Learning objective	Success criteria
• To understand how wheels move.	• I can identify what mechanism makes a toy or vehicle roll forwards. • I can recall that in order for a wheel to move it must be attached to an axle. • I can draw and label a diagram of an axle, wheel and axle holder.

Before the lesson

Watch

Teacher video: How do wheels move?

Have ready

- *Presentation: Wheels and axles.*
- Items that have wheels, such as bicycles, tricycles, trundle wheels, toy cars, skateboards and trolleys (arranged around the classroom – see Attention grabber).
- Equipment for the children to experiment with (per small group):
  - selection of straws;
  - paper;
  - glue or masking tape;
  - scissors.
- Link: *Assessment – D&T Y1: Wheels and axles* (optional – see Attention grabber).

Print in advance

- Activity: Wheels and axles images (one set per grup).
- Activity: Wheels and axles - key vocabulary (optional - see Adaptive teaching).
- Activity: Wheel, axle and axle holder model guide (as required).

Lesson recap

As this is the first unit in Key Stage 1, there is no knowledge to recap with the children.

Attention grabber

Presentation: Wheels and axles1

Display slides 2–8 of the *Presentation: Wheels and axles* and ask the children to look at each of the wheeled items arranged around the classroom and to try and work out how each item moves.

Ask the questions on slide 9 to develop the children's thinking and to encourage them to investigate the objects in more depth.

Discuss what the children have discovered.

Using slides 10–11, establish that wheels are circular discs attached to an axle, which rotates inside an axle holder. The axle holder is attached to the object's body (such as a vehicle or toy). Make it clear that the wheels and axle can turn, but the axle holder is fixed to the object's body.

Optional – provide each child with a copy of the *Knowledge catcher* (see link: *Assessment – D&T Y1: Wheels and axles*) and ask them to complete it to the best of their ability. Explain that at the end of the unit, they will revisit it, adding more information in a different colour.

Main event

Explore

Pick one of the wheeled objects from the Attention grabber and model how to draw a diagram of it, using the appropriate vocabulary to label it (wheel, axle and axle holder). Model how to show the movement, drawing an arrow with a coloured pen.

Ask the children to consider the following:

- **To what** the wheels are attached.
- **How** the wheels are attached.
- **Where** the wheels are placed in relation to the shape of the body.

Ensure the vocabulary wheel, axle and axle holder are used. These words are shown on slide 12 of the *Presentation: Wheels and axles*. Keep this slide displayed so the class can refer to the words during the rest of the lesson. Alternatively, hand out the *Activity: Wheels and axles – key vocabulary*.

Arrange the children into small groups to create their own diagrams of different objects, as modelled by the teacher. Look at each of the diagrams in turn and ask the children which parts they think are moving. These diagrams (with a picture of the object attached) should then be displayed on the wall for the next lesson.

Problem-solving

Ask the children to think about which parts move and what they attach to before asking how we can attach a moving part to a non-moving part. To support this, refer back to the objects they looked at in the Attention grabber and give the children the opportunity to look at them again.

Give the children straws, paper, scissors and glue or masking tape and ask them to see if they can replicate the way in which a moving part is attached to a non-moving part. Allow the children to experiment and do not expect a finished product.

Rather than give instructions, work on a table with a group and experiment, making silly mistakes and encouraging the children to solve problems and collaborate.

Use the *Activity: Wheel, axle and axle holder model guide* if the children require more direction and support.

Finish by asking the children how wheels work.

Wrapping up

As a class, discuss how wheels are used in everyday life:

- What items do you know that use wheels?
- Where can we find wheels in our school? (You may want to go for a walk to see this.)
- Why do we use wheels?

Hand out the *Activity: Wheels and axles images* to the small groups and ask the children to group them. Once they have finished, ask the children to explain why they have grouped them in this way.

Vocabulary

Axle

A long straight rod which connects to a rotating part (e.g. the wheels of a car).

Axle holder

The part of a mechanism which holds the axle steady.

Diagram

A picture showing what something looks like or explaining how something works.

Mechanism

Parts of an object that move together to make something work.

Wheel

A circular object that turns round. It can be fixed to a vehicle like a car or a bicycle to allow the vehicle to move easily over the ground.

Assessing progress and understanding	Differentiation
Pupils with secure understanding indicated by: explaining that wheels move because they are attached to an axle and that wheels and axles are used in everyday life, not just in cars. **Pupils working at greater depth indicated by:** explaining how they could use an axle to make a wheel move and how they could secure this mechanism to their vehicle or toy.	**Pupils needing extra support:** Could use the *Activity: Wheels and axles – key vocabulary*. **Pupils working at greater depth:** Should be encouraged to work independently and comment on the materials used for each part.

Learning objective	Success criteria
• To identify what stops wheels from turning.	• I ca recall that a wheel needs an axle in order to move. • I can fix a design so that the wheel can move. • I can use appropriate vocabulary to describe which parts are moving or not.

Before the lesson

Watch

Pupil video: Fixing broken wheels – Vehicle D

Have ready

- *Presentation: Quizmaster*.
- Link: Sid the science kid - How wheels work on VideoLink – **this is an external website and we do not have control over its content – please check before showing it to the children.**

Print in advance

- Activity: Broken vehicle images (one per child)
- Activity: Repair tickets (one per child).

Lesson recap

Display the *Presentation: Speak like an expert* and allow time for the children to think about a question to ask. Explain that the children must know the answer.

Presentation: Quizmaster1

Provide time for the children to ask their questions and for the other children to try and answer them.

Attention grabber

Watch: Sid the science kid - How wheels work.

Recap what the children discovered in *Lesson 1: How do wheels move?*:

- Wheels are circular discs.
- Wheels are attached to an axle.
- The axle moves inside an axle holder.
- The axle holder is attached to the body of the vehicle or toy.

Explain to the children that, just like Sid (from the video they just watched), they will look at some vehicles that are not working and will try to figure out why they are not working.

Remind the children that they will need to keep their explanations to themselves until the end of the session so that everyone has a chance to figure out what is not working.

Main event

Hand out the *Activity: Broken vehicles images* and the *Activity: Repair tickets* to each child and explain that they will write a repair ticket for each of the three 'broken' toy car images. They will need to explain why the toy is not working and what should be done to fix it.

The images are designed to highlight any misconceptions the children may have. By asking the children to identify and suggest how to fix the problems, they will be less likely to make the same errors later in the topic.

- Vehicle A: vehicle with triangle wheels.
- Vehicle B: vehicle with no axle (the wheels are glued directly to the car).
- Vehicle C: vehicle with wheels on one side only.

Ask the children to work independently to note what they think the issue is with each of the broken vehicles on the repair ticket.

Show pupils the Pupil v*ideo: Fixing broken wheels - Vehicle D*, which shows a vehicle with an axle glued to the axle holder.

Ask the children to write why they think the vehicle is not working correctly on their repair sheets.

Once children have diagnosed what they think the issues are with all four vehicles, discuss them as a class, encouraging the children to share the problems and solutions for each vehicle.

Questions

- What is not working?
- How do you know?
- What should it be doing?
- What would you need to change/fix to get it to work?
- How would you know if it was working again?

Wrapping up

Inform the class that they will design their own moving toy vehicle in the next lesson.

Ask them to discuss what they have learnt in this lesson that will help them in their designs. Share the following design criteria and explain that for their toy vehicle, it will need to meet each of these points:

- The vehicle should have round wheels that balance the body.
- The wheels need to be attached to an axle.
- The axle needs to fit inside an axle holder but not be attached to the axle holder.

Vocabulary

Axle

A long straight rod which connects to a rotating part (e.g. the wheels of a car).

Axle holder

The part of a mechanism which holds the axle steady.

Equipment

Things that are used for a particular activity.

Mechanism

Parts of an object that move together to make something work.

Wheel

A circular object that turns round. It can be fixed to a vehicle like a car or a bicycle to allow the vehicle to move easily

over the ground.

Assessing progress and understanding	Differentiation
Pupils with secure understanding indicated by: identifying the problem with each of the vehicles; explaining how it might be altered using the correct vocabulary (wheel, axle and axle holder). **Pupils working at greater depth indicated by:** using technical language to explain why the vehicle isn't moving and how it could be adapted so that it moves more easily.	**Pupils needing extra support:** Could be asked more questions or given scenarios to help them identify solutions; could benefit from working with a partner to write down shared ideas on the repair tickets. **Pupils working at greater depth:** Should be pushed to use more technical and precise language to explain the problems and solutions; could also be asked to design another broken car (with a different defect).

Learning objective	Success criteria
• To design a moving vehicle.	• I can recall what makes a wheel and an axle work. • I can design a moving vehicle. • I can label my design using appropriate vocabulary.

Before the lesson

Watch

Teacher video: Designing a vehicle

Have ready

- Presentation: *Gimme five!*
- *Presentation: Vehicles.*
- *Audio: Soundtrack: Mission Impossible.*
- Ruler.
- Materials for making vehicles:
  - body: cardboard tubes, cardboard boxes or yoghurt pots;
  - axle: straws or dowel (cut to size);
  - wheels: wooden wheels, card discs or plastic cotton reels.
- Optional extension activity (see Adaptive teaching):
  - the *Extension activity: ICT Flag design template* pre-downloaded or dropped on the intranet so the children can easily access using their logins;
  - laptops or tablets with access to Microsoft Office.
- Link: Ford assembly line on VideoLink – **this is an extended website and we do not have control over its content – please check before showing it to the children.**
- Download: Extension activity: ICT Flag design template - NEW (optional - one per child to be saved in a folder).

Print in advance

- Activity: Vehicle design sheet (one each).
- Activity: Vehicle design sheet with template - NEW (support - see Adaptive teaching).
- Resource: Pupil's PowerPoint draw tutorial (optional - see Adaptive teaching).
- Resource: Teacher's PowerPoint draw tutorial (optional - one for the teacher, see Adaptive teaching).

Lesson recap

Display the *Presentation: Gimme five!* and allow time for paired discussion.

Presentation: Gimme five!1

Take feedback about any key points the children recalled from the last lesson.

Attention grabber

During this lesson, the children will design a moving vehicle. They will be familiar with how modern cars look, but they

may not know that moving vehicles have changed a lot over time.

Presentation: Vehicles2

Display slide 2 of the *Presentation: Vehicles* and ask the class:

- How have the designs changed over time? (There is a roof on the modern car; windows all the way around; wing mirrors.)
- What is the same about them? (Wheels and axles; steering wheel; windscreen; lights.)

Focus on the similarities, particularly the wheels and axles that balance the car and help it move.

Share some information from slides 3–5 about Henry Ford and how his designs and manufacturing methods were so important.

Play the link: Ford assembly line on VideoLink to give the children an idea of what this looked like.

Show slide 6 and ask:

- How did people get around before cars? (On foot, by horse.)
- Why did cars make it easier to get around? (Cars move faster than on foot or by horse; cars do not get tired; you have to put in petrol/diesel or charge them up.)

Explain that the inventors who made the first vehicles had to try lots of different components to make them work and the children will start thinking about that in this lesson.

Main event

The children will use what they learned from previous lessons about wheels, axles and axle holders, in particular, the mistakes they solved in *Lesson 2: Fixing broken wheels*.

Remind the children that at the end of the previous lesson, they looked at a list of design criteria for the vehicle they will each make:

- The vehicle should have round wheels that balance the body.
- The wheels need to be attached to an axle.
- The axle needs to fit inside an axle holder but not be attached to the axle holder.

As the children make their vehicles, they should now consider if there are other points they should add to the list of design criteria, such as strength, colour, appearance and material.

Questions

- How does a wheel work?
- What do we need to make sure to guarantee our vehicles move?
- What else do we need to consider for our vehicles?

Plan

Model planning the vehicle design by measuring the body and drawing on a copy of the *Activity: Vehicle design sheet*. Remind the pupils to label their design, including the vehicle's body and introduce the word 'chassis'.

Add the axle holder, axle and wheels in a different colour, labelling them and including their length. Remember to discuss where and how each item will be attached. You might want to annotate some of this on your design.

Hand out a copy of the *Activity: Vehicle design sheets to* each child and give them time to complete them. Use *Activity: Vehicle design sheet with template* if required for children needing additional support.

Make available materials for making the vehicles. There is no need for glue or scissors at this stage. The children are not making their vehicles yet, only deciding which objects and materials they will use and ensuring they have allocated an item for each vehicle component: wheel, axle, axle holder, body/chassis.

Review

Ask the children to leave their plans on their tables and to move around the room, looking at everyone else's plans.

Once they have done this, they can revisit their plans and make any amendments based on ideas they have seen.

The children will need their vehicle design sheets for the next lesson.

Wrapping up

As a class, make a set of instructions for the next lesson, when the children will be making their vehicles. Explain that the instructions must include the following:

- What they have to do.
- In what order they have to do things.
- What tools they will need.

For example:

1. Cut your axle holders with scissors to the correct size and tape them to the body/chassis.
2. Attach one wheel to each side of the axle and then thread through the axle holder.
3. Attach the other wheel to the other end of the axle.

Vocabulary

Axle

A long straight rod which connects to a rotating part (e.g. the wheels of a car).

Axle holder

The part of a mechanism which holds the axle steady.

Chassis

The body of a car.

Mechanism

Parts of an object that move together to make something work.

Wheel

A circular object that turns round. It can be fixed to a vehicle like a car or bicycle to allow the vehicle to move easily over the ground.

Assessing progress and understanding	Differentiation
Pupils with secure understanding indicated by: designing a vehicle that includes wheels, axles and axle holders, which will allow the wheels to move. **Pupils working at greater depth indicated by:** using measurements in their vehicle designs and considering the design criteria.	**Pupils needing extra support:** Could benefit from using the *Activity: Vehicle design sheet with template* so that they can focus on drawing the mechanism. **Pupils working at greater depth:** Should measure each of the items in their design and add these measurements to their designs, possibly drawing their vehicles to scale; could download the *Extention activity: ICT Flag design template - NEW*, the *Resource: Pupil's PowerPoint draw tutorial* to draw a flag and a laptop or tablet to use Microsoft Powerpoint's drawing tools to create a flag. (Alternatively, use an online drawing application such a Sketchpad).

Learning objective	Success criteria

• To build a moving vehicle.	• I can make a wheel and axle mechanism. • I can evaluate my design to make it even better.

Before the lesson

Watch

Teacher video: Wacky races
Pupil video: Wacky races

Have ready

- *Presentation: Brain dump*.
- *Presentation: Wacky races*.
- Children's vehicle design sheets from *Lesson 3: Designing a vehicle*.
- Materials for making vehicles, such as card boxes, cotton reels, straws and pipe cleaners.
- Dowel pre-cut to 20 cm lengths for the axles or alternative suitable materials (two lengths per pupil).
- Materials for decorating vehicles, such as tissue paper, glitter and googly eyes (optional).
- Link: *Assessment – D&T Y1: Wheels and axles* (optional – see Wrapping up).

Lesson recap

Display the *Presentation: Brain Dump* and allow time for paired discussion.

Presentation: Brain dump1

Take feedback about any key points the children recalled from last lesson.

Attention grabber

Display slides 2–9 of the *Presentation: Wacky races* on the interactive whiteboard and highlight the various designs of the vehicles.

Presentation: Wacky races2

Recap the design criteria that you shared as a class in *Lesson 3: Designing a vehicle*, including any of the children's suggestions:

- The vehicle should have round wheels that balance the body.
- The wheels need to be attached to an axle.
- The axle needs to fit inside an axle holder but not be attached to the axle holder.
  Use Slides 10 and 11 to provide a visual if necessary.

Remind the children of the instructions they composed at the end of the last lesson, such as:

1. Cut your axle holders with scissors to the right size and tape them to the body/chassis.
2. Attach one wheel to each side of the axle and then thread through the axle holder.
3. Attach the other wheel to the other end of the axle.

Ask the children if they have any questions and point out where they can find the relevant materials and equipment for making their vehicles.

Play the *Pupil video: Wacky races* (see Watch) and consider leaving this to run during the lesson so the children can continue to refer to it.

Main event

Give each child:

- Their vehicle design sheet from Lesson 3.
- Two 20 cm pre-cut lengths of dowel (or other suitable materials) for the axle.

Ask the children to refer to their design sheets and gather all the materials they will need.

Stress the need for accurate cutting and using the correct amounts of glue or masking tape, as using too much could affect the overall look of their product.

Top tip: give the children a labelled plastic wallet to keep their parts in and keep tools and offcuts in clear labelled trays.

Re-cap and demonstrate how to attach the axle holders to the chassis using card pieces (see *Teacher video: Wacky races)* or play the *Pupil video: Wacky race*s (see Watch) again.

Give the children time to attach their axle holders to their own vehicles.

Once most children have completed the first section, model attaching the axle to the wheel using glue or masking tape, then threading it into the axle holder before attaching the last wheel (or play the relevant part of the *Pupil video: Wacky races*). Children then complete this second stage.

Encourage the children to work together, especially on the more fiddly parts.

Depending on the agreed design criteria and time available, you may want to give the children time to decorate their vehicles using paint, tissue paper, glitter, etc.

Wrapping up

Working in their table groups, explain that the children will be a judging panel and will look at each model vehicle on their table and decide if the model meets each item on the design criteria list (display the design criteria on the board).

- If the model does not meet each item on the design criteria list, the judging panel should make suggestions on the next steps to ensure the design criteria are met.
- If the model does meet each item on the design criteria list, the judging panel should suggest ideas for how the model could be made even better.

Remind the children to be sensitive when giving feedback as the judging panel and to think about how they would feel if they were receiving the suggestions. Praise groups who do this task constructively.

Finally, give the children time to test their cars. The most important thing to check is that the wheels turn correctly.

Optional – provide each child with the *Quiz - pupil answer sheet* and display the *Unit quiz* (see link: *Assessment - D&T Y1: Wheels and axles*). Read each question aloud and allow the children time to answer. Reveal the answers and ask them to self/peer mark their answer sheets.

If pupils completed the *Knowledge catcher* in Lesson 1, they can revisit them and add new information in a different colour.

Vocabulary

Axle

A long straight rod which connects to a rotating part (e.g. the wheels of a car).

Axle holder

The part of a mechanism which holds the axle steady.

Chassis

The body of a car.

Dowel

A rod, usually made of wood, that is used to hold two parts of something together by fitting into a hole in each part.

Mechanism

Parts of an object that move together to make something work.

Wheel

A circular object that turns around. It can be fixed to a vehicle like a car or bicycle to allow the vehicle to move easily over the ground.

Assessing progress and understanding	Differentiation
Pupils with secure understanding indicated by: making a moving vehicle which works (wheels move correctly); can explain what must be changed so that the vehicle can work if the vehicle doesn't work. **Pupils working at greater depth indicated by:** explaining how their model works and how they could improve it further using technical vocabulary.	**Pupils needing extra support:** Could benefit from working with a partner on the more practical elements of construction; could need reminding of what their next step is. **Pupils working at greater depth:** Should evaluate how accurate their design is in relation to their model; could adapt their plan/model further to make their vehicle work better; should test their vehicle.