Some helpful slides that we have used within lessons.

- Read through the slides where you feel less confident.
- Try and answer some of the questions or get a friend or family member to ask you some. Don’t know the answer? Do a bit of research and find out!
- Write notes down in the form of mind maps, lists or another way you find helpful.
- Remember, these are things we have already covered and you do know it.

Know your trees

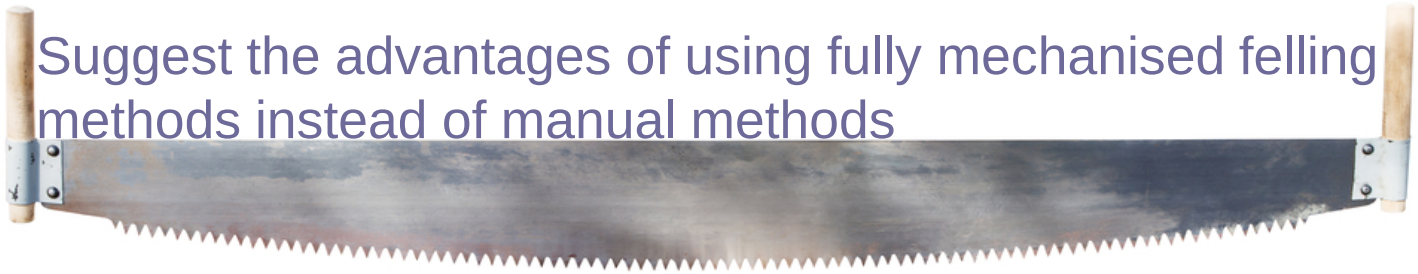
- Natural wood is categorised as either hardwood or softwood
  - Most hardwood and softwood trees have characteristics that help us recognise them
  - Both types can be grown and harvested responsibly in managed forests
  - This makes wood a sustainable and biodegradable resource
  - How can you characterise each type?

Natural

- A useful and versatile material, wood is:
  - Aesthetically pleasing
  - A good insulator
  - Durable and tough
- Wood generally has a good strength to weight ratio

Felling

- A tree is ‘felled’ when it is cut down
  - Traditional methods of felling used saws and axes. What do you think is used in modern felling as a replacement?
  - Chainsaws are used in modern felling
  - Agricultural logging uses machinery with large chainsaw attachments. These can fell, de-branch and log a tree in one swift action
  - Felling
  - Suggest the advantages of using fully mechanised felling methods instead of manual methods



Softwood

- Softwood comes from coniferous trees
  - Most coniferous trees have needles, are evergreen, and they keep their needles all year round
  - Softwood trees grow faster than hardwood trees making it relatively cheap and readily available
  - The grain is wider making it more absorbent
  - What problems could this absorbency cause with the timber?

Hardwood

- Hardwood is sourced from deciduous trees
  - Deciduous trees drop their leaves in the autumn and new leaves grow in spring
  - Hardwood is slower growing and is therefore more expensive
  - Sought after for its variety of colours and grains, it has good aesthetical and physical properties
  - It has a closer grain, making it more dense and hardwearing
- Which hardwoods are grown sustainably in the UK?

What's different about these trees? Write on your sheets as many words to describe, and explain if possible, their differences. Can you think of any examples for each?

Working properties

- Consider the different properties of timber when selecting your material
  - Strength – the amount of load or compression it can withstand
  - Toughness – absorption of energy through shock before splitting
  - Elasticity - will it return to shape after being compressed?
  - Hardness – how resistant is the surface? Will it survive scratches, knocks and abrasion?

Tough or hard?

- Hardwoods are used in wide range of applications
  - Ash is very tough, but also flexible and shock resistant
  - Beech is tough and very durable with a fine finish
  - Oak is tough, hard and durable with a variable grain
  - Select a suitable wood for each object shown below, giving reasons for your choice

Desirable hardwood

- Mahogany is sought after for its durability, colour and aesthetics
  - Its deep rich reddish brown hue gives beauty and warmth to furniture, musical instruments, boats and interior panelling
  - Unfortunately man's desire for mahogany has increased the destructive and illegal logging trade
  - What would be the result of continual illegal logging to the Amazon rain forest?
  - Why is it essential to source wood from sustainably managed forests?

Useful softwood

- Softwood is cost effective and readily sourced, making it an ideal choice for the construction industry
  - Pine is lightweight and easy to work with
  - Larch is durable, tough and has good water resistance
  - Spruce has a high stiffness to weight ratio
  - Cedar contains natural oils which offer natural water resistance
  - Why are softwood planks usually narrower than hardwood planks?

Manufactured boards

- These can be made from sawmill scraps, recycled wood, low grade timbers and even sawdust
  - Wood pieces are bound together with adhesives to make man-made / manufactured board
  - Manufactured board can be susceptible to moisture
  - Boards are rigid, stable and supplied in large sheets
  - What are the advantages of producing board in larger sheets?

Common boards

Medium density fibreboard or MDF	Chipboard or particle board	Plywood
Very dense board which makes it tough	Good compressive strength	Made up of alternative rotated layers of glued wood veneers
Its smooth surface makes it suitable for veneers and finishes	Edges chip easily	Available in various forms including marine ply for greater water resistance

- Compare the aesthetics of hardwood with manufactured boards. Suggest appropriate uses

Knotty problem

- Natural timbers can have natural defects
  - The most common natural defect is a knot
  - Softwoods such as pine, larch and cedar can also seep resin at the knot
  - What impact would knots have when working with timber?
  - How could knots be used to their advantage?

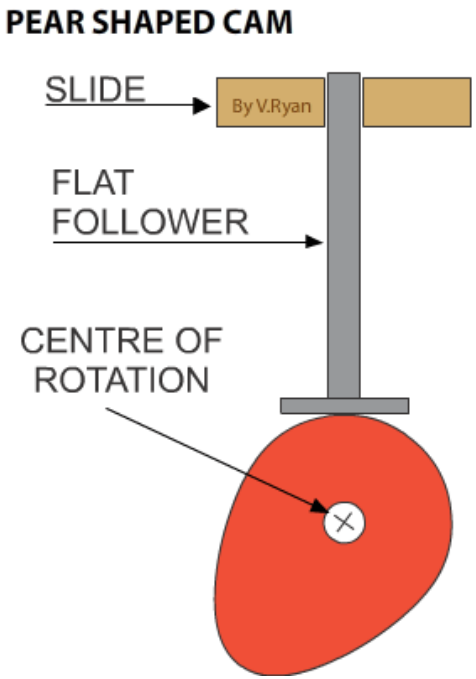
Questions

- From the following list of products, select the most appropriate material for each:
  1. A highly polished wooden floor
  2. A kitchen work surface
  3. Children's building block toys
  4. A low cost dining table
- Explain your choices justifying what makes each wood suitable for the task
- What are the hazards of working with manufactured boards and how do you protect against them?

What is a cam?

- A CAM changes the input motion, which is usually rotary motion (a rotating motion), to a reciprocating motion of the follower. They are found in many machines and toys.

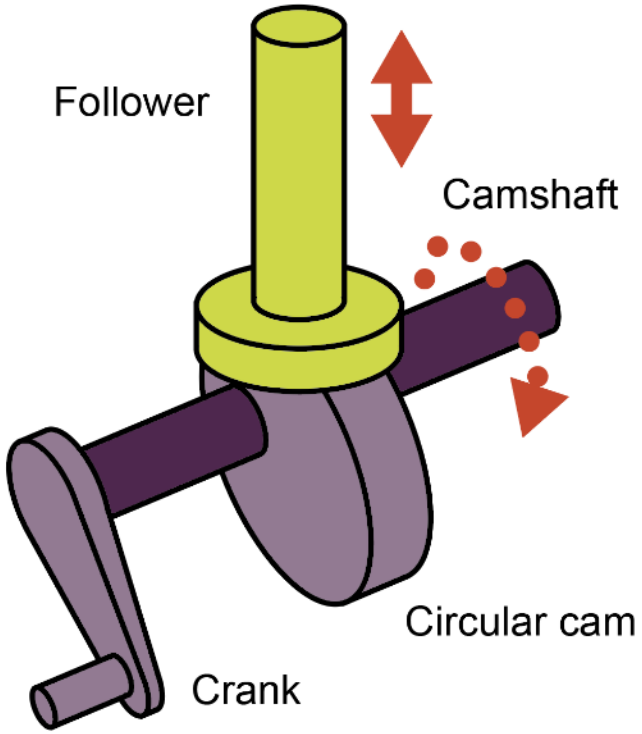
- Example of cams_technology student



- Can you guess what they're called?
- Which one have you used?

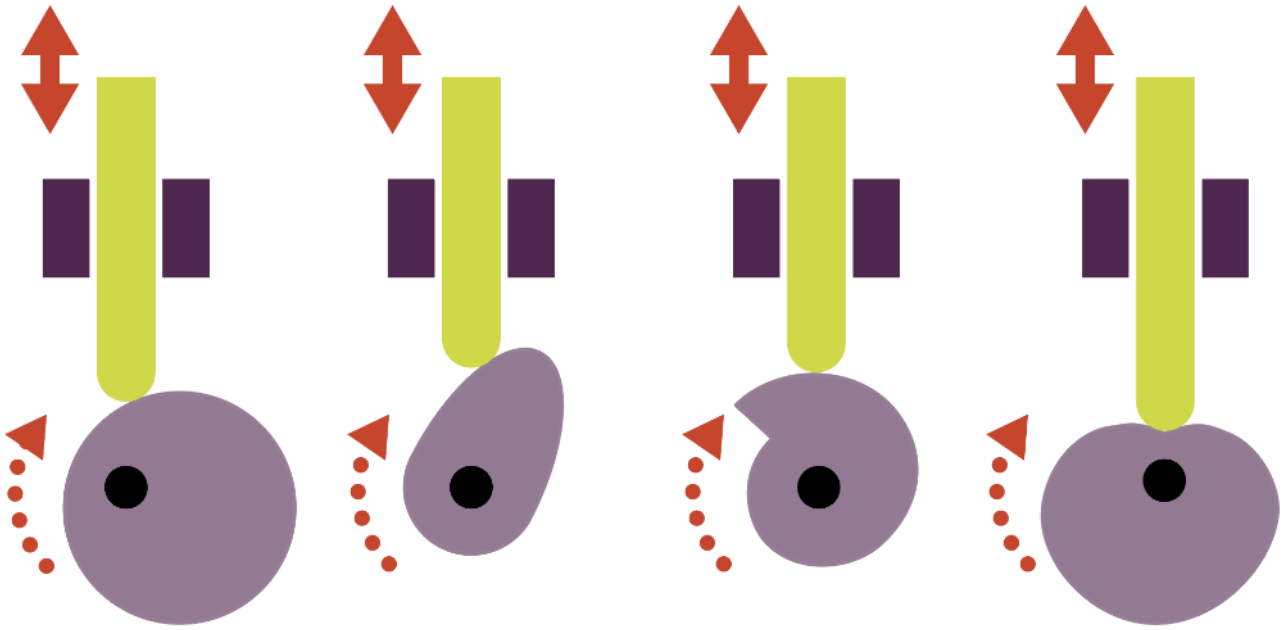
Rotary systems

- Rotary systems drive mechanisms in machinery and equipment
  - A rotating axle called a camshaft is used to drive, or is driven by, other mechanical components
  - Cams are shaped pieces of material that are attached to the camshaft
  - Cams change rotary motion into reciprocating motion through a follower



Types of cams

- Different shaped cams are used for different tasks:



