



Daisy Automotive Engineering

Explore how a car goes from just an idea to driving on the street by earning these three badges!

Badge 1:
Automotive Design

Badge 2:
Automotive Engineering

Badge 3:
Automotive Manufacturing



This booklet gives girls an overview of the badge requirements and badge steps for all three Daisy Automotive Engineering badges. It also includes interesting background information to spark girls' interest in automotive engineering. Volunteers can access the Volunteer Toolkit (VTK) to find complete meeting plans, including detailed activity instructions and handouts.

Welcome to the world of automotive design, engineering, and manufacturing. When you've earned these badges:

- You'll know how people come up with ideas and make plans to create new vehicles.
- You'll know how people make the parts that are needed to build a vehicle.
- And you'll know how people make lots of vehicles in a factory.

You'll also explore how you can help make vehicles that are safer or better for our planet.

Volunteers can access the Volunteer Toolkit (VTK) to find complete meeting plans, including detailed activity instructions and handouts.



Badge 1: Automotive Design

Imagine riding in a cool new car that can park itself and doesn't pollute our air! Now, imagine it actually driving on the street—that's what automotive designers do! Automotive design is thinking of new cars and other vehicles. A vehicle is a machine, like a car, van, or motorbike, that can move people or things from place to place.

Explore how automotive designers imagine and make plans for a new vehicle. Then, design your own!

Steps

1. Choose special features for your vehicle
2. Sketch your vehicle
3. Sculpt and share your vehicle

Purpose

When I've earned this badge, I'll know how people design cars.

STEP

1 Choose special features for your vehicle

Vehicles are made up of lots of parts. Some parts are in every vehicle, like the engine and wheels. Other parts are special, just for that kind of vehicle. These parts are called **design features**.

Different **customers**, or the people buying the vehicle, want different features. Some might want cupholders or TV screens for their passengers (the people riding in the car!). A parent driving a minivan might want doors that open and close by themselves. These are all special features created by automotive designers.

The automotive designer decides on the **design criteria** for the vehicle. Criteria are all the important things the design needs to have, like the parts and design features.

Now, imagine you were designing a new car. What would it do? What parts would it have? Choose parts and special features to create the design criteria for your vehicle.



GET MOVING!

Vehicles give us **mobility**. That means they allow us to move. When we move people or things from one place to another, we call that **transportation**!

Sometimes we need vehicles to do really special things, like take sick people to the hospital or bring books to a neighborhood with no library. Automotive designers created ambulances and bookmobiles to do just that.



After an emergency like a hurricane or earthquake, people might need places to take a shower, wash their clothes, or see a doctor. Designers have created big vehicles that can bring showers, washing machines, and doctors to people who need them.

What other kinds of vehicles for good or helping vehicles can you imagine?

PARTS OF A

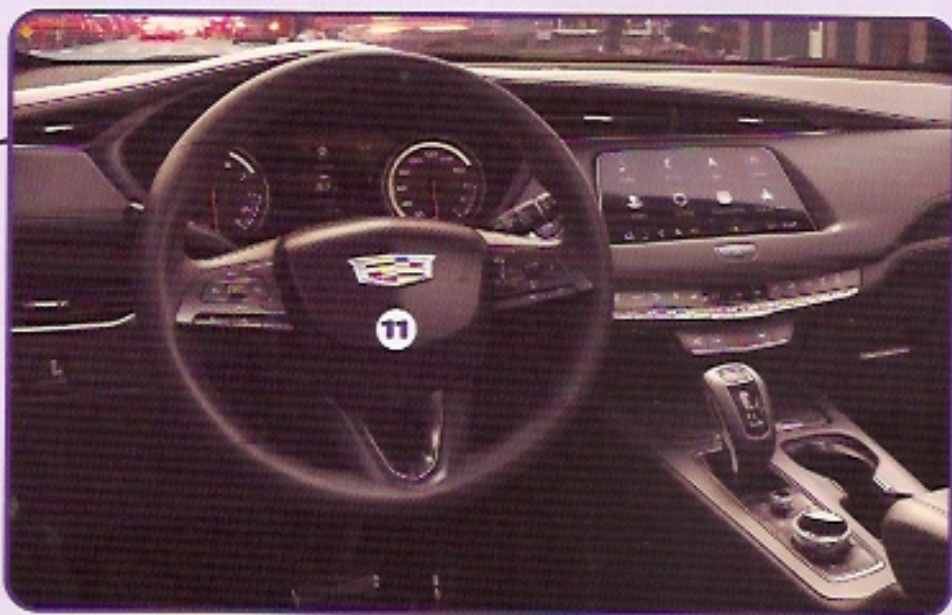
Cars and other vehicles are made up of lots of parts. There are parts on the outside, or the **exterior**, and parts on the inside, or the **interior**.

