

The background is a solid blue color with a repeating pattern of white icons. These icons include various mechanical tools like wrenches, pliers, and hammers, as well as electrical symbols like gears, stars, and circuit components. The text 'Lesson 4: The Chassis' is centered in a large, white, sans-serif font, underlined.

Lesson 4: The Chassis

By the end of this lesson, you will be able to:

- Clearly define what a chassis is.
- Provide some examples of where chassis are used.
- Explain the differences between robot chassis types.
- Compare and contrast different wheeled chassis types.



Introduction

In previous lessons, you learned about the parts of a robot and the tools that can be used to put them together. In this lesson, you'll learn what a chassis is and how to create one. You'll also explore some examples of different chassis designs. A chassis is a frame that provides structure and support, and is the basis for any robot. The first step to building a robot is building a chassis, so by the end of this lesson, you will have built your first Robits chassis.



What is a chassis?

What is a chassis?

As you learned in Lesson 2, a chassis is the supporting structure of a vehicle or robot. Every other part is built around the chassis and relies on it for stability and structure. These other parts can be either directly or indirectly attached to the chassis, but in all cases, the chassis is the basis of the structure. For example, a car's chassis is largely composed of the frame and wheels, with the engine and all other parts being added onto it. This also brings up an important point of clarification. A frame is not the same as a chassis. A frame is an important structural element, but a chassis contains the frame in addition to other parts.



A typical Ford chassis. It includes the wheels, frame, and brakes of the car.



Discussion:

Where might you have seen chassis used in your daily life?



**Where are chassis used in
daily life?**

Examples of Chassis in Use:



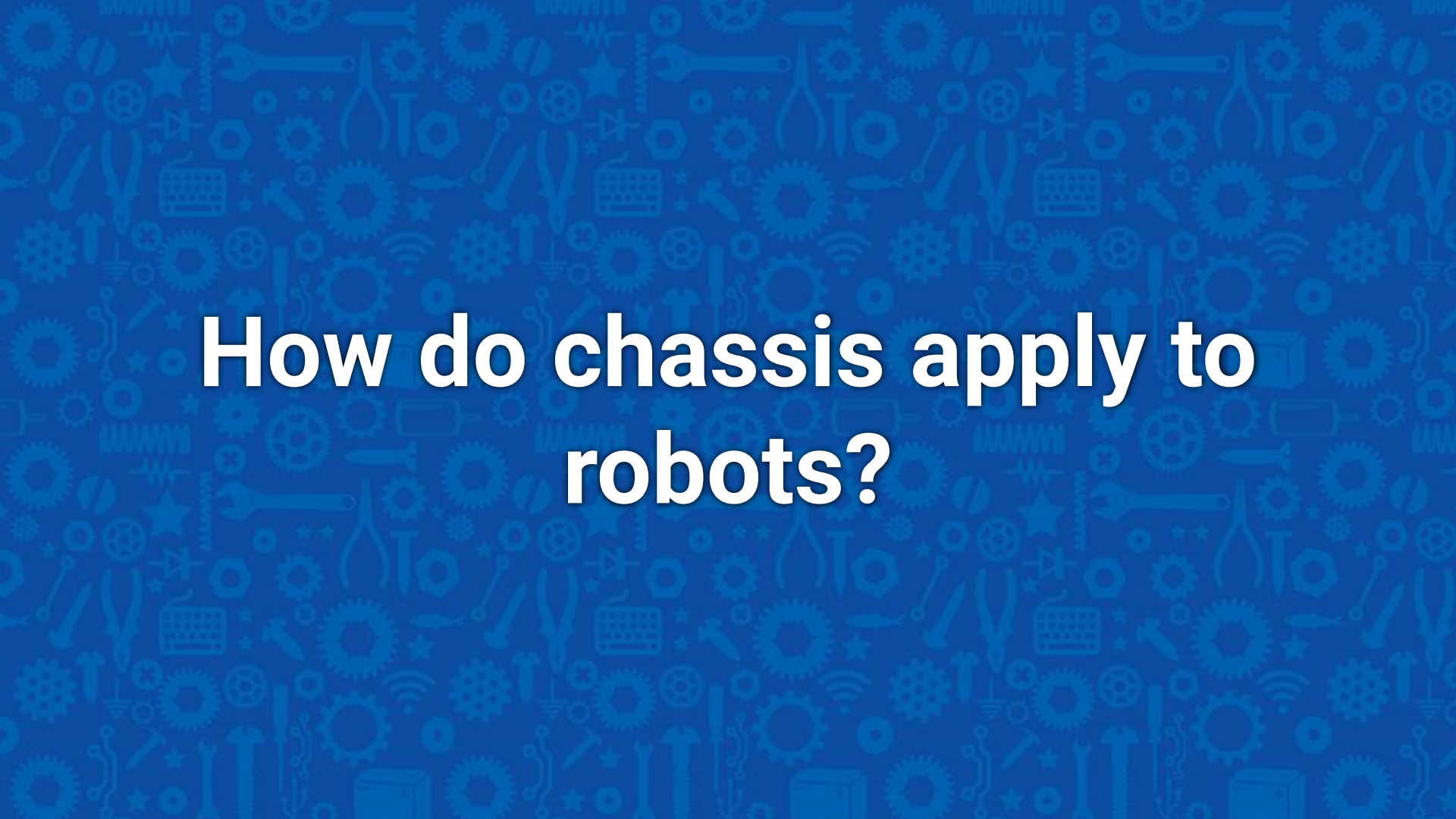
A bicycle is an excellent example of a chassis in use, since its chassis is immediately visible. Triangles in the structure of the chassis make it strong enough to hold the weight of a human.