Eccentric cam

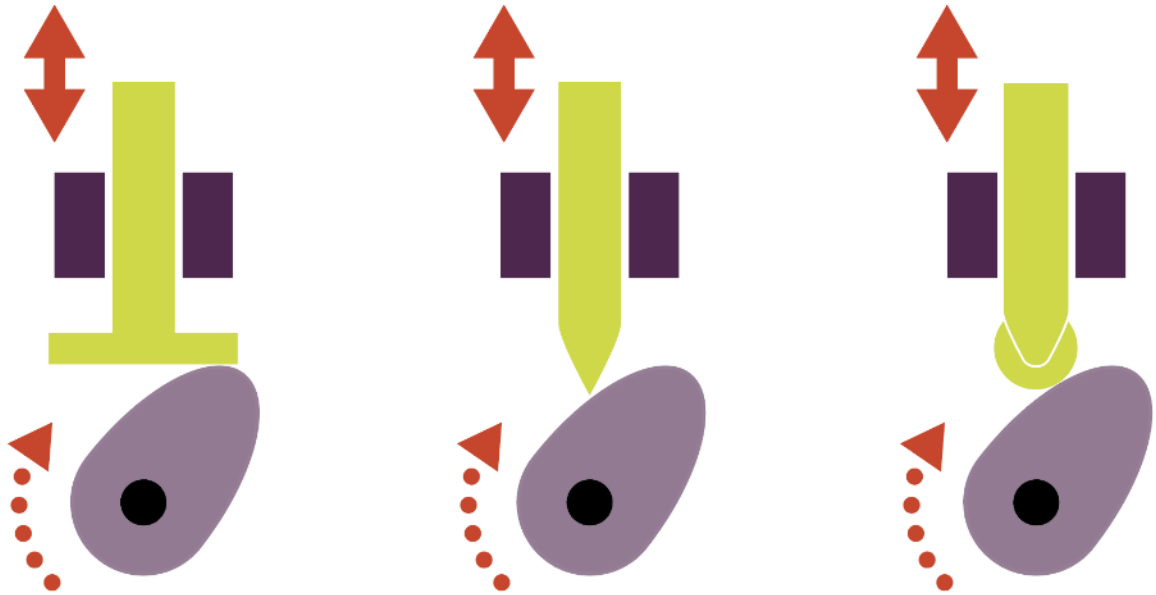
Pear cam

Snail cam

Heart-shaped cam

Types of followers

- Followers rest on a cam and track its rise and fall



Flat follower

Knife-edged follower

Roller follower

Movement and motion

- Motion is the action of something being moved
  - Motionless is something at rest
  - There are different types of motion which can be added together and even changed from one to another
- How would you describe the motion acting upon the ball bearings in a Newton's cradle?

Linear motion

- Movement in one direction along a straight line

Reciprocating motion

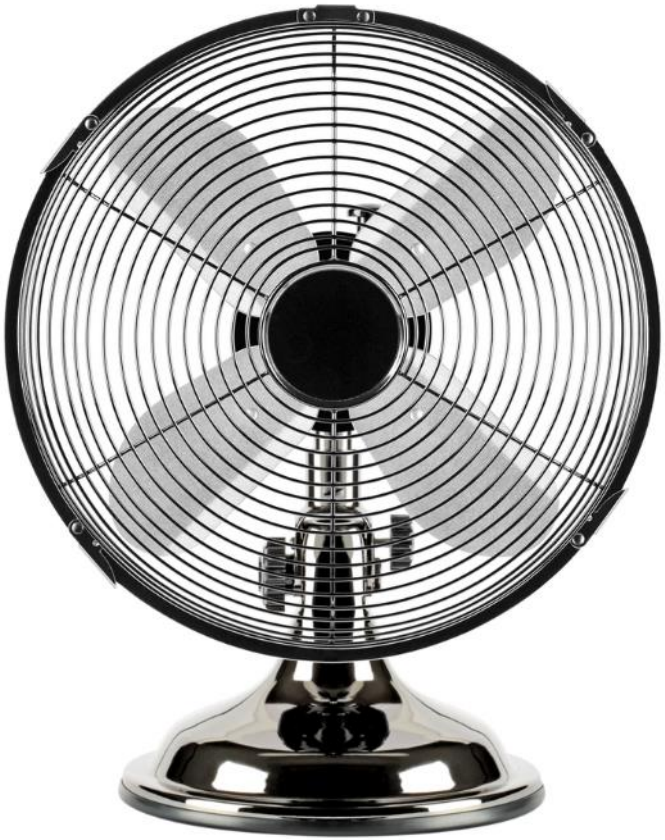
- A repetitive back-and-forth or up-and-down linear action
  - A reciprocating saw blade cuts by travelling back and forth along the same path at high speed
  - What else moves like this?

Oscillating motion

- A repetitive back-and-forth motion along a curved path
  - The pendulum on a grandfather clock oscillates to keep time
  - Which rides in a children's playground also oscillate?

Rotary motion

- Objects moving in a circular motion usually around a fixed axis
  - Can you name the parts on a car or the power tools in a workshop that rotate?



- How would you define a mechanical device?
  - Is a hammer a mechanical device?
  - How about a pair of scissors?

Manufactured boards

- Identify the types of manufactured board shown below and suggest a use for each one

Choice of material

- A day in the life of a child's toy is a tough one!
  - They are thrown, dropped in water, left outside, stood on and chewed
  - Justify a suitable type of wood to make a child's toy

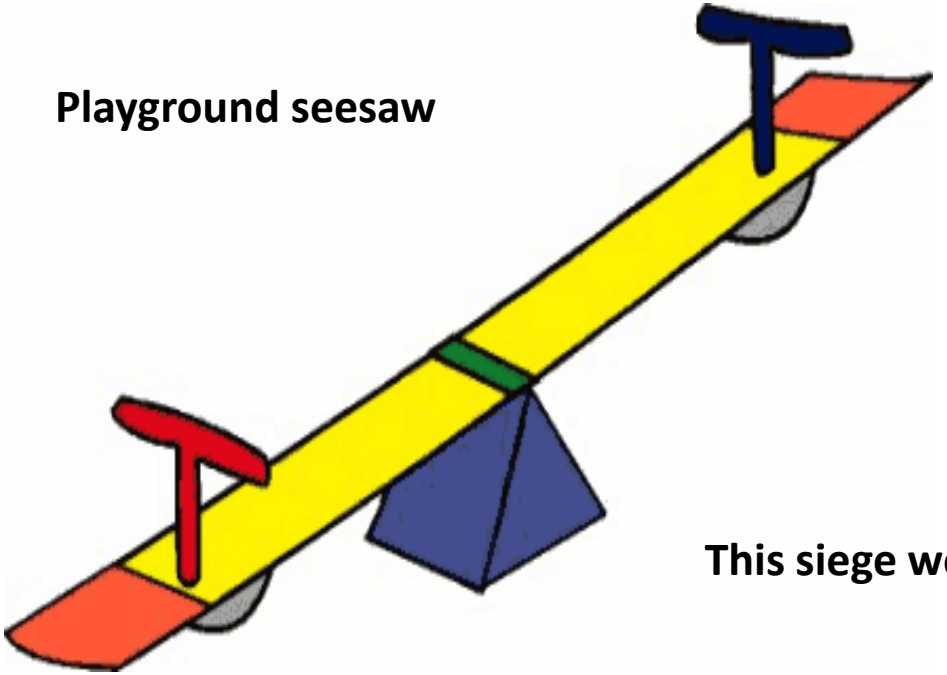
Natural or man-made

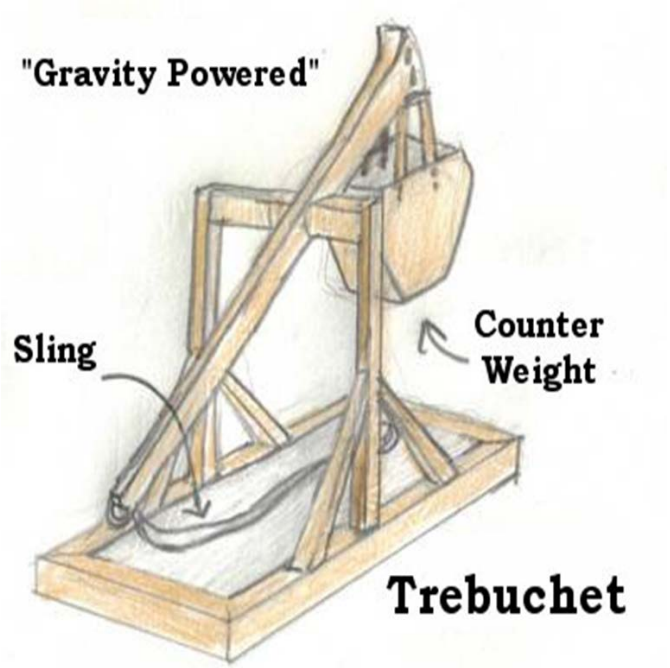
- The type of material a product is made from will also influence the price of the end product
  - Similar products may be made from different timbers to appeal to different markets
  - Some timbers are traditionally used for certain products
  - Which timber would you select to make a gate? Give **two** reasons why?

The simplest type of mechanism is called **LEVER**. Levers can be used to change the **DISTANCE** and **POWER** of movement.

Can you think of any examples?

Playground seesaw





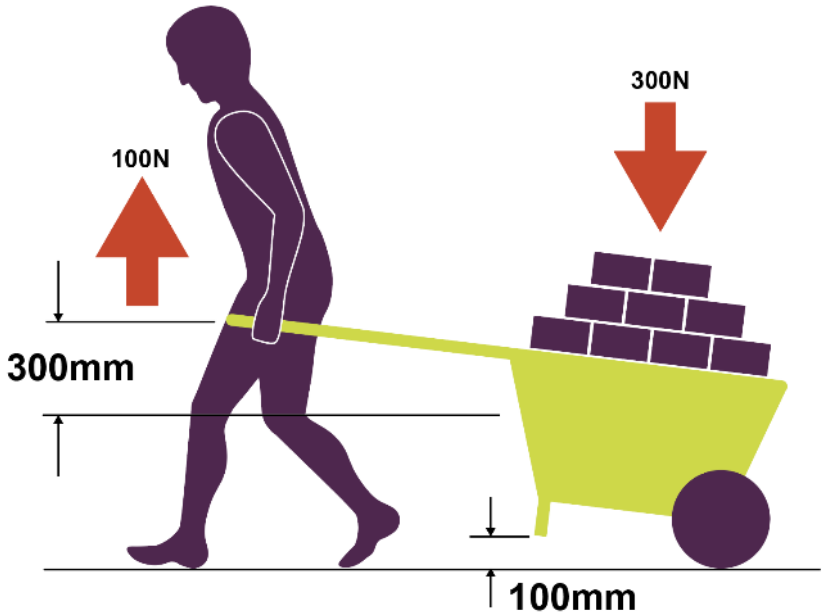
This siege weapon was used in Medieval Times

Levers

- Levers help provide **mechanical advantage** (MA)
  - They have **two** parts – a **bar** and a **pivot** also known as the **fulcrum**
  - Identify the three elements at work: the effort, the load and the position of the fulcrum
  - To calculate the MA, use the formula:

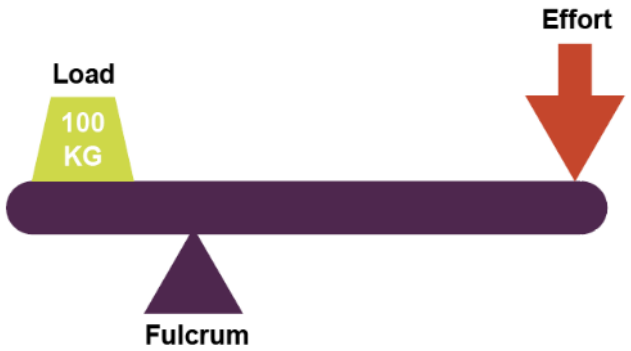
$$MA = \frac{\text{Load}}{\text{Effort}} = \frac{300N}{100N} = \frac{3}{1}$$

  - Also written as 3:1 or MA of 3



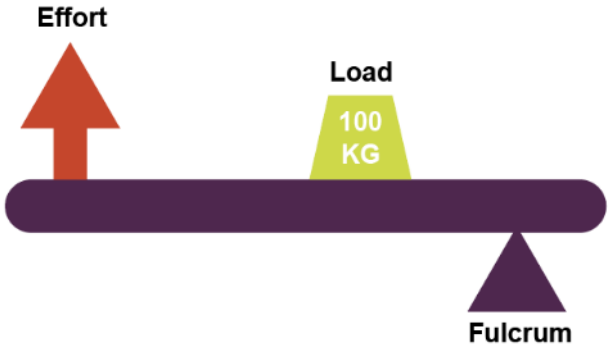
First order lever (Class 1)

- Class 1 levers act in a seesaw or scissor action
  - The load and effort are at opposite sides with the fulcrum positioned at any point between
  - What would happen if the fulcrum of the scales was moved to the left?