EXTERIOR

- 1 The **axles** connect two wheels and spin, causing the wheels to turn.
- 2 The **body** is the outside shape of a vehicle.
- 3 **Doors** open and close to let people get in and out.
- 4 The **hood** can be opened to take care of the engine and other parts.
- 5 People store cargo in the **trunk** of a vehicle.
- 6 Most vehicles have four **wheels** with tires that roll to move the car.
- 7 **Windows** help people inside the vehicle see where they're going.
- 8 The **windshield** lets the driver see in front of the vehicle.



VEHICLE



INTERIOR

- 9 The **engine** powers the vehicle to make it go.
- 10 Each passenger sits in a **seat** with a **seat belt** to keep them safe if there's an accident.
- 11 The driver rotates the **steering wheel** to make the vehicle turn.



STEP

2 Sketch your vehicle

When you have an idea, it's helpful to draw a picture and make a plan.

A **creative designer** comes up with ideas for vehicles and draws them. When she has an idea, she makes many different pictures of the vehicle. She'll draw the **exterior** (the outside) of the vehicle and the **interior** (the inside), too.

Once you have design criteria, you can use them to sketch your vehicle with all the important parts and features. Then, you can use your drawings to show others what your vehicle looks like!

DRAW IT!

Car Stars

What if your car could float or fly? What if it could turn into a robot, talk, or think for itself?

Cars in movies, television, and cartoons can! **Lightning McQueen** is one famous car that can talk and drive himself through movie magic.

Sometimes, these kinds of special features end up being real features in cars. While they used to just be in the movies, we now have cars with telephones, screens for watching videos, and maps that give directions.

STEP

3 Sculpt and share your vehicle

Making a model is an important part of designing a vehicle. A model might be made of clay or wood, or even made by a 3D printer. Just like a drawing, your model helps you show your idea to others and look for ways to make the design even better.

Sometimes, automotive designers make models of a whole vehicle. Other times, they'll make models of specific parts, like the steering wheel, to show more details.

Other automotive teams could then use your final design criteria, sketches, and models to help them build the vehicle with real parts.



The design team might have a clay sculptor who models the vehicle out of clay.

Imagination at Work

It takes a team of people to design a new vehicle.

- A **creative designer** imagines new vehicles and draws them. If you like art and using your imagination, you might like this job.
- A **clay sculptor** makes clay models of vehicles. If you like making things with your hands and working with other people, you'd like this job.
- A **studio engineer** works with the designers to create a vehicle that can one day be built in a factory. If you like working with lots of people to solve problems and make something new, this job is for you!

Now that I've earned this badge,
I can give service by making a poster to share what I've learned
about mobility, vehicles, or automotive design.

I'm inspired to:



Badge 2: Automotive Engineering

It's fun to imagine new kinds of vehicles. For some people, it's even more fun to build them! After automotive designers have an idea for a vehicle, automotive engineers figure out how to make it. They use science and math to choose the best materials and build a model of the vehicle. Then, they test it to see if it works and find ways to make it better.

