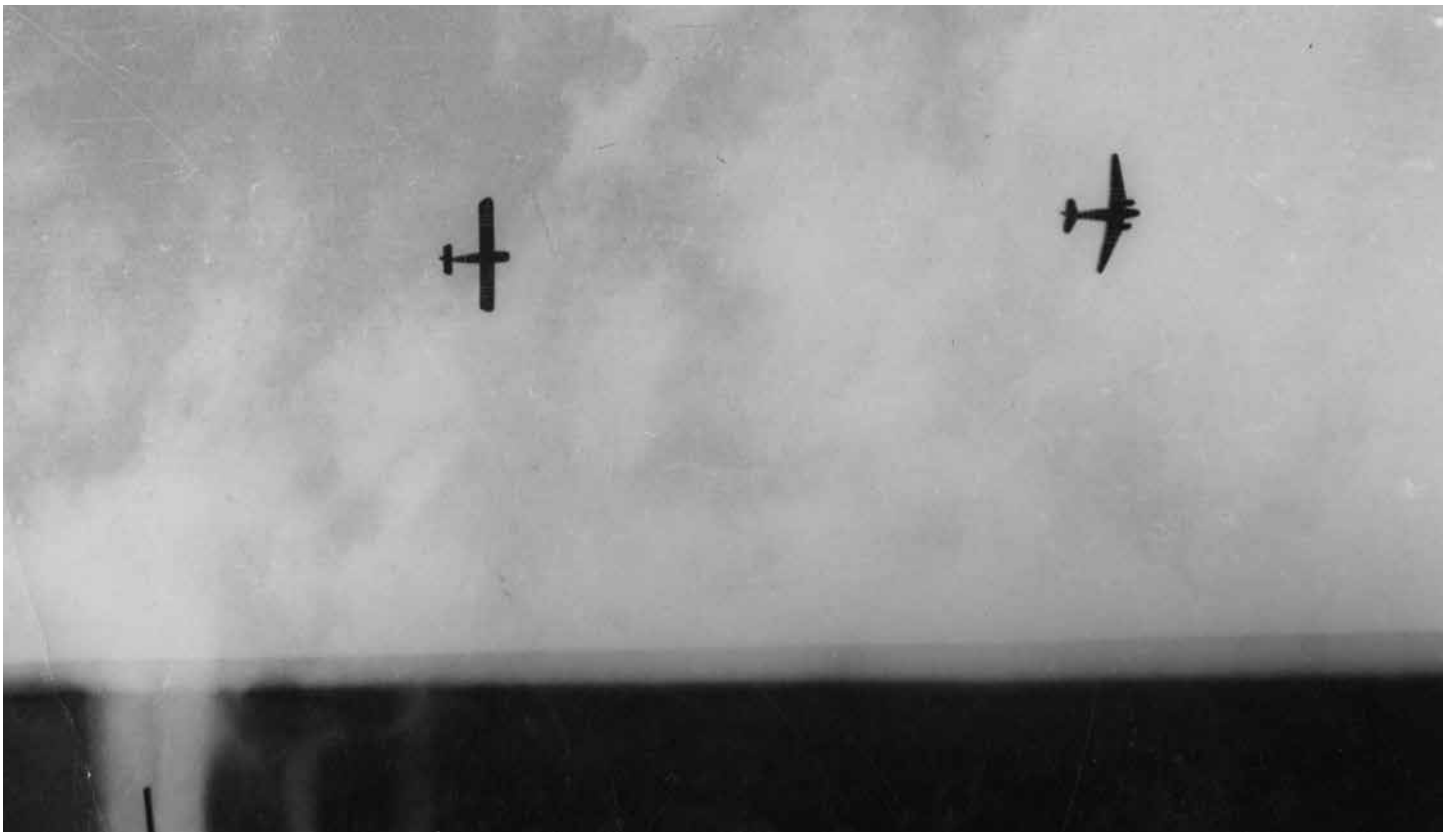
For example, the famous Higgins Boats, which made the landings at Normandy on D-Day possible, were developed by modifying boats Higgins Industries designed for fishing and working in the wetlands of south Louisiana. These boats are examples of **adaptations** of civilian technology for military use in the war. Similarly, the C-47 airplanes that dropped paratroopers behind enemy lines on D-Day were lightly modified from the DC-3 commercial airliner. The C-47 airplanes were **adopted** for military use.

Two of the biggest innovations of World War II, RADAR and atomic weapons, were **applications** of previous research. Great Britain was a center for the development of radio technology. While its cities and ports were under air attack by Germany, Great Britain sent some of its technology to the United States where it was then developed into RADAR that could be used in aircraft, boats, and ships to find the locations of enemy planes and ships. Another example of the application of discoveries is the development of atomic weapons. German scientists had discovered nuclear fission just before the outbreak of World War II. However, it was scientists in the United States who learned to control and deploy this discovery to make the first atomic bombs.

Today our society faces many problems, some of which seem as challenging as those faced by people in 1941. By looking back to the past and seeing how problems were solved, we can be better prepared to confront challenges today. We can **adopt** already existing technologies for new uses. We can **adapt** some past innovations to solve new problems. We can, and should, use our knowledge of both the past and the present to address some of today's most pressing needs.

1. **What are some technologies that you value? Write them down, and explain whether you think each is an example of adopt, adapt, or apply?**

NAME: **DATE:**



A C-47 pulling a glider across the sky. June 6 1944. D-Day, over the English Channel.
(Image: The National WWII Museum, 2011.178.014.)

2. What is a big problem in the world today that matters to you? How could future STEM professionals (like you!) solve this problem?

3. Which of the three methods of innovation do you think will be the most important for solving the problems of today and tomorrow? Explain your thinking.