

Lesson Plan Intro

This lesson plan is intended to provide students with a connection to the ways innovation and invention are born out of competition and necessity. Harry Miller and Fred Offenhauser impacted the world of racing, and particularly the Indianapolis 500, for decades. The competition between the two of them, as well as the larger racing community, created an engine legacy that is attributed to winning the most Indianapolis 500 races. Through their story and how they fit into the larger context of what was taking place in America in the early twentieth century, the IMS Museum hopes to help classrooms explore the ideas of innovation and invention.

Essential Questions

- What is *innovation*?
- What is *invention*?
- What does innovation mean to you and how do we see it in our lives today?

Objectives

- Introduce the story of the Miller-Offenhauser engine legacy
- Discuss the differences between *innovation* and *invention*
- Discuss what factors affect innovation

Instructions

1. Read over materials provided
2. Conduct further research if necessary
3. Present materials and information to class
4. Guide through activities

Time Needed

- 1-3 class periods
- 30 minutes to present materials
- 30 minutes for student research
- 30 minutes for student presentations
- (optional 30 minutes for additional work on group projects- extending to 4 class periods)

Activity

1. Compose a short essay on the topic of innovation, identifying innovations the student would like to see.
2. Individually or as a group activity, create a “pitch” for the innovation that they would like to see in their world
 - a. Create a poster or model of the innovation
3. Present to the class

Age/Grade Level

Ideal age/grade level for projects ranging 3rd -5th grade

Assessment

Discussion and evaluation of final projects (both essay and presentation)

Overview/Background

During the 100+ years of the Indianapolis 500 race, there have been many innovations and technological advances. The spirit of competition extends beyond the drivers and applies to all the designers, manufacturers, engineers, and owners that are behind each car on the track. This lesson plan will discuss the story of Harry Miller and Fred Offenhauser, two manufacturers/designers who helped to shape the Indy500 for more than half a decade.

At the turn of the century, the automobile was becoming less of a novelty and more of a reality for many consumers. People like Harry Miller started developing unique designs for every part of an automobile, streamlining, tweaking, and adjusting. External factors like World War I altered car manufacturing and supply chains, forcing people like Miller, to come up with ways of replacing the European parts they no longer had access to.

Racing was quickly becoming an American pastime, and the Indianapolis Motor Speedway was at the heart of a huge boom in automobile manufacturing. Originally slated as a “proving” ground for the hundreds of Indiana automakers, the Speedway proved to be a popular attraction and the usage shifted to what we know it for today. As the world changed around it, the Speedway welcomed the innovations made to the cars. Racing worldwide was shaped by the engines and cars created by Harry Miller and Fred Offenhauser. The competition between drivers, teams, owners, and manufacturers, led to great leaps in inventions and innovations in the racecar.

Offenhauser engines, commonly referred to as “Offys,” still hold the spot as the “most winningest” engine at the Indianapolis 500. There are not many engines that have a family tree, but the Offy is one of them. The evolution of the Offenhauser engine can be traced back like a lineage. The different engines that came before, and after, the Offy, show a clear line of inventors and innovators. Through the story of Miller, Offenhauser, and other key players, students will learn how competition and friendly rivalry leads to invention and innovation.

Content Standards

Indiana Social Studies: 3-1, 4-1: “Describe how significant people, events and developments have shaped their own community and region;” “Trace the historical periods, places, people, events and movements that have led to the development of Indiana as a state”

5-4: “Describe productive resources and market relationships that influence the way people produce goods and services and earn a living in the United States in different historical periods. Students consider the importance of economic decision making and how people make economic choices that influence their future”

- 3.1.4
- 3.1.5
- 4.1.13
- 4.1.14
- 4.1.15

- 4.1.17
- 5.4.4

Indiana Language Arts: Reading nonfiction : “Read and comprehend a variety of nonfiction within a range of complexity appropriate for grades...”

- 3.RN.2.1
- 3.RN.2.2
- 3.RN.2.3
- 4.RN.2.2
- 4.RN.2.3
- 5.RN.2.2
- 5.RN.2.3

Writing :“Write routinely over a variety of time frames and for a range of discipline-specific tasks, purposes, and audiences; apply reading standards to write in response to literature and nonfiction texts”

- 3.W.2.1
- 3.W.3.1
- 3.W.3.2
- 4.W.2.1
- 4.W.3.1
- 4.W.3.2
- 4.W.4
- 5.W.3.1
- 5.W.3.2
- 5.W.4

Speaking and Listening: “Listen actively and adjust the use of spoken language to communicate effectively with a variety of audiences and for different purposes”

- 3.SL.2.1
- 3.SL.2.2
- 3.SL.2.5
- 3.SL.3.1
- 3.SL.4.1
- 3.SL.4.2
- 4.SL.2.1
- 4.SL.2.2
- 4.SL.2.5
- 4.SL.3.1
- 4.SL.4.1
- 4.SL.4.2
- 5.SL.2.1
- 5.SL.2.2