Cars, and race cars in particular, are another good example of a chassis in use. A car's chassis must be strong and safe so it can support the car's passengers and cargo. A race car's chassis must be lightweight in addition to that.



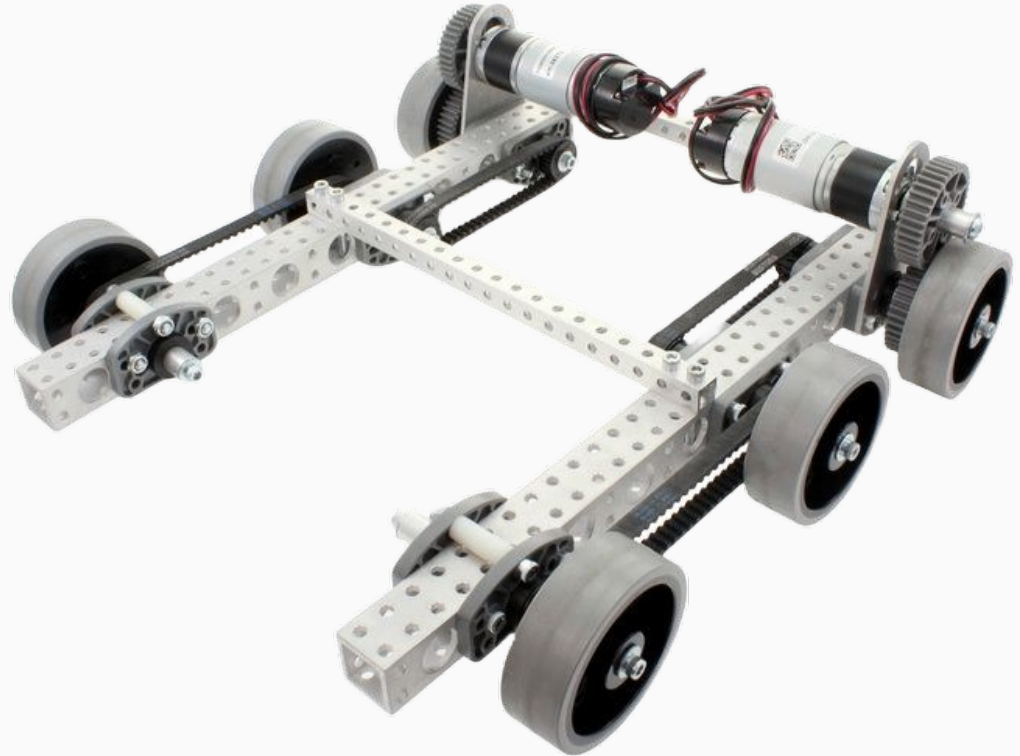
Believe it or not, a TV is an example of a chassis in use. TV's and similar electronics use chassis to keep all their components in proper order. Additionally, certain TV's can be mounted to walls using specialized chassis.