Find out how automotive engineers turn ideas into real cars!

Steps

1. Create your automotive engineering plan
2. Build a vehicle prototype
3. Test your vehicle prototype

Purpose

When I've earned this badge, I'll know how automotive engineers work together to build cars and other vehicles.

Super Smart Cars

Many cars today have special features to help people drive more safely.

For example, some cars can:

- sense when another car is passing it, and alert the driver so she stays in her lane
- tell when it is drifting out of its lane into another lane or off the road
- know if it's getting too close to a car in front of it
- park themselves
- use a camera to show the driver what is behind her when she's backing up
- Someday, cars may be able to drive themselves without people controlling them at all!

STEP

1 Create your automotive engineering plan

Have you ever had an idea and wanted to make it real? Maybe an idea for a new dance or recipe?

Automotive engineers turn automotive designers' ideas into real cars!

Teamwork is when people work together to solve a problem or do something. Designers and engineers use teamwork to figure out how to make new vehicles.

First, the engineers get a checklist of criteria with parts and features from the designers. Then, they figure out how to build the parts. Finally, they decide how to put all the parts together to make a vehicle.

Now imagine you're engineering a vehicle to help an animal shelter. What parts and features does it have? What does it look like? Once you know these things, you have an engineering plan!



STEP

2 Build a vehicle prototype

Once you've made an engineering plan, how do you see if your vehicle works? You build a prototype! That's a working model of your idea.

A **prototype** can be a simple sketch, or a model built out of cardboard or clay. It lets you show your idea to other people and see if it works the way you want it to.

When you build your prototype, it doesn't need to be perfect—it's a first try. It's even a good thing if your prototype has problems, because that's how you figure out how to make it better. Problems show you what doesn't work. Then you know what to fix!

Pioneering Problem Solvers

- In 1888, **Bertha Benz** was the first person to drive a car a long distance to road test a vehicle prototype. The car was called the Benz Patent-Motorwagen. Bertha's road trip was 65 miles! After her long drive, she invented brake pads and identified other ways to make the car even better for long-distance travel.
- **Margaret A. Wilcox** was one of the first women in mechanical engineering. In 1893, she invented the first car heater. Her design sent air that had been over the hot engine into the car to warm passengers. Today, car heaters still work this way!
- **Charlotte Bridgwood** and **Florence Lawrence** were mother and daughter. They engineered two important safety features in the early 1900s that are still used in vehicles today: the windshield wiper and the turn signal!



Portrait of Bertha Benz

STEP

3 Test your vehicle prototype

Because automotive engineers are making something new, they test their prototypes to see if they work. They test their vehicles to see if they're safe to drive. They also test them to see if they work in bad weather or on bumpy roads.

After testing, engineers make changes to their prototype to make it better. The new prototype is called an **iteration**.

When you test your prototype, think about any changes you would make to your next iteration. How can you make your vehicle go faster or carry more cargo?

IMPROVEMENTS

CRAZY CARGO

What would you do if you needed to transport something really special, like a panda bear, the space shuttle, or a ton of special statues? You'd need to engineer a specialized cargo vehicle!

NASA created crawler-transporters to move **heavy rockets** and the **space shuttle**. The crawlers are so big, they could move something the size of a baseball field! NASA also engineered a jet for the space shuttle. It can fly the shuttle all the way from California back to the Kennedy Space Center in Florida.



Shipping companies transport **wild animals** all over the world. To help the animals ride safely in airplanes and trucks, engineers and veterinarians work together to design special containers. They can now safely transport all types of animals, like pandas, tigers, polar bears, eagles, penguins, elephants, lions, gorillas, and even a tiger shark!



The **Terracotta Warriors** are famous life-sized statues of soldiers and horses that were found buried with the first Chinese emperor. (An emperor is like a king!) When museums around the world want to show the clay statues, carpenters make special wooden boxes for them to travel in. These boxes have padding inside to protect the very-breakable cargo from bumps and moisture. The trucks that carry the warriors even have special controls on their engines so they can't go too fast.

Now that I've earned this badge,
I can give service by finding ways to make something better,
like my soccer dribble or schoolwork.

I'm inspired to:



Badge 3: Automotive Manufacturing

Automotive manufacturing is putting parts together to make lots of vehicles to sell. What would you do if you had a BIG job to do, like manufacturing cars? How many people would you need? What kinds of materials? These are all things manufacturers have to think about.

Find out how automotive manufacturers build and test vehicles to make sure they're ready for the road.

Steps

1. Explore efficient manufacturing and assembly lines
2. Create an assembly line to manufacture vehicles
3. Examine and test your vehicles for quality

Purpose

When I've earned this badge, I'll know how manufacturers assemble high-quality vehicles.

STEP

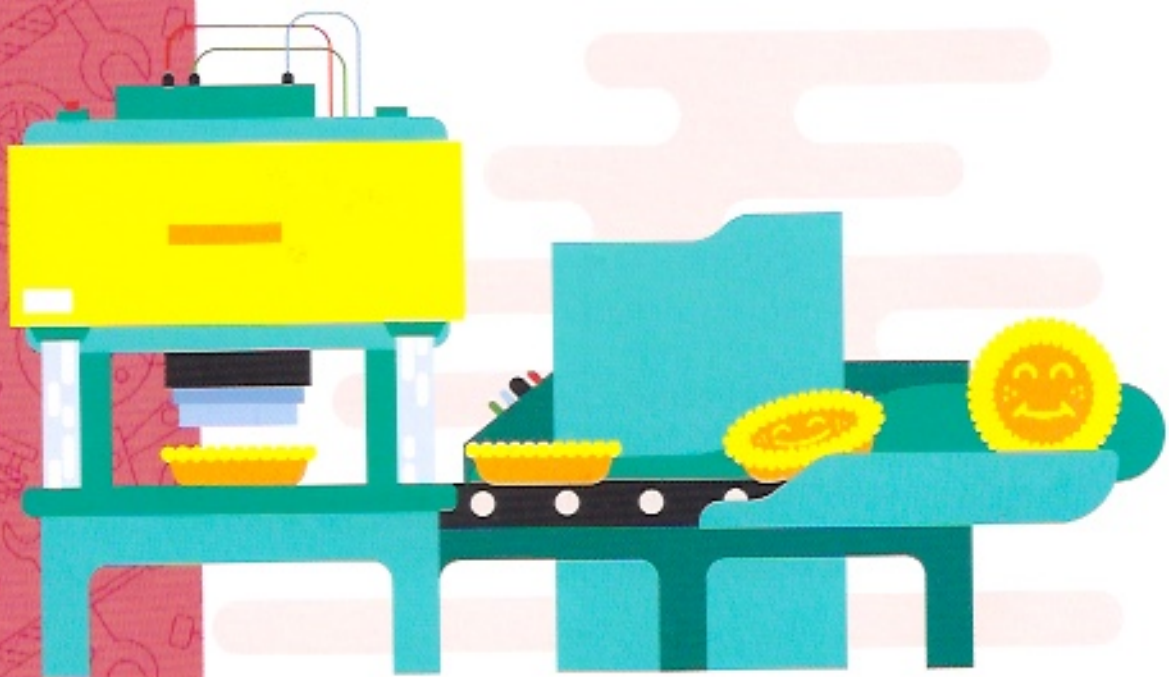
1 Explore efficient manufacturing and assembly lines

Imagine you had to make a lot of pies. There are lots of ways you could do it. However, you'd want to be **efficient**. That means making the pies without wasting time or materials.

If you had people to help, you could work together. You might set up the ingredients and pie pans in order. Then, each person might do a different step of the process.