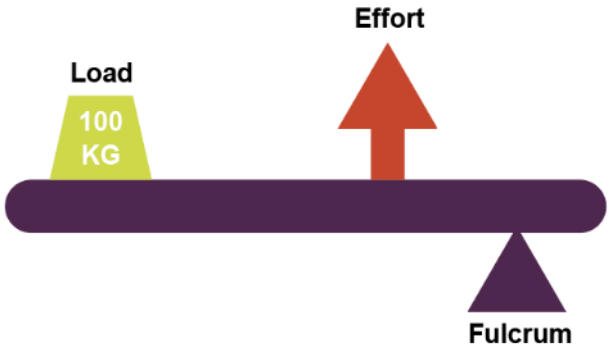
Second order lever (Class 2)

- Class 2 levers act in a wheelbarrow action or that similar to a nutcracker
  - The effort is at the opposite end to the fulcrum, with the load positioned between
  - Identify the effort, load and fulcrum on the nutcrackers



Third order lever (Class 3)

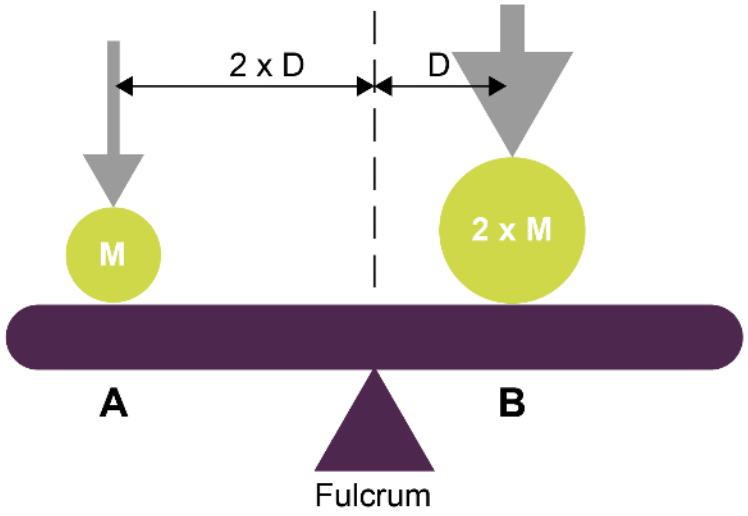
- Class 3 levers have a pincer-like action seen with tweezers and tongs
  - The load is at the opposite end to the fulcrum, with the effort positioned between
  - Explain how the acts of fishing or sweeping the floor could be class 3 levers



Equilibrium

Add keyword to NOTES page 15

- When the effort and the load are equal, equilibrium can be created in a mechanism
  - If two people of the same weight, both sat equidistant from the fulcrum of a seesaw, what would happen?
  - What happens if one person moves further away?
  - To make a seesaw balance, where would you need to sit if you had twice the mass as the other person?



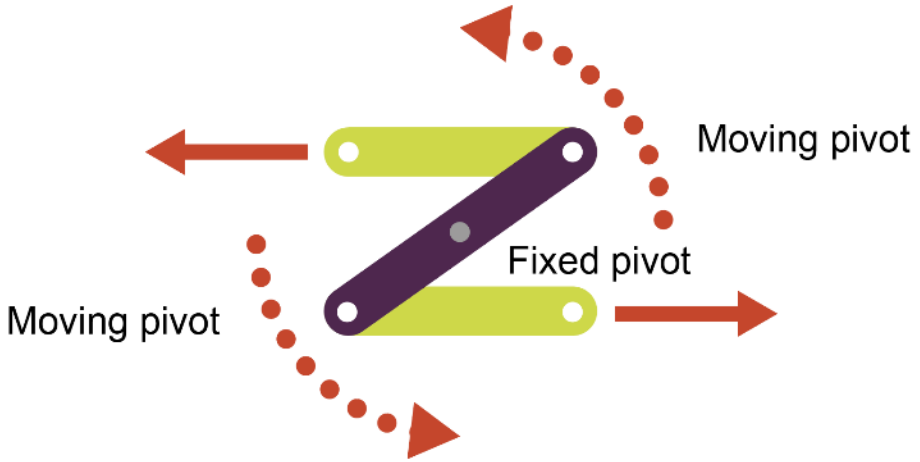
Linkages

- Linkages are mechanisms that use rigid parts to:
  - Change the magnitude of a force
  - Change the direction of a force, or
  - Transform it into a different motion

Animated linkages

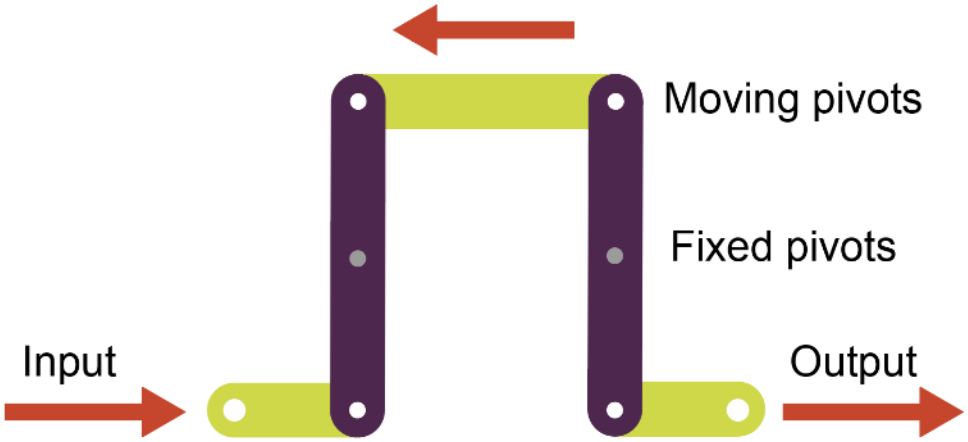
Reverse motion linkage

- This changes the direction of the input motion
  - If the input is pulled, the output will push
  - The linkage uses a fixed central pivot
  - Do the input and output rods move in straight lines?



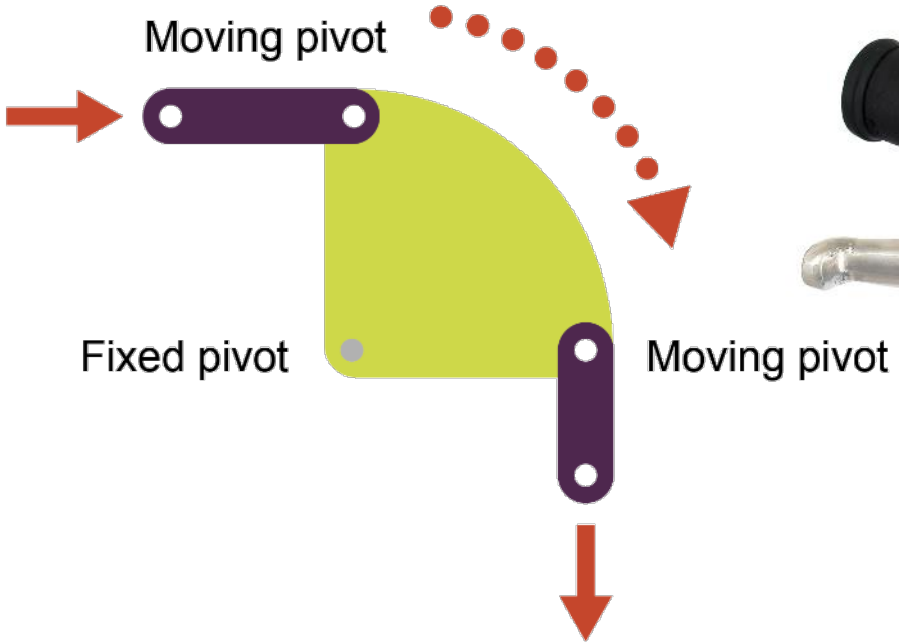
Parallel motion linkage

- Also known as push / pull linkage as it keeps the direction of the output the same as the input
  - What happens if you move both of the fixed pivot points up or down?



Bell crank linkage

- Input direction is converted through 90 degrees
  - It changes horizontal motion to vertical and vice versa
  - Often found in steering and throttle mechanisms on vehicles

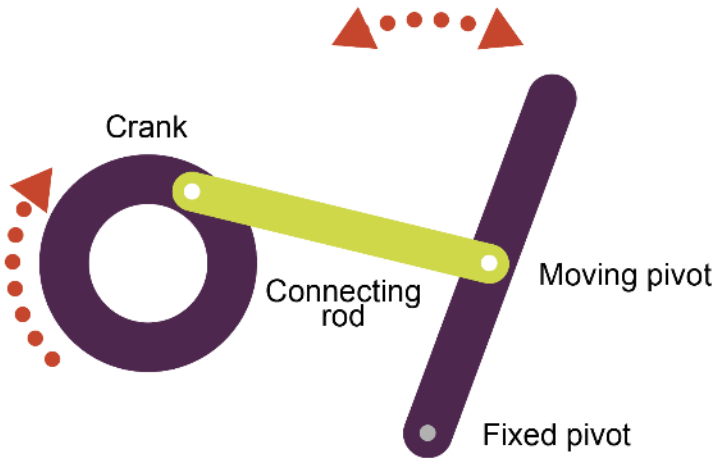


Crank and slider

- Crank and sliders convert rotary motion into reciprocating motion and vice versa
  - A linkage commonly found in engines to transfer the energy from pistons
  - The slider is guided along a set path
  - How could this linkage be used in a pump to create pressure?

Treadle linkage

- Treadle linkages convert rotary motion into oscillating motion and vice versa
  - Which way round are the motions in an old fashioned sewing machine?
  - How about a windscreen wiper?



Investigation and research

- Sources of data and information fall into two categories – **Primary** and **Secondary**
  - Primary data is new data, gathered by the researcher
  - Sources include: interviews, focus groups, questionnaires and case studies
  - Secondary data is gathered as part of research or reporting on primary data
  - Sources include articles, books and magazines
  - What other ways are there of gathering both primary and secondary data?

What do you need to know?

- The design proposal will raise a series of questions
- Where might you gather the following information?
  - What are the client's requirements?
  - Who will use the product?
  - Suitable materials for manufacture and the cost?
  - What size should it be?
  - Primary sources of data can also include: physical material testing, measurements and user observations

Product analysis

- As part of your research, it's essential to know what else is on the market and how it's made
  - Consider the functionality of the product
  - Observe the aesthetics and customer appeal
  - Note the use of materials and the finish
  - Analyse both the successful and weak areas of a design
  - Qualitative feedback from focus groups is informative
  - How does this analysis help a designer improve their design?

What other acronym can you think of that would help you?

Product analysis results

- Consider the following areas and their options:
  - Form – shape, size, weight, colour, texture
  - Materials – mild steel, glass, cotton, oak
  - Manufacturing processes – injection moulded, drape formed
  - Cost – production costs and retail price
  - Function – what does it do?
  - Standard components – nuts, bolts, switches, rivets, zips
  - Ergonomics – how easy it is to be used
  - Environmental factors – use of sustainable materials, recyclable

Response to a product: what is a focus group?