**How do chassis apply to
robots?**

A Robot's Chassis:

Like the chassis of any other manufactured object, the chassis of a robot is a core structural element. It provides a base for which the robot is built around, and all subsystems of the robot, such as grippers, lifting mechanisms, or electronics, are attached to and rely on this base. Any chassis you build with your Robits kit will be fairly simple, but robot chassis can be incredibly complicated. Robots are used to complete many different tasks, and so their chassis must reflect the task that they are assigned, meaning robot chassis can come in a variety of different shapes, sizes, and designs.



A possible robot chassis. Every chassis is designed for a specific function.



**What different types of
chassis can a robot have?**

Possible Chassis Types:

Robot chassis can come in various different shapes and sizes, but for the most part they can be broken down into four types:

- Wheeled Chassis
- Tracked Chassis
- Legged Chassis
- Rotored Chassis

The type of chassis varies based on what job a robot does. Any Robots chassis you build will be a wheeled chassis, but it is important to be aware of the different types of chassis a robot can have, as well as some of their applications.





**What are the differences
between chassis types?**

Wheeled Chassis

A wheeled chassis is one of the most common types of chassis for a robot to have, because it is simple, easy to use, and inexpensive. A robot that uses a wheeled chassis uses two or more wheels as its primary form of propulsion. Wheeled chassis are versatile, and can take many different shapes, so we'll be looking at the differences between wheeled chassis shortly. Most competition robots, RC cars, and rovers use wheeled chassis.



A hopping robot made to jump great heights. This robot utilizes a fairly basic wheeled chassis.

Tracked Chassis

A tracked chassis is another common type of chassis for a robot to use because it's very similar to a wheeled chassis. The difference between a tracked chassis and a wheeled chassis, though, is that a robot that uses a tracked chassis uses tank treads to move instead of wheels. Using treads greatly decreases the speed the robot can drive at. Tanks and bulldozers are examples of vehicles that use tracked chassis.



A bulldozer is a great example of a vehicle with a tracked chassis.

Legged Chassis

A legged chassis is the most complicated type of chassis a robot could use on account of how difficult it is to make a robot walk. As the name would suggest, a robot that uses a legged chassis primarily uses artificial legs to move around. Legged chassis are also expensive, and so they're fairly rare. Boston Dynamics uses legged chassis on several of their robots.



Boston Dynamics' robot dog, "Spot," beautifully showcases a robot with a legged chassis.

Rotored Chassis

Rotored chassis apply exclusively to drones and submersible robots. This type of chassis doesn't use wheels, legs, or treads. Instead, it uses several rotors to keep a robot moving underwater or through the air rather than on the ground. Most rotored chassis are complex and expensive due to the fact that they must be built with utmost precision. People use robots with rotored chassis for recreational use, but companies like Amazon are looking into using robots with rotored chassis to assist with their deliveries.



Drones and submersible robots are the only types of robots that use a rotored chassis.

Discussion:

With your group, brainstorm some ideas for ways you could use each chassis type.

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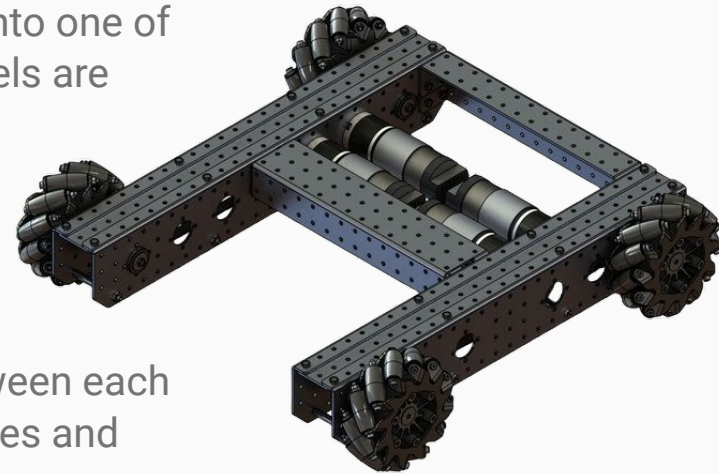
**What are the different
wheeled chassis types?**