- 5.SL.4.1
- 5.SL.4.2

Resources

Attached info sheets

Websites:

- Basic overview - <https://www.milleroffy.com/Racing%20History.htm>
- Simple article - <https://www.wfyi.org/news/articles/celebrating-the-genius-of-harry-a-miller>
- Harry Miller - <https://www.museumofamericanspeed.com/harrymiller.html>
- <https://www.motorsportmagazine.com/archive/article/february-1973/34/lifetime-offenhauser>

Materials

- Key-players posters
- Innovation timeline
- Guided essay worksheet
- Student project worksheet
- Grading rubric

Harry Miller

Harry Miller was born in Menomonie, WI in 1875, and began his automotive career developing carburetors. Miller moved to Los Angeles, CA in 1894 and founded his own company called the "Miller Carburetor and Manufacturing Co." Early on Miller hired designer **Leo Goossen** and machinist **Fred Offenhauser** to design and develop parts, engines, and whole cars, for racing. Miller invented an original metal material to make his parts out of. The new metal was a blend of aluminum, nickel and copper, he named it "Alloyanum". Alloyanum was used to make carburetors and pistons and was lightweight and strong which was perfect for racing.

The first full engine Miller built was in 1915 and by 1920 almost every part of Miller's cars were made in his own factory. Miller engines and cars dominated the racing scene. In 1923, 46% of the cars in the Indianapolis 500 were Millers, by 1925, 73% of cars were Millers. His victory at the track would come to end after the 1929 stockmarket crash. Miller sold the rights to his business and patents at the urging of his advisors in 1933.



Fred Offenhauser

Fred Offenhauser was born in Los Angeles, CA in 1888 and began working for **Harry Miller** in 1913 at the age of 25. It only took one year of working for Offenhauser to be named the head of the engineering department. In 1914 Miller's shop was asked to work on a "Peugeot" engine, a French engine that required parts and maintenance. Because of WWI, the Peugeot engine couldn't get the parts that it needed, Miller and Offenhauser were asked to help. Miller and Offenhauser were so impressed by the engine that they decided to base their own designs from it. In 1919, Offenhauser was named the plant manager under Miller and **Leo Goossen** joined the company.

Offenhauser purchased some of Miller's patents when he sold the rights in 1933. Other former employees started working for Offenhauser and the Miller engine was developed into the "Offenhauser". Offenhauser engines, nicknamed the "Offy", would rule the racetracks. Other engine designers would go to Offenhauser and Leo Goossen to build new engines, based on the Offy design. It is estimated that Offenhauser built around 150 racing engines.



Louis Meyer and Dale Drake

In 1946, Offenhauser sold his company to **Louis Meyer** and **Dale Drake**. Meyer was a 3-time Indianapolis 500 winner and Drake was an engineer and mechanic. **Leo Goossen** continued to work for the company and developed the Offy engine through the 1940s, 1950s and 1960s. From 1947 to 1964, the Offy powered all the winning cars of the Indianapolis 500. When Meyer decided to sell his shares and start his own company, Goossen and Drake continued and renamed the company the "Drake Engineering Co.". In 1968, a Drake engine powered the Indianapolis 500 winner with the first turbocharger to win the race.



LOUIS MEYER & DALE DRAKE

Leo Goossen

Leo Goossen was born in Kalamazoo, MI in 1892. Goossen began his career working for the automobile manufacturer Buick, as a clerk in the blueprint room. In 1910 he was assigned to create drawings for the “Buick Bug”, a racecar. In 1919, after moving out West, Goossen found himself in Los Angeles, working for **Harry Miller**. Goossen was responsible for taking Miller’s ideas and making them work. It was Goossen’s drawings that ensured the Miller engine’s success. After Miller sold his company in 1933, Goossen wouldn’t rejoin **Fred Offenhauser** until 1944. Goossen stayed with the company through the sale to **Louis Meyer** and **Dale Drake** and would go on to design many iconic engines and cars.



Innovation Timeline – For teacher use/to be read to the classroom

Innovation and invention are both important in racing, but the two words get mixed up a lot.

***Invention* is the creation of something new that has never existed before**

***Innovation* is a change to something that exists**

For example, the first telephone was an invention, the first cell phone can be called both an invention and an innovation, and the first smart phone is an innovation.



Innovations are new imaginings, new ideas, and asking new questions to come up with solutions to our everyday problems.

GQ: Can you think of any other inventions and innovations?

The Offenhauser engine was full of innovation! The story of the Offenhauser engine begins with a French company, Peugeot, and their racing engine. The Peugeot engine would power the winning car in the 1913 Indianapolis 500 and for the next 75 years it set the tone for motor design in open-wheel racing.