That's how automotive manufacturers make lots of cars. They do it in a **factory**, a big building with machines.

Some of the machines are **die presses** that shape and cut out materials into vehicle parts. They use an **assembly line** to put all the workers, machines, and materials in a line to build vehicles.



ROBOT HELPERS

Automotive manufacturers were some of the first to put robots to work on their assembly lines. Why? Lots of reasons:

Safety Robots can pour melted metal, move lots of heavy parts, and fix machines. A robot can do these jobs without getting hurt, which makes the assembly line safer.

Speed Robots can make assembly lines more efficient. They might assemble parts of a vehicle, like a motor, or install a windshield faster than people can.



Quality A robot can do the same job over and over without getting tired (or bored!) and make fewer mistakes. In an automotive factory, they might do something that happens over and over again, like welding the metal parts of the car together. (Welding is using melted metal to join two other pieces of metal together.)

Sometimes, engineers even have robots work together, moving materials to the assembly lines before welding the pieces together!

Would you like to have a robot on your team? What job would you give it?

Super Assembly Lines

- In 1901, Ransom Olds invented the first vehicle assembly line for the Oldsmobile Company. Another manufacturer, Henry Ford, then added moving platforms, so the cars could move along the line from worker to worker.
- In 2014, a team of 21 workers from Old El Paso made an assembly line to set a world record for the longest line of tacos! First, they made 1567 tacos. Then, they had a competition to see who could eat the most!
- In India, a motorcycle assembly line is run entirely by women! The women use co-bots, or collaborative robots, to move heavy machines. While the motorcycles are bought mostly by men, the company is very proud that they're built by women.

STEP

2 Create an assembly line to manufacture vehicles

It's a big job to manufacture vehicles. So, you need someone who can figure out how to do it!

A **plant engineer** organizes the assembly lines in a plant (that's another word for factory!) to make each kind of vehicle. She:

- ▶ creates the assembly lines for the manufacturing team to build the vehicles
- ▶ watches what's happening in the whole factory
- ▶ makes sure the workers, or **assembly line operators**, are safely making the vehicles.

It's important that an assembly line is efficient, but it's even more important that it's safe!

Now that you know how assembly lines work, create your own! Make a safe and efficient assembly line to build a set of vehicles.



TERRIFIC TEAMS

When you want to solve a big problem or do a big project, it helps to have a great team. Here are some teams of women that did great things:

ROSIE THE RIVETER

Rosie was a character created by the United States government to encourage women to work in factories during World War II. Most men had become soldiers, and factories needed people to make products like airplanes and uniforms. Millions of women jumped in and worked in factories, for the first time, on assembly lines.

TRASH TO TREASURE

In the Gambia, a country in West Africa, a woman named Isatou Ceesay formed a team to solve some big problems. With women in her village, she recycles plastic bags and turns them into change purses. Their teamwork helps clean up their village and protect the environment. The money they make from selling their purses helps pay for education and medicine!

ALL-WOMAN SPACE WALK

In October 2019, two female astronauts, Christina Koch and Jessica Meir, made the first all-woman space walk. They spent more than seven hours working outside of the International Space Station. Christina and Jessica worked together to replace a part of a battery that collects energy from the sun.



STEP

3 Examine and test your vehicles for quality

When you make something to sell, you want it to be **high quality**. That means your product has all of the important parts and features, without any mistakes.

How do automotive manufacturers know if their vehicles are **high quality**? They test and check them to make sure they're well made. That's called **quality control**.

For example, **manufacturing engineers** make sure:

- ▶ the parts for the new vehicle can be made and put together
- ▶ the new vehicles are high quality
- ▶ the workers were safe as they assembled the vehicles

How will you check the quality of your vehicles? Do the parts stay attached? Do the vehicles roll?



**Now that I've earned this badge,
I can give service by working with my friends to become
better at sports, theater, or whatever we're doing!**

I'm inspired to:



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