- A focus group is made up of a diverse group of people who might trial an early version of a design
  - Qualitative research will gather their reaction, perception and attitude toward a product
  - Testing and questions will also give information on their experience of using or working with the product

Focus group Frasier

Ergonomics and anthropometrics

- Ergonomics
  - The science of how humans interact with objects
  - Design for efficiency and comfort in the working environment
- Anthropometrics
  - Measurement of the physical properties of the human body
  - It derives from the Greek words '*Anthropos*' (human), and '*metron*' (measure)
  - Should this form primary or secondary research?

Ergonomic design

- When designing a product, it should be both comfortable and functional
  - Designers will study the way people interact and work with an object
  - They will consider the physical and emotional connection to a product
  - Touch and feel as well as sound and smell are all relevant
  - Can you identify some well known items that have evolved and improved with the use of ergonomics?

Day to day ergonomics

- Many everyday items have been made more comfortable and effective to use
  - Do you think these are more expensive to make? Discuss

Design brief

- This is the conclusion of all your research and data
  - A statement of intent will summarise your design plan:
  - What are you going to design?
  - Who is the target audience?
  - Where are they going to use the product?
  - What is the budget?
  - When does it need to be completed?
  - What size does it need to be?
  - Some of these are known as immovable constraints
  - Which do you think are immovable and why?

Sir James Dyson is a firm believer in using failure to drive success. His first Dual Cyclone cleaner that hit shelves in 1993 took 15 years and 5,127 iterations. The new Supersonic™ Dyson hairdryer took 599 failures over four years to perfect the final 600th iteration on sale today… and development continues.

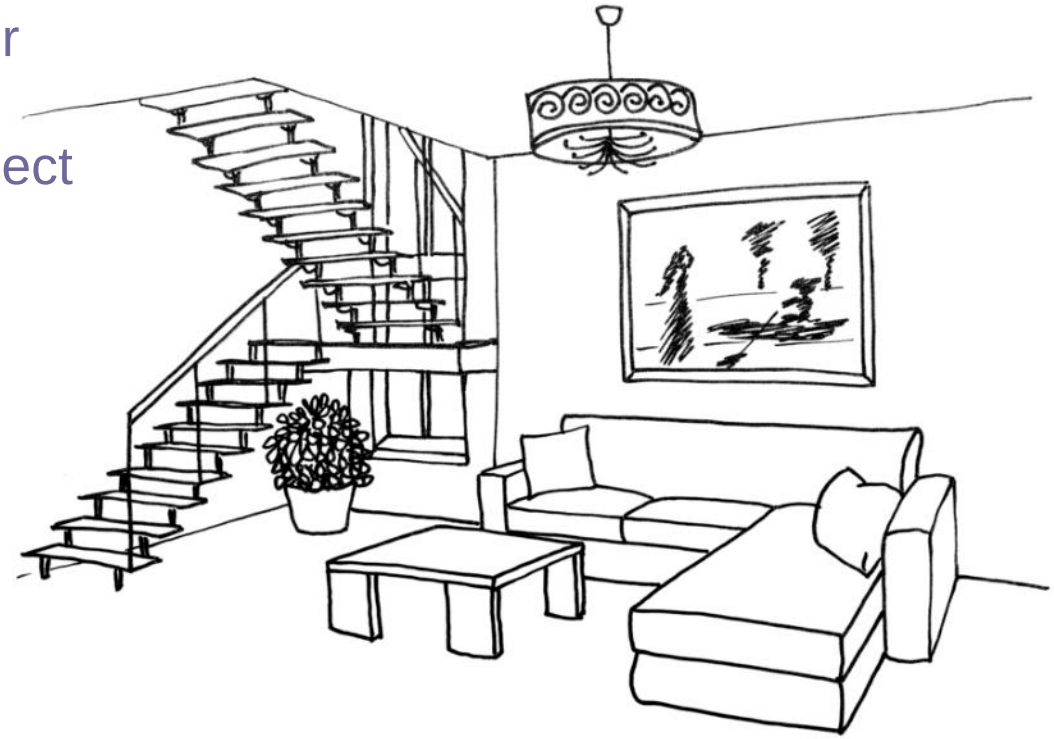
Dyson_problem solving

Design fixation

- Design fixation can negatively impact design
  - It can limit creativity and result in similar or ‘safe’ design ideas
  - Designers can fall into common pitfalls of:
    - not properly understanding a client’s needs
    - failing to consider alternative solutions
    - lack of research into new materials or technology
  - What strategies would you suggest designers utilise to keep their ideas fresh?
  - 

2D and 3D sketching

- 2D drawings are good for expressing ideas, dimensions, mechanical and electrical concepts
  - 3D drawings are better at representing the look and feel of an object
  - A 3D room plan allows the viewer to imagine they are present in the room

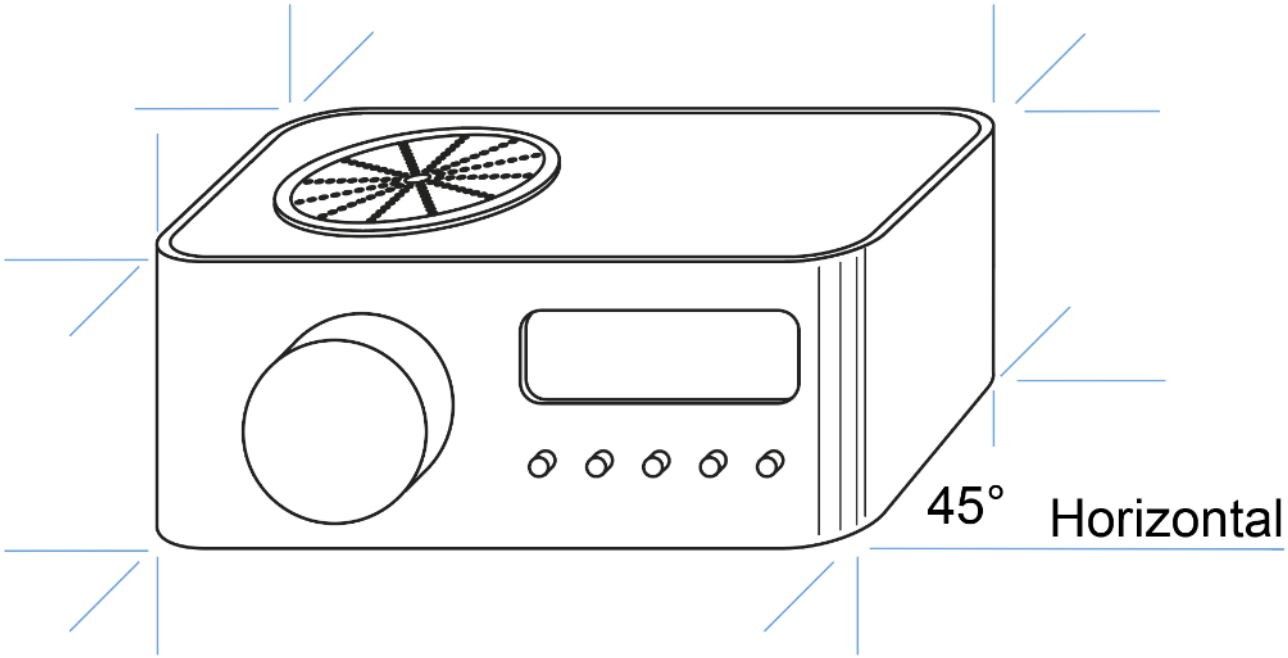


Drawing techniques

- Graphical projection and perspective are useful drawing skills for presenting designs
  - There are **three** key types of 3D drawing styles:
    - Oblique projection
    - Isometric projection
    - Two point perspective

Oblique projection

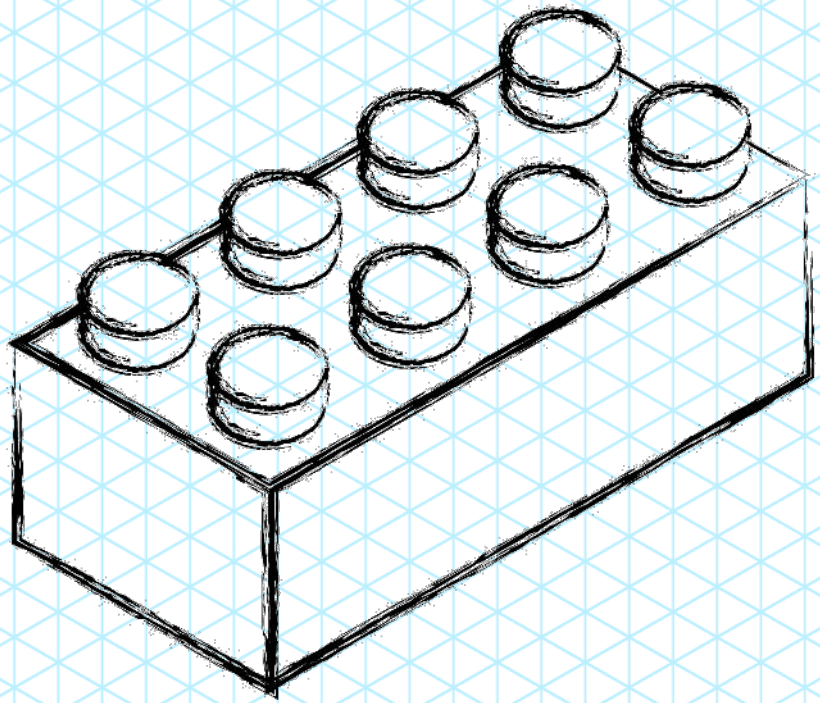
- Oblique projection is a simpler technique and useful in the early stages of design
  - What are the problems with oblique projection?



Isometric projection

What angle do we use to draw an isometric shape?

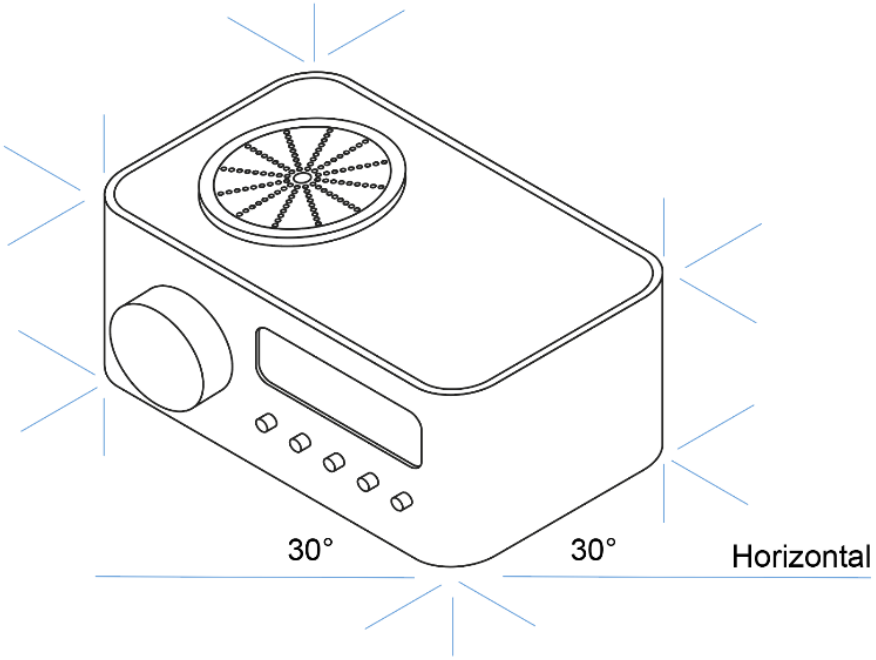
- Isometric drawings shows three faces of an object
  - Lines leading away are all parallel instead of narrowing, towards a vanishing point which can create slight distortion
  - Isometric grid paper can be a helpful guide when drawing in isometric projection