In 1914, just ahead of the racing season, World War One prevented important parts shipments from making it to the United States. Because of the lack of parts, many drivers needed to find new ways of repairing and servicing their engines. Driver Barney Oldfields commissioned Harry Miller's shop to work on his Peugeot engine and car, exposing Miller to the design. Miller and his employee, Fred Offenhauser, were so impressed with the design of the Peugeot that they decided to modify it and expand upon it. Miller built his engines out of his own metal alloy, "alloyanum", which made them lighter weight but strong and resistant to wear and tear. Miller-built-or-powered cars won the Indianapolis 500 five times between 1922 and 1929, the year Miller retired. A Miller engine also won in 1930 and 1932. A version of the Miller engine would grab the win in 1933 as well.

By 1933, Miller needed to sell his shares and patents of his company due to bankruptcy. Offenhauser was ready to take up the torch, purchasing many patents and setting up shop immediately. Offenhauser engines were based on Miller's ideas and would end up winning every Indianapolis 500 from 1933 to 1938.

GQ: Do we think Offenhauser was an inventor or an innovator? Why?

In 1946, Offenhauser sold his business to Louis Meyer and Dale Drake. From 1947 to 1964 the Offenhauser engine produced under Drake and Meyer, won every race at Indy. Leo Goossen, Miller's original draftsman and designer, signed on with Drake and Meyer and put Offy's back on the map in 1968 with the introduction of the turbocharger. From 1972 to 1976, Offy's claimed the wins.

This pedigree of engines won 39 races in 50 years, spanning from 1922 to 1976.

GQ: How would the chain of invention to innovation look if we take the histories of Harry Miller, Fred Offenhauser and Dale Drake? Who invented and who innovated?

Peugeot Engine: In 1913, the Indianapolis 500 first saw the engine that would be the base of the Indy car motor design for the next 75 years

- Cylinder, valve, and sparkplug placement made this engine unique, powerful, and fast

1914: WWI made it hard to get the Peugeot parts for the Indy 500, and Miller's shop was commissioned by Barney Oldfield to work on his car. They were impressed by the engine and modified/created their own version

Miller Engine: Goosen, Miller and Offenhauser built a 182-inch twin-cam, 32-valve straight eight that put them on the map

- Miller-built-or-powered cars won the Indy500 five times between 1922-1929
- Miller's "old eight" won the 1930 and 1932 Indy500 and a larger-displacement version of his four won in 1933

Miller sold the rights to his designs to Offenhauser in 1933

Offenhauser Engines: Very much stuck with Miller's designs, winning every Indianapolis 500 from 1933 to 1938, and 1941

Drake-Meyer – Bought in 1946: from 1947 to 1964, Offys won every Indy 500 (17 years)

- Goosen's turbocharger put Offys on the map in 1968 and won from 1972 to 1976

Activity worksheets

These worksheets are intended to be guiding aids for the essay and presentation that are the main activities of this lesson plan. These sheets can be used or not, depending on the needs/wants of the classroom and students.

Once each sheet is filled out, the final essay and presentation should be completed. It is not necessary to grade the worksheets unless it is the desire of the teacher; that is why no grading rubrics for these sheets are provided.

Reading Worksheet

This worksheet is intended for 3rd graders and those that may benefit from a distilled and guided version of the reading posters.

Essay

The essay is intended to support the ideas of innovation that are learned in the lesson. It is meant to be a way for students to explore what innovation means and what they would like to see in their world. The essay length should reflect grade appropriate requirements.

Presentation

The presentation may be done individually or as a group. If as a group, then the worksheet should be filled out as a group and not individually (or each student may fill one out and then the groups can decide amongst themselves which innovation they would like to focus on). Presentations should use either a poster or a multimedia model to show what the innovation is/would look like and to act a sort of “pitch” to a company that students would like to invest in the product/innovation.

Reading Worksheet for Innovation

Name: _____

Date: _____

Innovation and invention are both in racing. *Invention* is making something new; *innovation* is changing something.

The first telephone was an *invention*, the first cell phone was both an *invention* and an *innovation*, and the first smart phone is an *innovation*.

Innovations are new ideas that come from asking new questions to solve our everyday problems.

The Offenhauser engine is a great example of innovation. The story of the Offenhauser engine begins with a French company called *Peugeot*. The Peugeot company built an engine for the car that won the 1913 Indianapolis 500.

In 1914, World War I was happening in Europe, which stopped important shipments to the United States. A United States racecar driver had to look for help with his Peugeot engine and he found Harry Miller. Harry Miller and Fred Offenhauser were so impressed with the design of the Peugeot engine that they decided to copy the design and make it better.

Harry Miller's engines were in cars that won the Indianapolis 500 five times between 1922 and 1929. A Miller engine also won in 1930 and 1932.