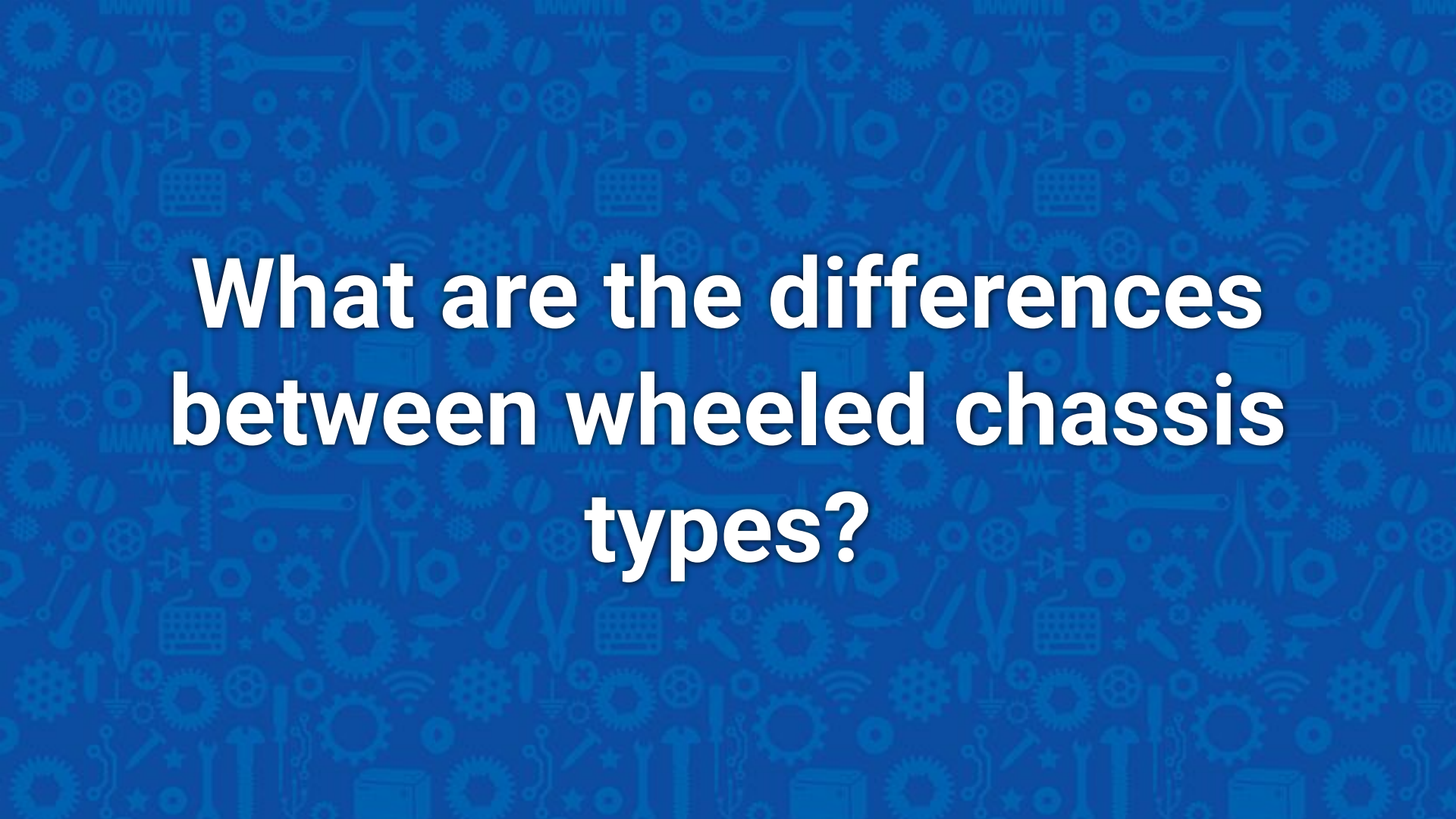
Wheeled Chassis Types:

The term, “wheeled chassis,” covers a wide variety of chassis designs. In general, however, most wheeled chassis can be sorted into one of three categories, depending on where the motors and wheels are mounted onto the frame. The categories are as such:

- Tank Drive Chassis
- Kiwi Drive/ X-Drive Chassis
- Non-Traditional Chassis

In the following slides, we will discuss the differences between each type of wheeled chassis. We will also look at some examples and applications of each type.

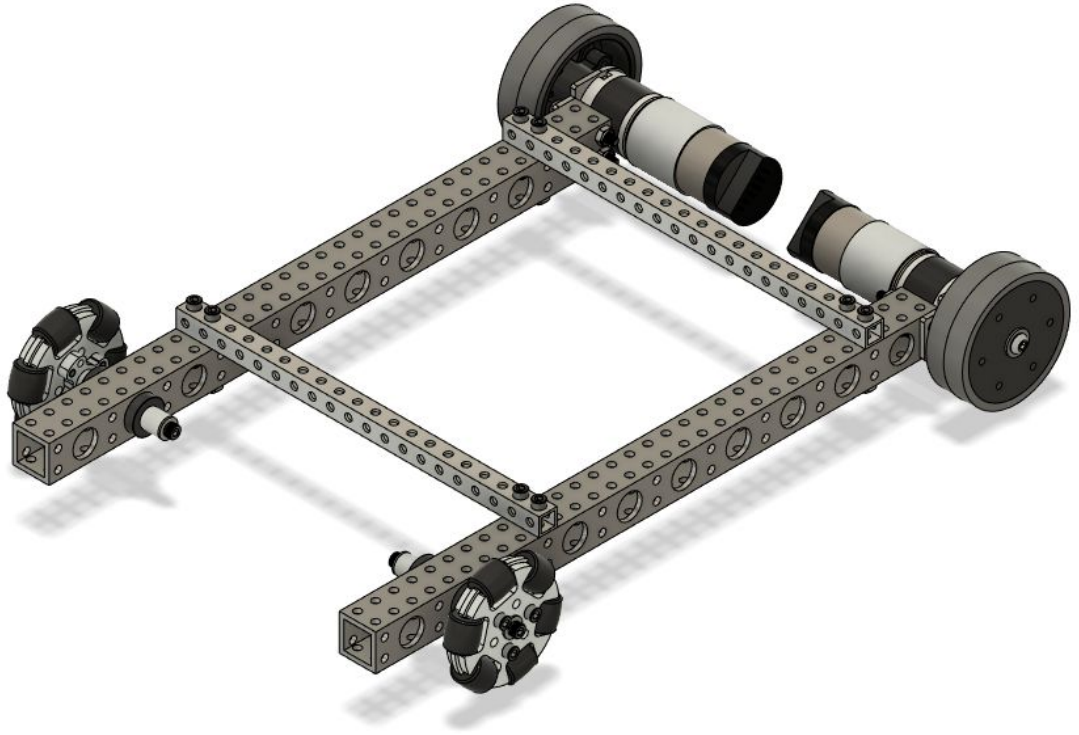


The background is a solid blue color with a repeating pattern of white mechanical icons. These icons include gears, wrenches, pliers, screwdrivers, and other tools, arranged in a dense, overlapping manner.

**What are the differences
between wheeled chassis
types?**

Tank Drive Chassis

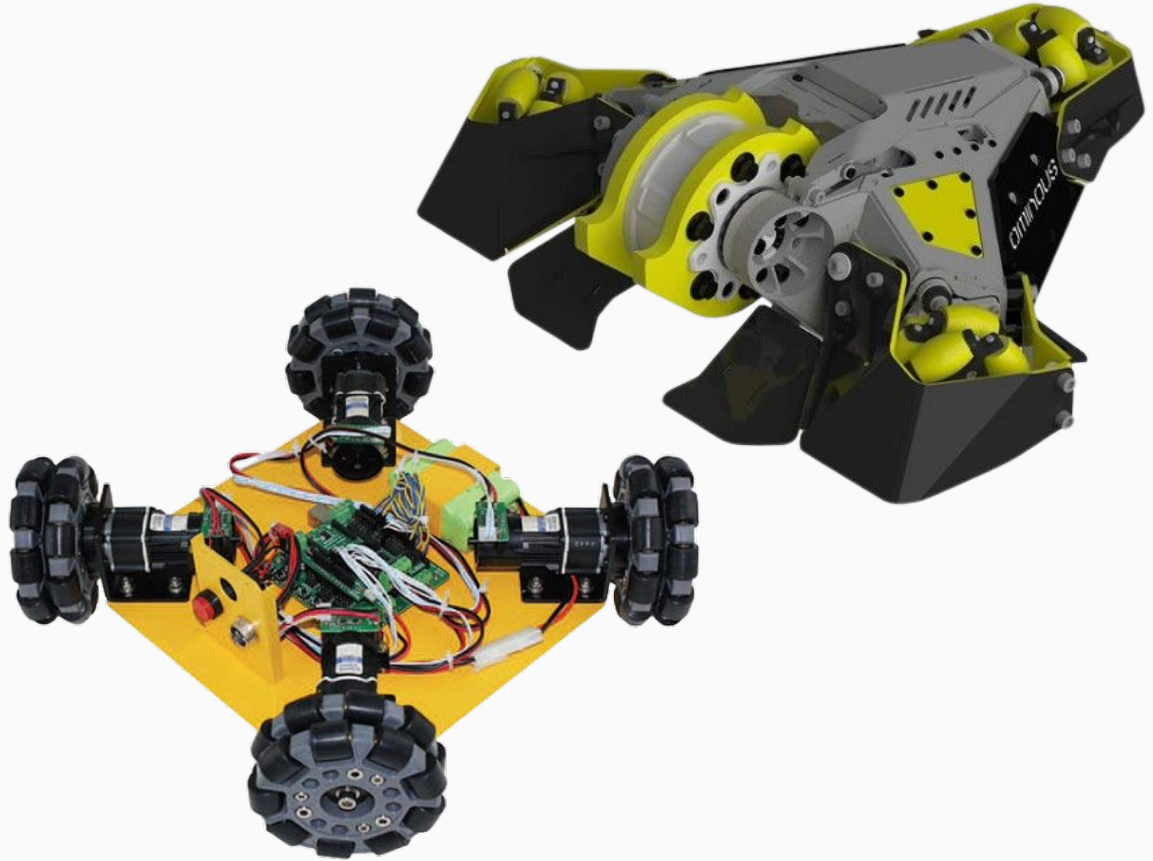
Tank drive chassis are the most common type of wheeled chassis. They are simple and effective, and due to the right angles in their geometry, it is easy to attach any subsystems a robot may require. Typically, the wheels of a tank drive chassis are only attached to two sides of the chassis, but additional wheels can be added to modify functionality. Each wheel is attached to its respective side so it runs parallel to that side, and each side of the chassis works independently of the other, but all wheels on a single side work in tandem. There are always the same number of wheels on each side, but the total number of wheels on the chassis can range from two to well over six.



This Robits chassis showcases a fairly standard tank drive chassis design.

Kiwi Drive/ X-Drive Chassis

Kiwi drive chassis and X-drive chassis are two chassis types that are more complicated than tank drive chassis both in construction and functionality. Kiwi drive chassis are generally shaped like triangles or octagons, and they use three wheels that are equally spaced apart in a Y-shaped formation. X-drive chassis, on the other hand, are often shaped like octagons, and they use four wheels that are equally spaced apart instead of three. These four wheels are arranged in an X-shaped formation, hence the name, X-drive. In both cases, though, the wheels can be spun independently of one another, and none ever work in tandem based on which side of the chassis they're mounted on. This allows a robot that uses one of these chassis to achieve a greater degree of motion, as it can move anywhere without turning, a behavior that depends on which wheels are being spun.



An example of a kiwi drive robot (top right) and an example of an x-drive robot (bottom left).

Non-Traditional Chassis

Any chassis that doesn't fit into either of the previous categories would be considered a non-traditional chassis. More specifically, non-traditional chassis are typically chassis that have an irregular number of wheels or an uncommon wheel layout, and are often highly specialized to be able to complete only a single task. For example, imagine you have a robot that's designed to climb to the top of a flagpole to fix the flag at the top. This "flag fixer" robot would most likely have two sets of wheels that it would use to straddle the sides of the flagpole. Each set of wheels would be mounted toward the center of the robot, with their tires pointing inward. Because of this design, our flag fixer robot would have a non-traditional chassis.



BB-8, from Star Wars, uses wheels hidden in his body to roll around.

Discussion:

With your group, brainstorm some ideas for ways you could use each type of wheeled chassis.



**Now that you understand
what chassis are, let's try
building one!**

Activity:

With your group, follow the Robits Beginner Chassis Assembly Guide to build your first chassis.



**Now that you've finished
your chassis, let's add
electronics in Lesson 5!**

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