Isometric projection

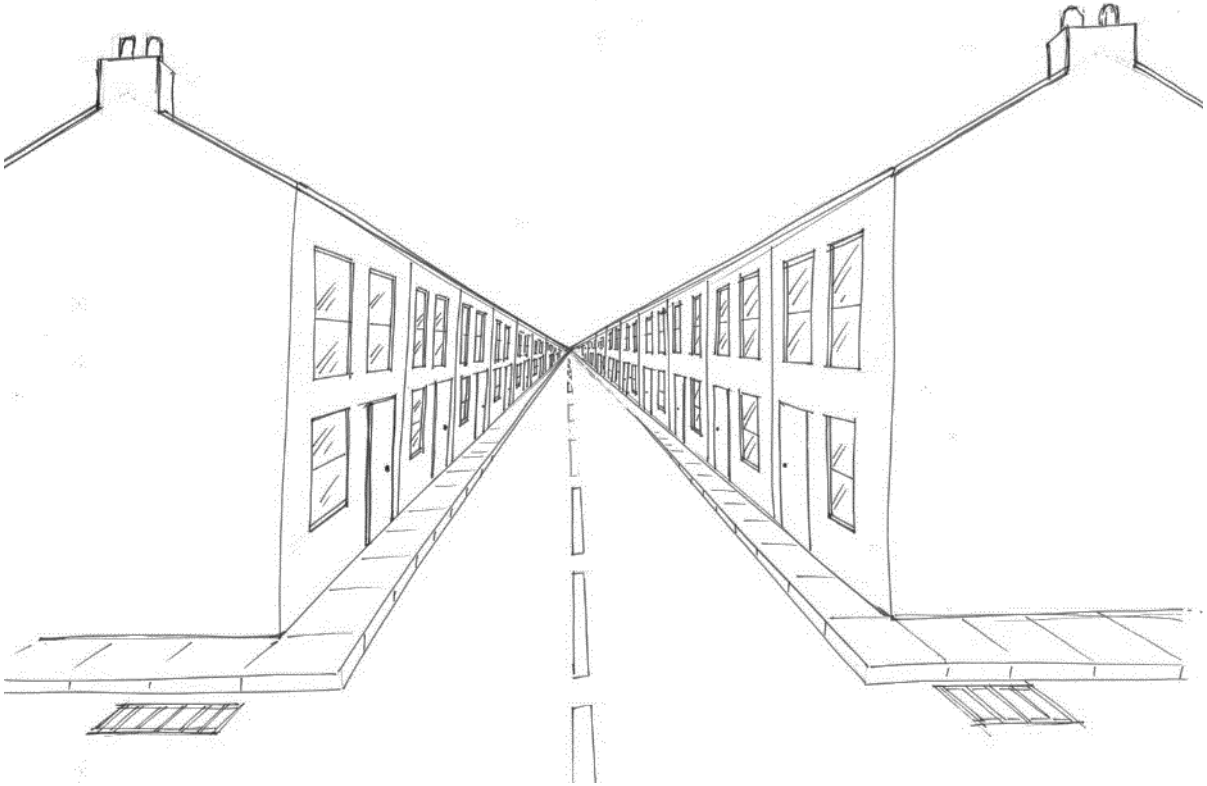
When/where have you seen this style of drawing before?

- Isometric projection enables designers to draw an object in three dimensions which aids visualisation
  - All lines are drawn at a 30° angle away from the nearest corner of the object and accurate measurements can be added



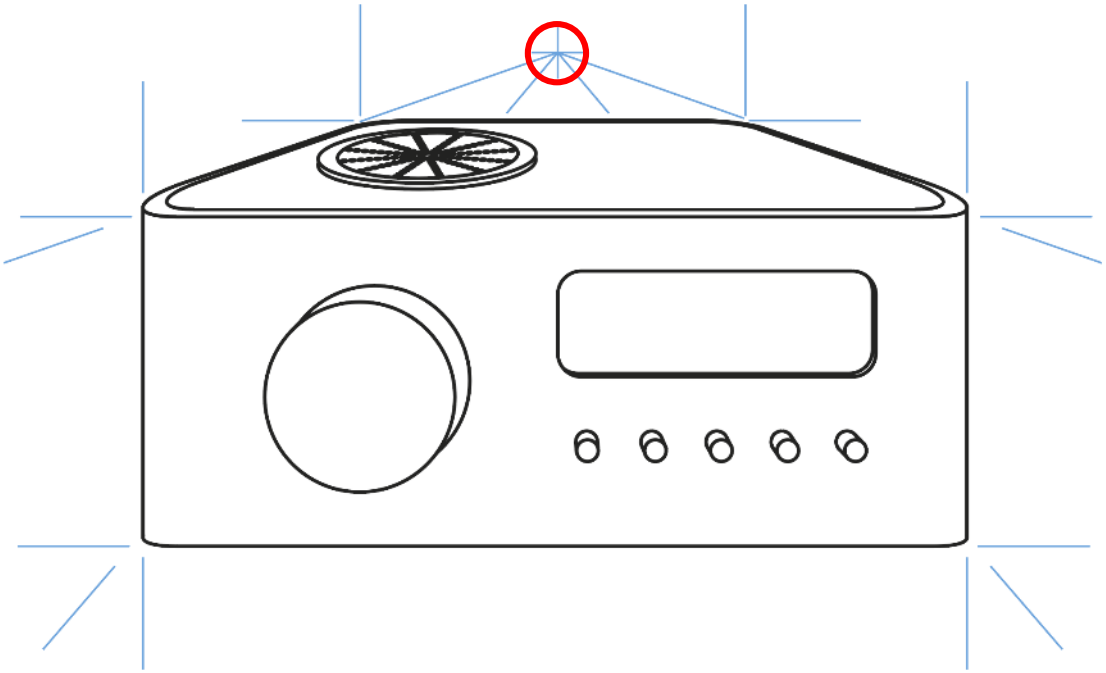
One point perspective sketch

- This is one of the simplest styles, that you may sketch in a notebook, however its use is limited



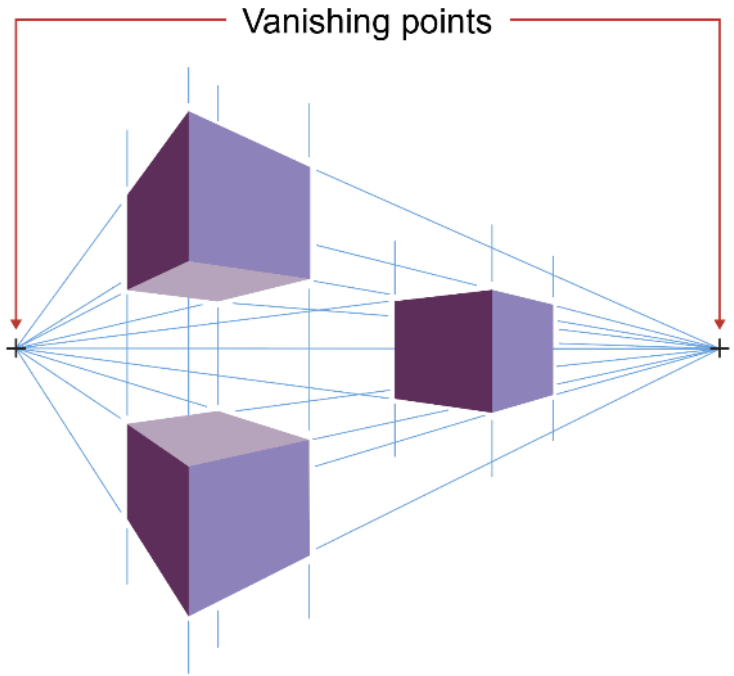
One point perspective

- If you look square onto a item, you can't see the sides
  - Items seem to get smaller and converge towards a single vanishing point



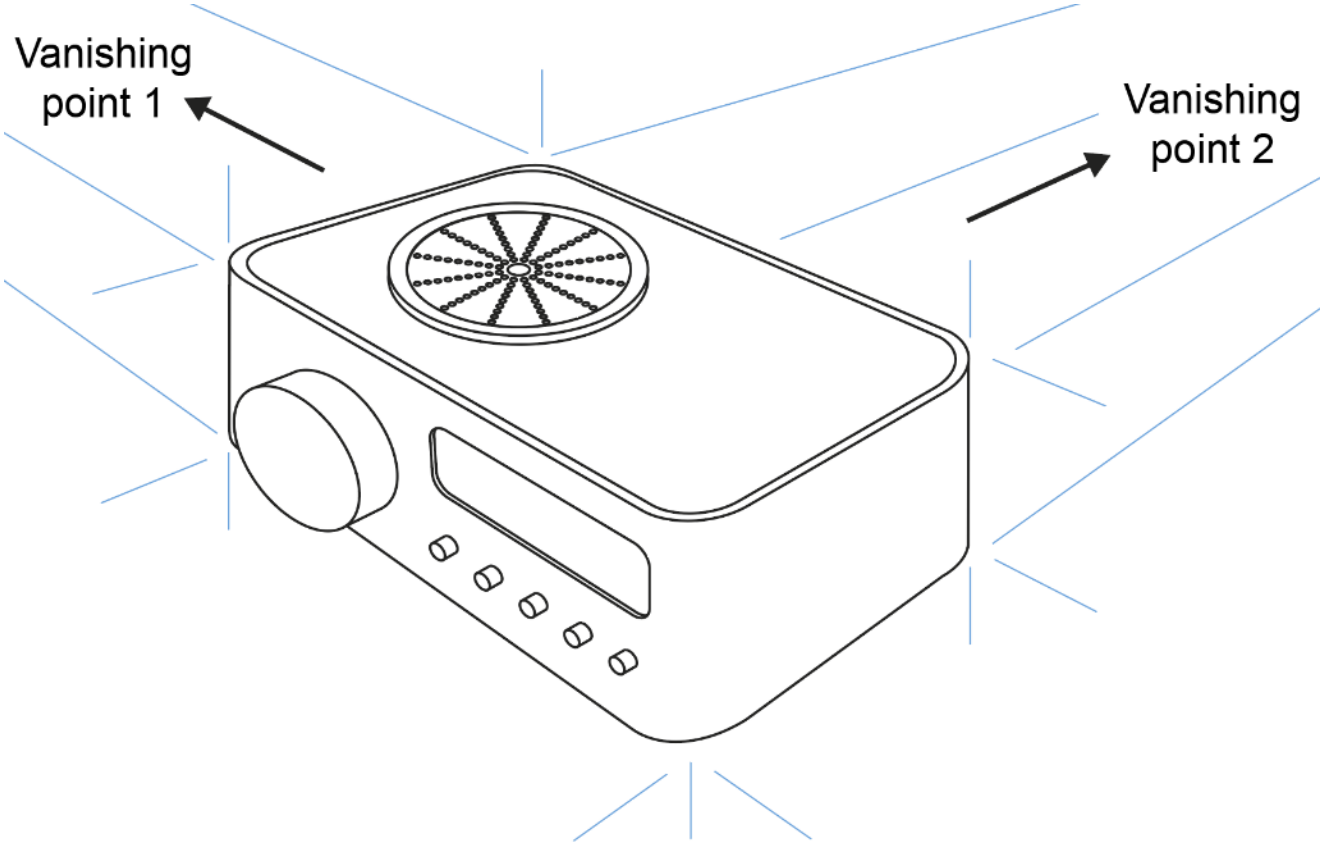
Two point perspective

- Two point uses two vanishing points, so shapes that project towards them appear smaller
  - This vanishing effect simulates the natural way we observe objects
  - The following drawing used a rule for working out the structure, combined with freehand sketching for curved shapes



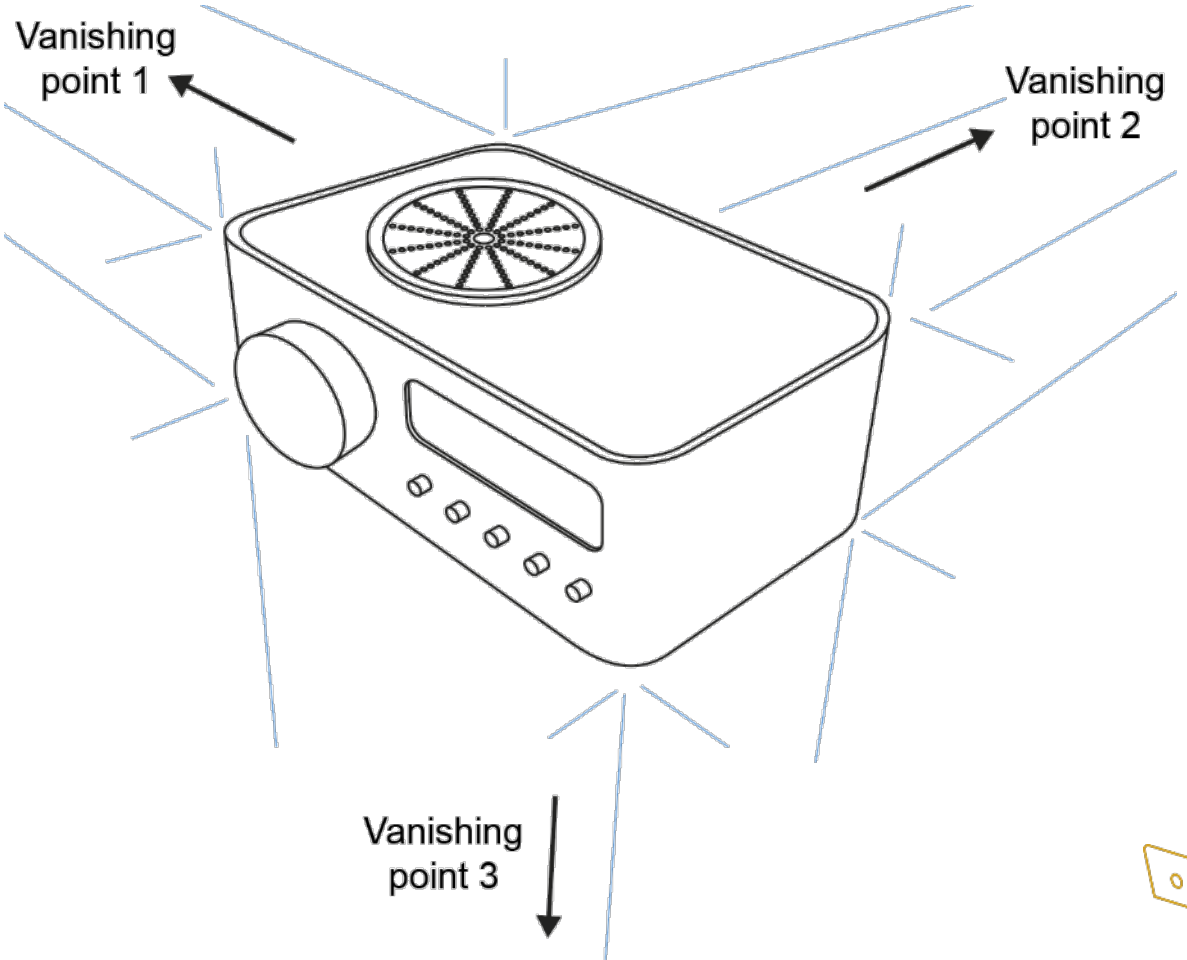
Two point perspective

- Does this look more realistic than oblique or isometric projection?



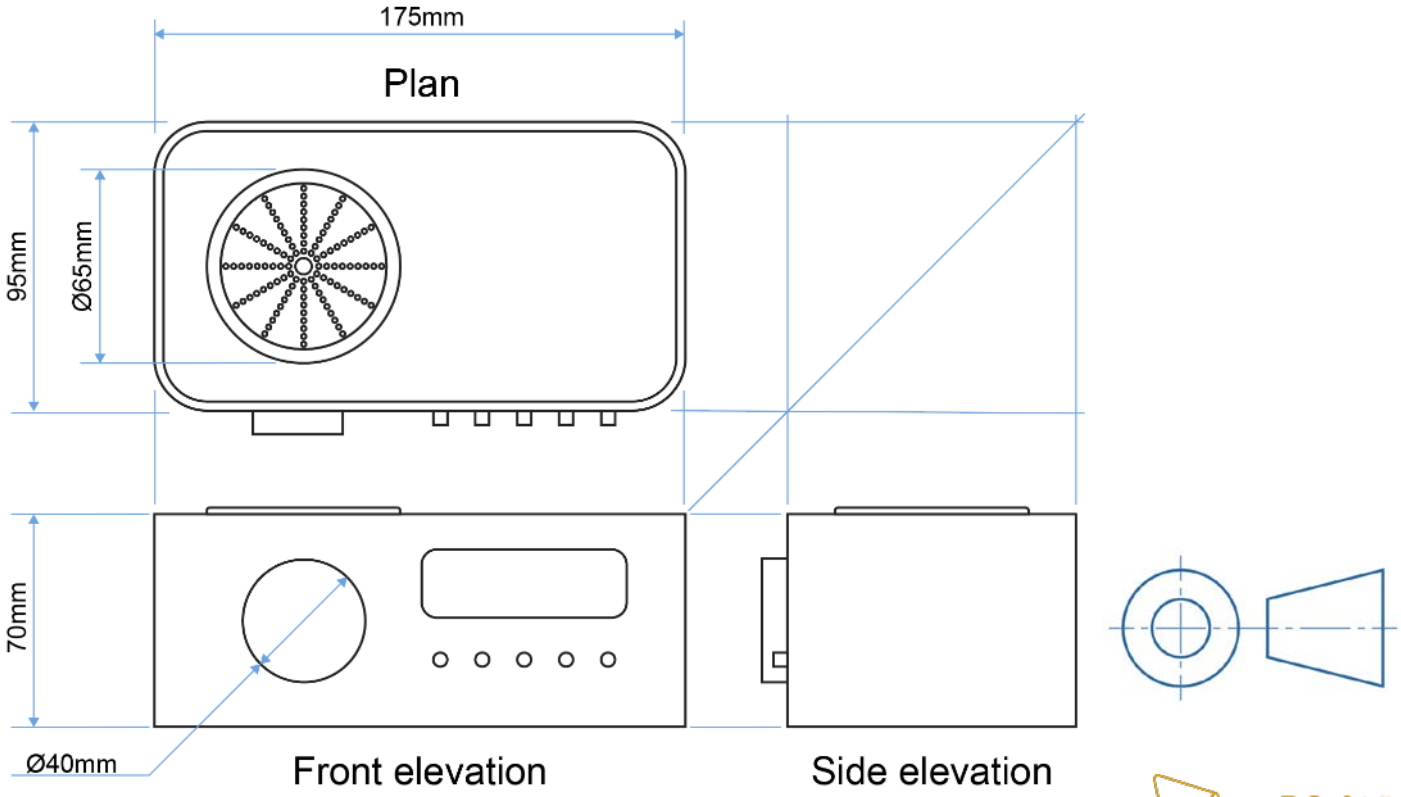
Three point perspective

- Where are the three vanishing points?



3rd angle orthographic drawing

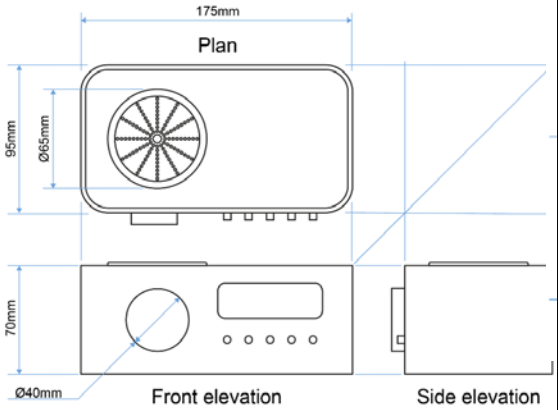
- Orthographic drawings typically include the plan view, with front and side elevations



What's it called?

- Write the name of each style of technical drawing.
- Say one advantage of each and one disadvantage of each.
- **Star challenge:** Which style do you think is the most useful to a designer?

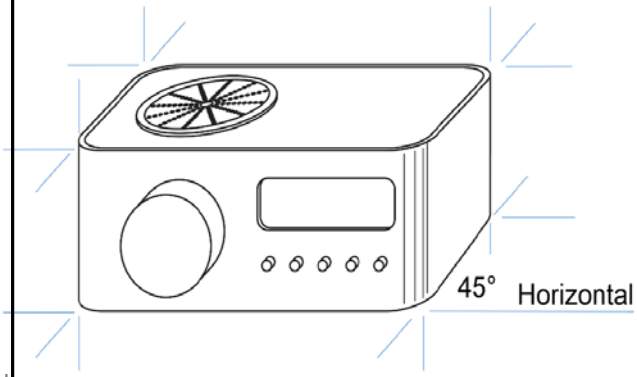
Name:



Advantage:

Disadvantage:

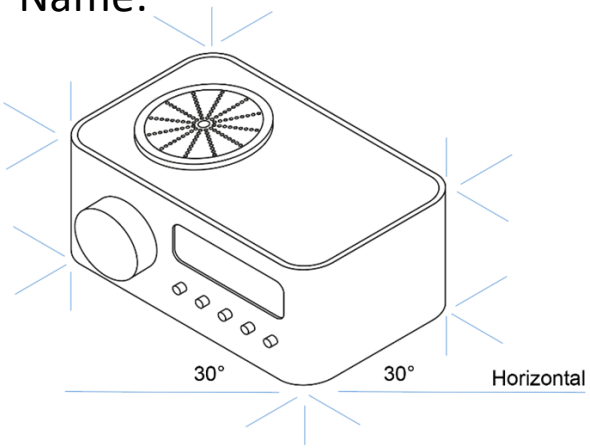
Name:



Advantage:

Disadvantage:

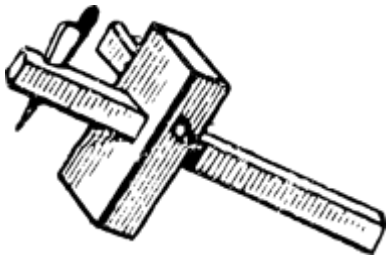
Name:



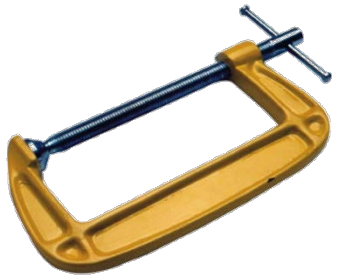
Advantage:

Disadvantage:

Tools + EQUIPMENT

			
Name	**Tenon Saw or Back/Dovetail Saw**	**Marking Gauge**	**Try Square**
Process	**Sawing straight lines in wood or plastic (not metal)**	**To scribe a line parallel to a surface edge in order to cut wood joints etc.**	**Drawing a line at 90 degrees OR checking a corner is square (90 degrees)**

Tools + EQUIPMENT

			
Name	**G Clamp**	**Hack Saw**	**File**
Process	**• When clamping a piece of wood whilst sawing. • Applying pressure whilst assembling**	**Sawing metals or plastics to a required size/shape.**	**Shaping or smoothing a piece of wood, metal or plastic.**

Tools + EQUIPMENT

			
Name	**Dust Mask**	**Ear defenders**	**Apron**
Use	**To protect your breathing when working with dusty or hazardous materials.**	**To protect your ears when using loud machinery.**	**To protect your clothing from soiling or from being caught in machinery/tools.**

protective EQUIPMENT

			
Name	**Gaunlets**	**Goggles**	**Safety Boots**
Use	**Protect your hands- particularly from heat when brazing or carrying out heat treatments.**	**Protect your eyes from dust particles or any other flying debris from machining.**	**Steel toe caps protect feet from being crushed by dropping tools or work.**

Fragile Earth

- Our planet is a well-balanced eco-system
- Our consumption of the Earth's resources is damaging our environment
  - World population is predicted to hit 9.7 billion by 2050
  - How can new technologies help the environment and address the sustainability of resources?

Sustainability of raw materials

- Finite (non-renewable) resources and fossil fuels
  - Being used faster than they are naturally replaced
  - Cannot be synthetically reproduced
  - Includes coal, gas and oil
- 84% of our energy comes from non-renewable sources
  - Governments are working hard to reduce this through harnessing more non-finite energy sources

Non-finite materials

- Non-finite resources include those that are unlikely to be exhausted, or those that are replaced faster than we can use them
- These include:
  - Oxygen
  - Fresh water
  - Timber
  - Leather
- Is paper a renewable resource?

Responsible design

- Considerations include:
  - Production techniques that may use non-renewable energy
  - Toxic by-products created in manufacture
  - Environmental impact of mining or harvesting
  - The product itself or production processes may emit CO_2
  - Powering a product may require non-renewable energy
  - Transportation and distribution distance
  - Maintenance and repair costs
  - Welfare of workers in the material supply chain
  - Recyclability at the end of a product's lifetime

Waste disposal

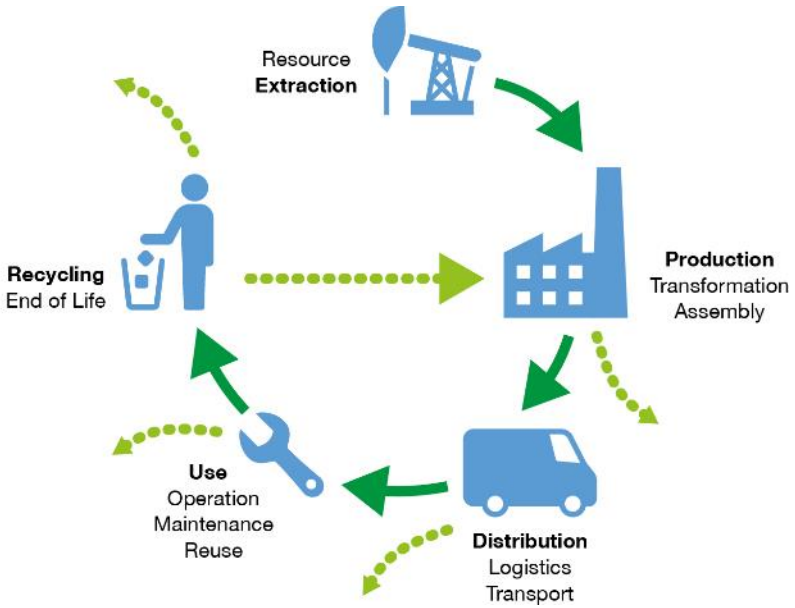
- The production and consumption of resources creates waste
  - How we treat and dispose of this waste can dramatically improve its impact on the planet
- What impact might the following methods have?
  - Incineration / burning
  - Landfill / burial
  - Dumping at sea
  - Recycling

Impact of consumption

- What happens when waste is liquid, toxic or radioactive?
  - Chemicals can leach into the soil and water courses
  - Some industrial waste may be radioactive, particularly that from nuclear reactors
  - What is meant by a radioactive half-life?
  - How is radioactive waste dealt with?

Life Cycle Assessment

- Conducting an LCA will evaluate the environmental impact on a product
  - What factors would you consider at each stage of the LCA?
  - What can a company learn by assessing their products' lifespan in this way?
  - How can they use this to make future improvements?



Continuous improvement

- Continuous improvement is an approach that seeks to continually improve and develop products, services and procedures for the better
  - A Japanese approach called ‘Kaizen’ (*Change for better*) rewards employees who suggest and develop improvements, regardless of how small they may seem
  - The cumulative impact of minor improvements can be significant

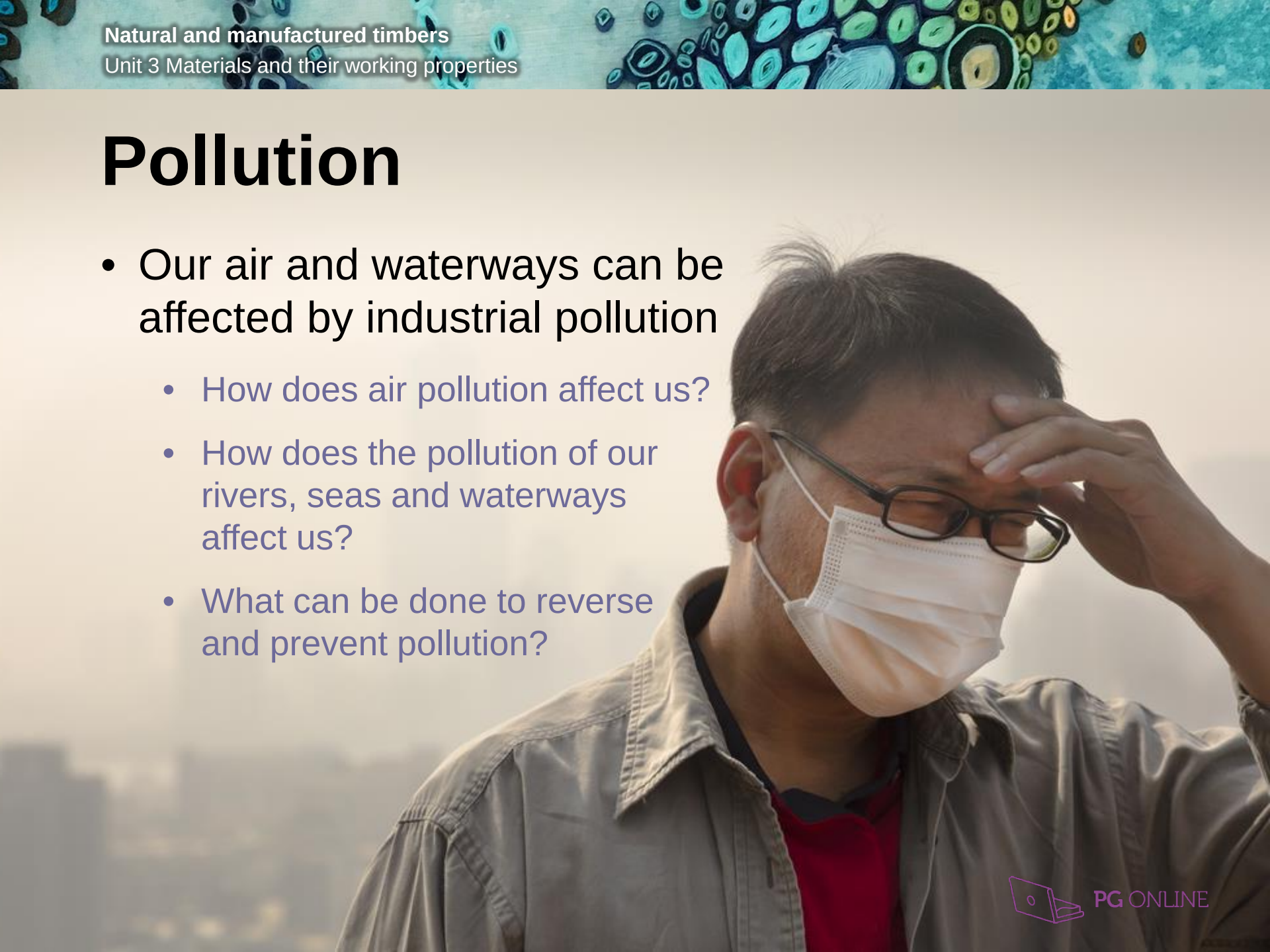
改善

Efficient working

- Efficient working aims to remove waste from any process which may manifest itself as:
  - Wasted time
  - Over production
  - Wasted resources including power
  - Wasted activity
- Digital printing technology has enabled small publishing companies to benefit from printing books on demand rather than printing and warehousing large print runs. How might this improve efficiency?

Pollution

- Our air and waterways can be affected by industrial pollution
  - How does air pollution affect us?
  - How does the pollution of our rivers, seas and waterways affect us?
  - What can be done to reverse and prevent pollution?



Global warming

- Primarily caused by an excess of CO_2 in the atmosphere that traps heat, warming the planet
- Burning fossil fuels releases CO_2 from the earth
  - What are some of the effects of global warming?
  - What are some of the techniques, policies and products being created to reduce or reverse these effects?

Impact on the enviroment

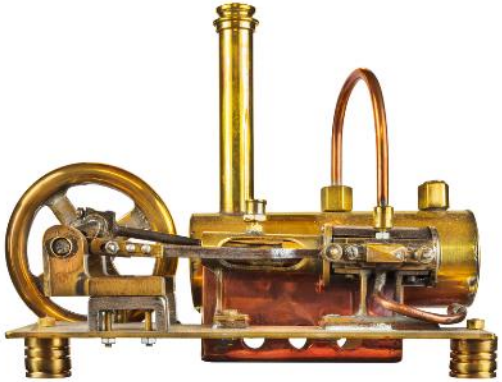
- Plastic microbeads in exfoliating scrubs, body washes and toothpaste
  - Not a new idea, but only recently have we found them inside deep sea animals and they are polluting oceans
  - Plastics absorb toxins
  - Fish eat plastics
  - We eat fish. Mmmm
  - Plastic in the food chain

Helping the environment

- Hydrogen fuel cells produce only water as waste
- Electronic paper could replace printed paper
  - What might be the environmental impacts of producing these technologies?
  - How might each of these technologies actually help the environment?

Eco-friendly technology

- Old technology combined with new ideas can create excellent new products
  - The engine has become more and more efficient with refinements and technological developments
  - Where / how could current technology be developed in the future to do more?



Reducing consumption

- Digitisation and consolidation of many devices in one
  - Reading a book, playing a CD and taking a photo can all be done with one device, without requiring any more raw material
  - Devices also combine Sat Nav systems, calculators, torches, watches, alarm clocks and more

In pairs, answer the questions.

1. What type of fuel's waste turns into water? (1MARK)
2. Name 3 types of finite resources. (3 MARKS)
3. Give 2 examples of renewable sources? (2 MARKS)
4. What considerations need to be made to demonstrate the designers responsibilities? (3 MARKS)
5. What advantages are there using the Kaizen philosophy? (2 MARKS)
6. What is a LCA? (2 MARKS)
7. Burning fossil fuels releases Carbon Dioxide into the Earth's atmosphere which is linked to Global Warming.

Give **two** effects of global warming. (2 MARKS)

Metal what metals have been used for these products?

Why did they use these metals?

Brass

Carbon steel

copper

Stainless steel

Mild steel

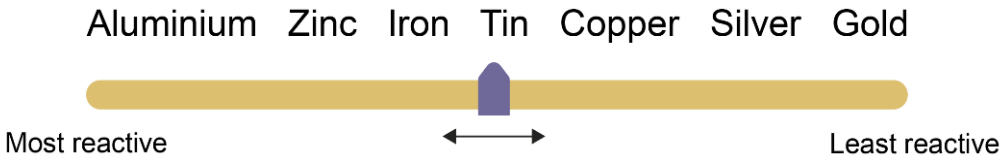
- Ferrous
- Non-ferrous
- Alloys
- Casting
- Primary data

Metal

- Metals have been essential in the development of civilisation
  - The word ‘metal’ comes from the ancient Greek word *‘metallon*’ which means to mine, excavate or extract from the ground
  - Prehistoric man used metals to make tools and weapons
  - Which common metals would you find in a domestic kitchen?

Ore

- The Earth's crust contains many types of rock
  - Metallic minerals are found naturally in rock or ore
  - Ore is obtained by mining and the metals within it are extracted
  - The method used for extraction depends on the metal's reactivity with air, water or acids
  - The more reactive the metal, the more expensive it is to extra



Finding metal

- Some naturally occurring metals are found as lumps in the rock and don't require a chemical extraction

- Why is gold expensive in comparison to aluminium?

PG ONLINE

Extraction processes

- Some metals exist as oxides
  - Metals such as copper, iron and zinc are oxides. These are heated with carbon to extract the metal
  - Electrolysis is used to extract metals such as aluminium Extracting metals
- Are metals a renewable resource?
  - How can man reduce the speed at which we will run out of natural resources?

Iron ore

- Iron can be extracted from iron ore by using a blast furnace and the process of smelting
  - Smelting extracts common industrial metals such as iron
  - The extreme heat draws off the metals in a liquid state called ‘hot metal’
  - The impurities are removed and the iron mixed or ‘alloyed’ with a small amount of carbon to create steel
  - The amount of added carbon affects the strength of the steel Ore to steel

Benefits of automation

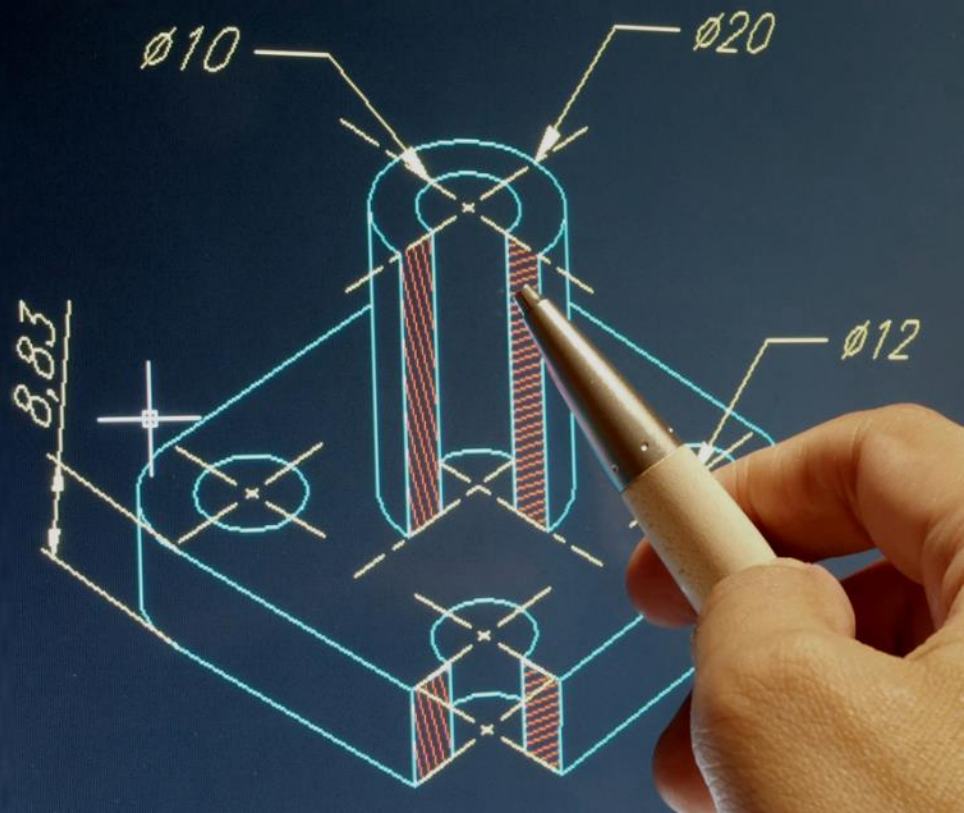
- Robots and automated systems often replace manual jobs, and can therefore save labour costs
- What other benefits are there of automation to:
  - Product manufacturers or service suppliers?
  - Consumers?
- What products are still handmade?
  - Why would manufacturers prefer to make things by hand?

Automated guidance systems

- Some companies including Google are developing autonomous self-driving vehicles
  - How might this improve the lives of the elderly or impaired?
  - What ethical considerations might developers need to make?
  - Who is at fault if an accident happens?
  - Does the car's programming swerve to protect occupants at the cost of injuring others?
  - Do people come before animals?
  - Google driveless car

Computer Aided Design (CAD)

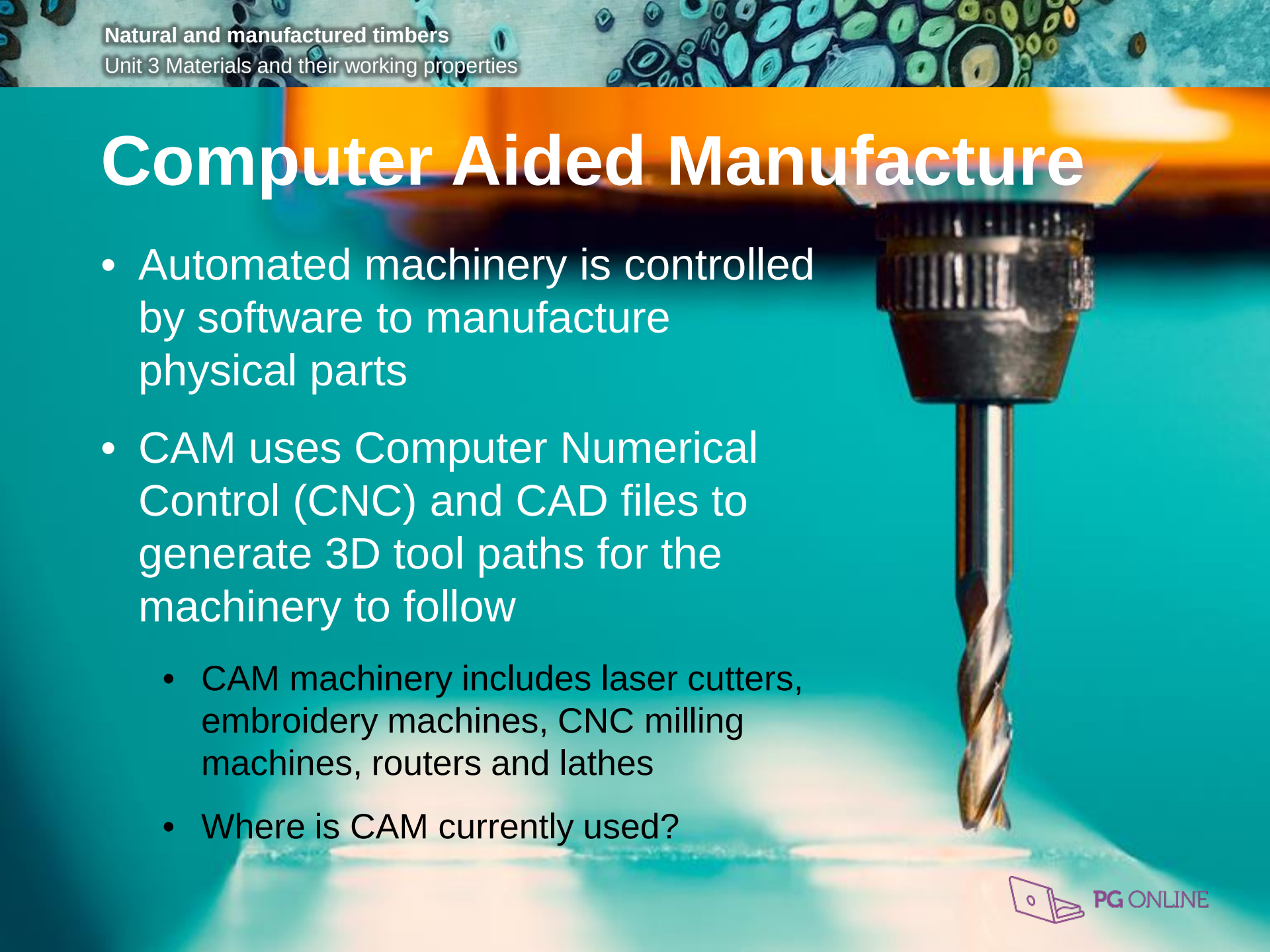
- CAD software is used to create precision 2D or 3D drawings, models or technical illustrations
- It is commonly used by designers, architects, engineers and artists
  - What are the advantages of CAD over hand drawn designs?
  - Many designers still prefer to start sketching by hand
  - Why?



Advantages and disadvantages

Advantages of CAD	Disadvantages of CAD
Designs can be created, saved and edited easily, saving time	CAD software is complex to learn
Designs or parts of designs can be easily copied or repeated	Software can be very expensive
Designs can be worked on by remote teams simultaneously	Compatibility issues with software
Designs can be rendered to look photo-realistic to gather public opinion in a range of finishes	Security issues - Risk of data being corrupted or hacked
CAD is very accurate	
CAD software can process complex stress testing	

Computer Aided Manufacture



- Automated machinery is controlled by software to manufacture physical parts
- CAM uses Computer Numerical Control (CNC) and CAD files to generate 3D tool paths for the machinery to follow
  - CAM machinery includes laser cutters, embroidery machines, CNC milling machines, routers and lathes
  - Where is CAM currently used?

CNC milling

- CNC milling machines work in three dimensions to produce intricately and accurately machined objects such as this jet engine turbine wheel
    - Digital designs are converted into a series of x, y, z coordinates for the machine to follow

CNC laser cutting

- By cutting at different speed rates, laser cutters can burn through or etch the surface of a material
- They can cut complex shapes in a wide range of materials including:
  - Paper
  - Polymers
  - Timber
  - Metals and
  - Textile based materials

Why use CAM? PAIR SHARE

- Why are CAM systems becoming increasingly used in industry?
- What are the drawbacks of using CAM to:
  - The organisation?
  - Staff within the organisation?

Cardsort: place the points under the correct heading. Star challenge: think of an additional advantage and disadvantage.

Advantages of CAM	Disadvantages of CAM
• Faster than traditional machines and tools • More accurate than traditional methods • High repetitive accuracy • Machines can run 24/7 • Cheaper to produce large volumes once set-up costs are absorbed • Can produce work directly from CAD files	• Expensive set up costs for equipment • Training costs and time • CAM machines need specialist engineers when they need maintaining or repairing • CAM machines can do work that is traditionally done by skilled workers and has led to unemployment in many manufacturing sectors

Flexible Manufacturing Systems (FMS)

- FMS involve an assembly of automated machines commonly used on short-run batch production lines where the products frequently change

They can be easily:

- recalibrated
- reprogrammed
- retooled

Lean Manufacturing

- ‘Lean’ is a Japanese philosophy created by Toyota
- It aims to manufacture products just before they are required to eliminate areas of waste including:
  - Overproduction
  - Waiting
  - Transportation
  - Inappropriate processing
  - Excessive inventory
  - Unnecessary motion
  - Defects

Just In Time (JIT) production

- Items are created as they are demanded
- No surplus stock of raw material, component or finished parts are kept
  - What are the benefits of holding no stock?
  - What are the drawbacks of ordering parts as you need them?
  - What are the potential problems of relying on ‘just in time’ deliveries of materials?
  - How do JIT systems subscribe to the ethos of ‘lean’ manufacturing?

Advantages and disadvantages

- The advantages of Just in Time manufacturing include:

Advantages of JIT	Disadvantages of JIT
No warehousing costs	Reliant on a high quality supply chain
Ordered secured before outlay on parts is required	Stock is not available immediately off-the-shelf
Stock does not become obsolete, damaged or deteriorated	Fewer benefits from bulk purchasing

Answers

Issue	Waste area
Stock is kept in a warehouse for up to six months	Overproduction
Commonly connected parts are kept in storage bins two metres apart	Defects
The parts warehouse is three minutes by forklift truck from the assembly area	Excessive transportation
Goods are manufactured at twice the rate they can be finished	Unnecessary motion
Goods frequently fail quality control tests	Waiting

How does Just In Time manufacturing help to reduce areas of waste identified by Lean manufacturing philosophies?

- JIT aims to manufacture just ahead of demand. This reduces the need to hold stock, reduces the time taken to manufacture the additional stock and prevents the deterioration of unnecessary stock.