In 1933, Harry Miller decided to sell his company to Fred Offenhauser. Fred Offenhauser spent years making the engines faster. Fred Offenhauser's engines were based on Harry Miller's ideas and would end up winning every Indianapolis 500 from 1933 to 1938.

In 1946, Fred Offenhauser sold his business to Louis Meyer and Dale Drake. From 1947 to 1964 the Offenhauser engine won every Indianapolis 500. Leo Goossen, Harry Miller's original designer worked for Drake and Meyer. In 1968 the "turbocharger" was added to the engines, making them even faster! From 1972 to 1976, Offenhauser engines won the Indianapolis 500. Engines, based on those from Peugeot and Harry Miller, won 39 races in 50 years, from 1922 to 1976.

What is the difference between *invention* and *innovation*? _____

Who was an innovator? (circle all that apply)

Harry Miller

Fred Offenhauser

Leo Goossen

Louis Meyer/Dale Drake

Why would someone want to use an engine to innovate? _____

What is another type of innovation you can think of? _____

Personal Innovation Essay Prewriting

Name: _____

Date: _____

What is an innovation?

Think about what type of innovation you might like to see. Is there something you use everyday that could be improved? Write about what innovation you would create:

Type of innovation

Does it solve a problem or fill a need?

Why did you choose this innovation?

Who would use this innovation?

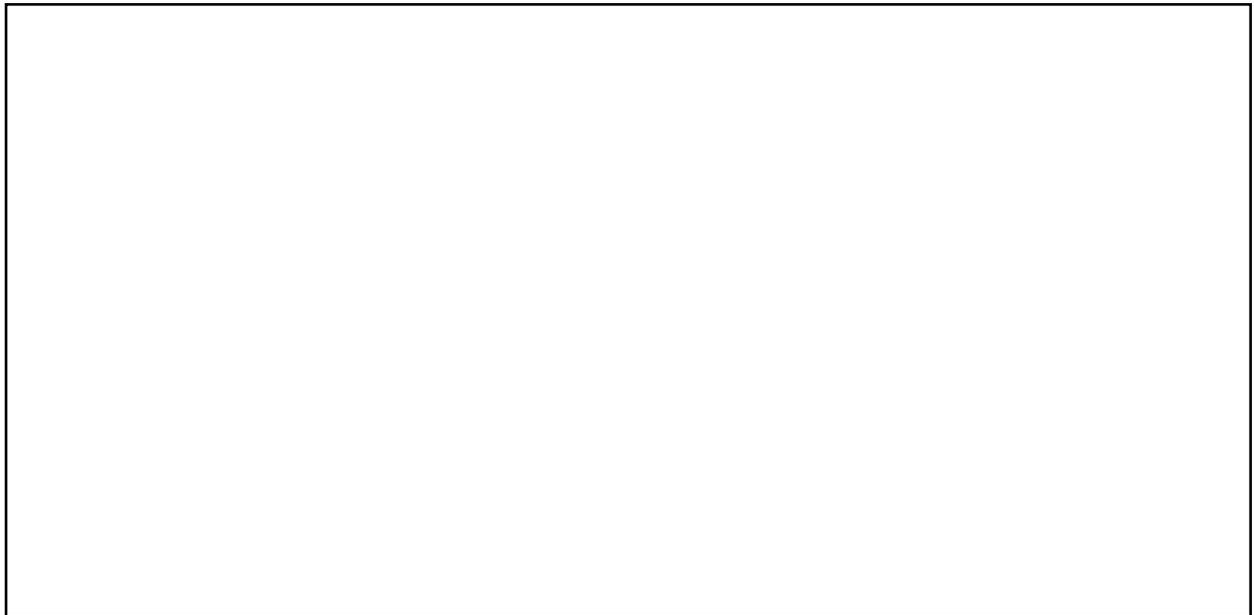
Innovation Project Worksheet

Name _____

Date _____

What is the innovation you would like to see created?

What does it look like? Sketch it out!



Who would use this innovation?

What makes this innovation unique?

What is the invention you are improving?

ACME Corp. is looking for the newest innovations to provide for their customers. They have agreed to give you five minutes to pitch them your ideas. What would you say to their executive team to get them to buy your innovation?

Essay Grading Rubric

Understanding of what an innovation is (20 points)	
Explanation of innovation is clear (20 Points)	
Good argument for need of innovation (20 Points)	
Structure of essay and use of complete sentences (20 Points)	
Spelling and grammar (20 points)	
Total (100 points)	

Additional Notes:

Presentation Grading Rubric

Creativity of design and layout (20 points)	
Ability to work in a group (20 points)	
Class presentation quality overall (20 points)	
Clear explanations and information (20 points)	
Content (depth) (20 points)	
Total (100 points)	

Additional Notes: