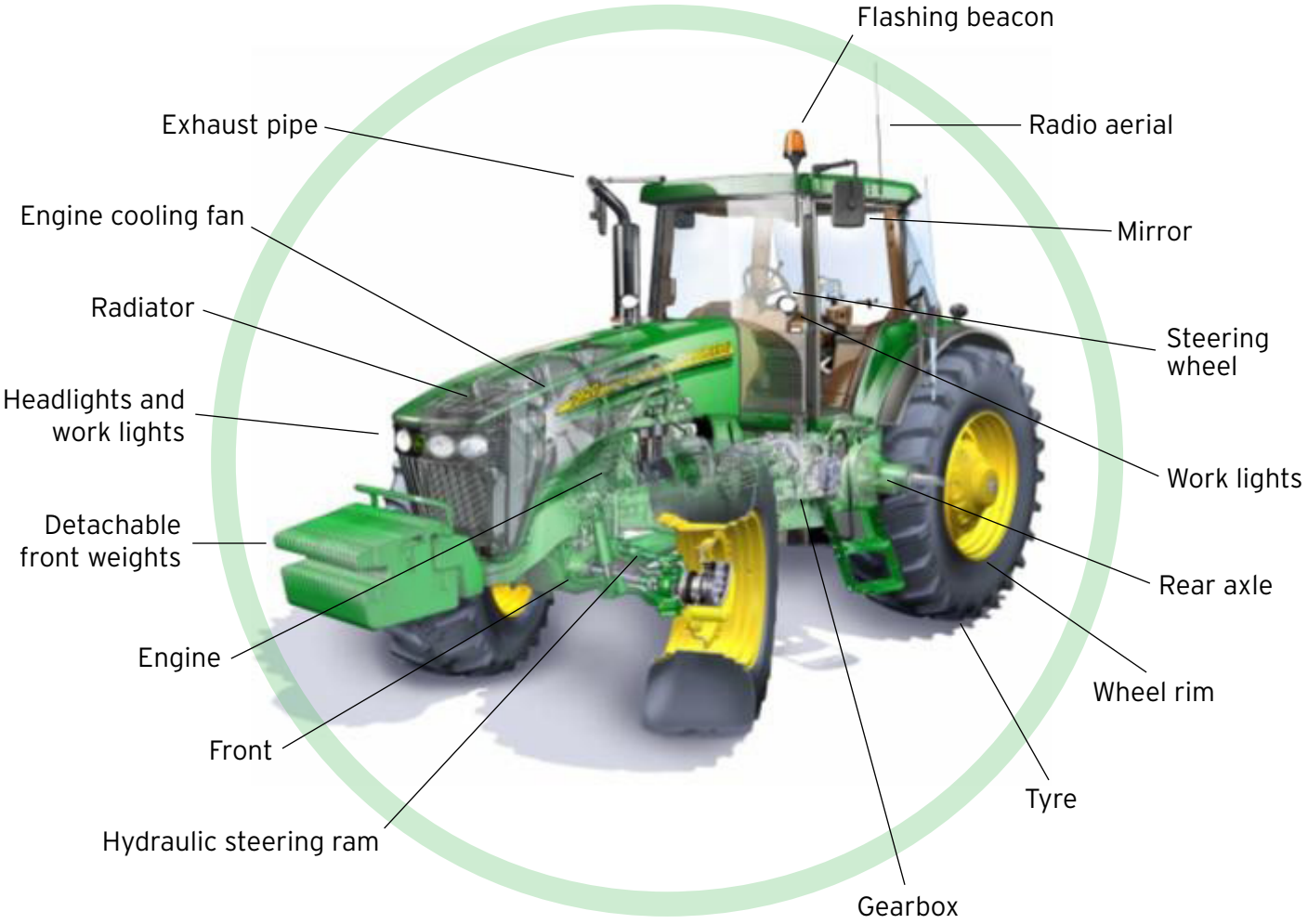
STEM and Tractors



The history of the tractor

The tractor is one of the most common sights on any farm today. However, for centuries, farmers worked the fields with horse or ox-drawn ploughs and hand tools for planting and reaping.

About five hundred years ago, it would take almost two days to plough a hectare of land using oxen. Today it takes a tractor less than half an hour to plough the same area. There are also self-drive tractors which go up and down fields being guided by satellites.

The modern tractor was developed from steam- powered traction engines during the 1850's. With the introduction of petrol engines in the 1880s, it wasn't long before tractors appeared using the new petrol driven engines around 1889. The early tractors were really heavy machines weighing around 10,000 kg. In 1902, the first lightweight tractor emerged weighing 1,500 kg. Along with the mass production of the car, tractor production reached around 70,000 a year by 1930.

The basic design of the tractor hasn't altered much since the early 1900's. The two large rear wheels provide traction, or grip, while the two smaller wheels provide steering. The first tractor tyres were made from steel and pneumatic (air-filled) tyres didn't appear until the 1930s.

Frequently Asked Questions

Why does a tractor have large wheels at the back and small ones at the front?

Large wheels are for traction, while the small wheels are for steering.

What have computers got to do with tractors?

Computers are used in a variety of different ways to make tractors easier and more efficient to use. The materials used to build tractors, the shape, paint, fuel and even sorting out engine faults all depend upon the use of computers. Many tractors have computers in the cab which can help with field mapping and save on applying costly sprays and fertilisers.

What is GPS?

'GPS' stands for 'Global Positioning System'. This is a world-wide radio-navigation system formed from a constellation of 24 satellites and their ground stations. GPS can be used by the tractor driver to find out exactly which field should be ploughed and how to find its way home, even in the dark.

What about driverless tractors?

Satellite tracking systems, mobile communications and on-board computers have helped make driving a tractor safer and easier. Wireless systems are used to control farm machinery and some tractors can be operated remotely. This helps as many of the jobs a tractor does are repetitive, for example ploughing.

In 2017, there was the world-first hands-free hectare. In this project farmers drilled, tended and harvested a crop of spring barley without any humans entering the field. Only machines were involved in planting and harvesting the crop.

Science

Beetle banks are strips of uncultivated land where beetles and other bugs live. They come out into the crop and help the farmer by eating the pests on the crop.

FIRST LEVEL
Tractor movement

What movements can you relate to a tractor?

When pushing or pulling another piece of equipment, does this make the tractor go faster or slower, why? What other factors may slow the tractor down?

Whatever piece of equipment the tractor pulls or pushes will directly impact on its ability to move. The pupils should also recognise the impact of friction caused by rough or smooth surfaces (tarmac, mud or dry soil) and resistance caused by air, extra machinery and any tractor attachment that is dragged through the soil.

SECOND LEVEL
Motion, angles and surfaces

Set up a ramp to run a toy tractor down. You can have different groups with ramps or pieces of wood to run the tractor down which can be set at different angles. You can also look at the impact of different surfaces on the movement of the tractor. Any results can be graphed.

What impact do farmers have on the environment?

Farming covers a lot of the countryside. Think about the effect of farming on the environment, and how the countryside might look without farming. For example, does ploughing damage the soil? Does farming affect wildlife? Are hedgerows important? Split into two groups with one looking at how farmers look after the countryside and the other looking at environmental problems like spraying chemicals.

Once the groups have completed their research, they should share the results with the other groups in the form of a discussion or debate.

Technology

FIRST LEVEL
Tractor parts

Label the parts of a tractor. Write the parts on cards (see page 1) and get the group to work out where they are on a tractor picture

Identify the part of the tractor. For example, wheels, engine, cab, seat, steering wheel. Think about what materials are used to make the different parts of a tractor?

Lego tractors

Provide each group with a box of Lego. Ask the pupils to design and build a tractor. Encourage the pupils to experiment with size, shape and using different sized wheels. The pupils should keep a note of each of their designs and alterations. Which design did they think was the best?

SECOND LEVEL
Tractors through the ages

Look at pictures of tractors from different eras. Arrange the pictures into different decades from past to the present day. Using the tractors as a focus for each decade, organise the pupils into groups, with a group for each decade. Each group should try and find other pictures or stories of people, buildings and events that occurred in the decade they have chosen to represent.

Technology of the farm

How has technology changed on farms? What fuels do tractors use, how much work do they do? Why are self drive tractors useful? What are the downsides of technology on the farm?

What might have caused any changes in farming? The pupils can present their information in a format they feel is appropriate. For example, a PowerPoint presentation

H&S and tractors

Think about the health and safety rules that should be applied when driving a tractor. Using ideas from the discussion or some of the examples below, either design posters or produce a PowerPoint to share.

- Wear hearing protection
- Do not carry passengers
- Watch out for ditches
- Do not park a tractor on a steep slope
- Do not dismount from a moving tractor
- Remove the starting key when not using the tractor
- Wear boots

Tractor build and design

Work in small groups to design and build a tractor. Once they have completed building the tractor, discuss what forms of power can be used to enable the tractor to move to imitate the action of a real tractor. The pupils should experiment with different wheel sizes, fixed or rotating axles and the framework structure. The tractors can then be tested on various inclines to determine which design and form of power is the most effective.

Technology

Tractors and soil

Investigate the role of tractors in farming today. Find out what jobs a tractor does on a farm – ploughing, planting, rolling, spreading. How heavy is a tractor – today and in the past? What is the impact of the tractor on the soil – compaction and what are farmers doing to limit soil compaction.

Social Studies

FIRST LEVEL
Tractor jobs on the farm

Look at the jobs a tractor does throughout the farming year. What are the seasons and how busy is a tractor at different times of year? Divide a large sheet of paper into four parts to represent the seasons. For each season, write and/or draw what jobs the tractor would do for that season. Use a mixture of words, pictures and diagrams to illustrate the time-line.

Field mapping

Look at current of old maps and compare the size and shape of fields. How have the fields changed? Can they suggest why these changes have occurred?

SECOND LEVEL
Farming in different countries

Look at farming in different countries and how tractors are used. What size are the tractors, are horses used and how many people are involved in farming. Look at Farming in Nepal and try the squashed tomato challenge

Arable farming through the seasons

There are several video clips to get you started.

A crop sprayer travels up and down fields using tram lines. The tramlines are placed at set distances apart in the field to ensure that there is no overlap of the spraying zone.

Maths

FIRST LEVEL

Shapes

What shapes can you see on the tractor? (e.g. circle, triangle, square)

This question could be followed by discussing the use of shapes for vehicles. Why are wheels round? Why are windows all similar shapes?

Draw the shapes that you identified onto pieces of coloured paper. You can draw lots of the same shapes, but make sure that you have drawn all of the shapes that you could see on the tractor. Cut out the shapes and organise them into piles of the same shape. What objects or pictures can you make using the assorted shapes (tangrams)? Can you use some of the same shapes to make a triangle, square or circle (tessellation)?

SECOND LEVEL

Tractor wheels and car wheels

What is the diameter of a tractor tyre and how does this compare to a car? Can you measure the diameter, radius and circumference of a car tyre? Why do tractors need large tyres? The wheel is the metal part and the tyre is the rubber part. This will give 2 measurements which can be compared.

Tractor prices

Look at the prices of some modern tractors and compare these with historical prices. Use the prices to make a bar chart.

Old tractor prices

1960: £4000	1967: £3100
1967: £3200	1969: £1650
1970: £3200	1971: £3500
1971: £2800	1975: £4200
1976: £2750	1979: £3950
1979: £5700	1980: £5900
1980: £2500	1981: £4150
1982: £5700	1982: £5300
1986: £5900	1987: £10400
1987: £10500	1989: £10900

2022 tractor prices

ARMATRAC	£28,000
BELARUS	£17000
BRANSON	£39995
CLAAS	£65,350
FENDT	£97471
FARMTRAC	£26500
JOHN DEERE	£42605
KIOTI	£33000
NEW HOLLAND	£35255
MASSEY FERGUSON	£66290

Tractors and other farm machinery are both imported and exported from the UK and industry is worth £4 billion a year and employs 25,000 people.

	Exports	Imports
Product category	**Value (£ million, 2018)**	**Value (£ million, 2018)**
Tractors	1,124.70	784.8
Mowers for lawns, parks and sports grounds	207.2	202.6
Harvesting and thresing machinery	192	425.4
Engines for tractors	119.4	285.5
Soil preparation and cultivation machinery	95	198.6
Other agricultural and forestry machinery	195.9	233.7
Other outdoor power equipment	4.9	80.2
Total	**1,939.10**	**2,210.70**