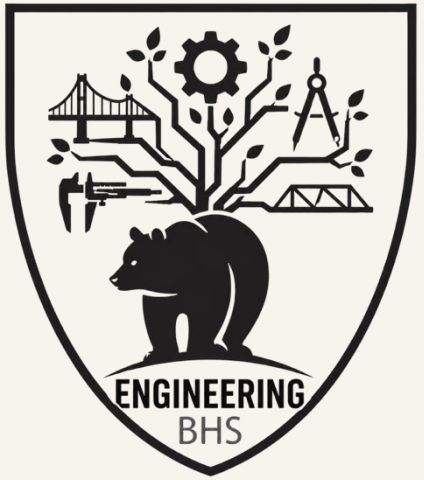
1 – Engineering Contexts and Systems

What is an Engineer?



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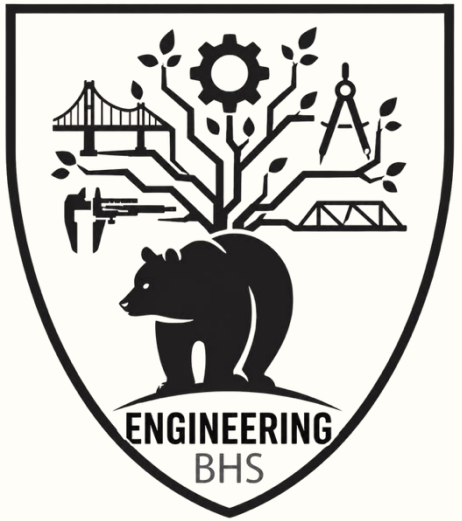
Today we are learning…

To **understand** the branches of **engineering** and the **engineering approach to problems**



DAILY REVIEW

Engineering and Engineers

1. What types of engineers can you name?
2. What is the main role of an engineer?
3. Why have you chosen engineering science?
4. Do you know any engineers?
5. Do you think engineers need to do maths?

SUCCESS CRITERIA

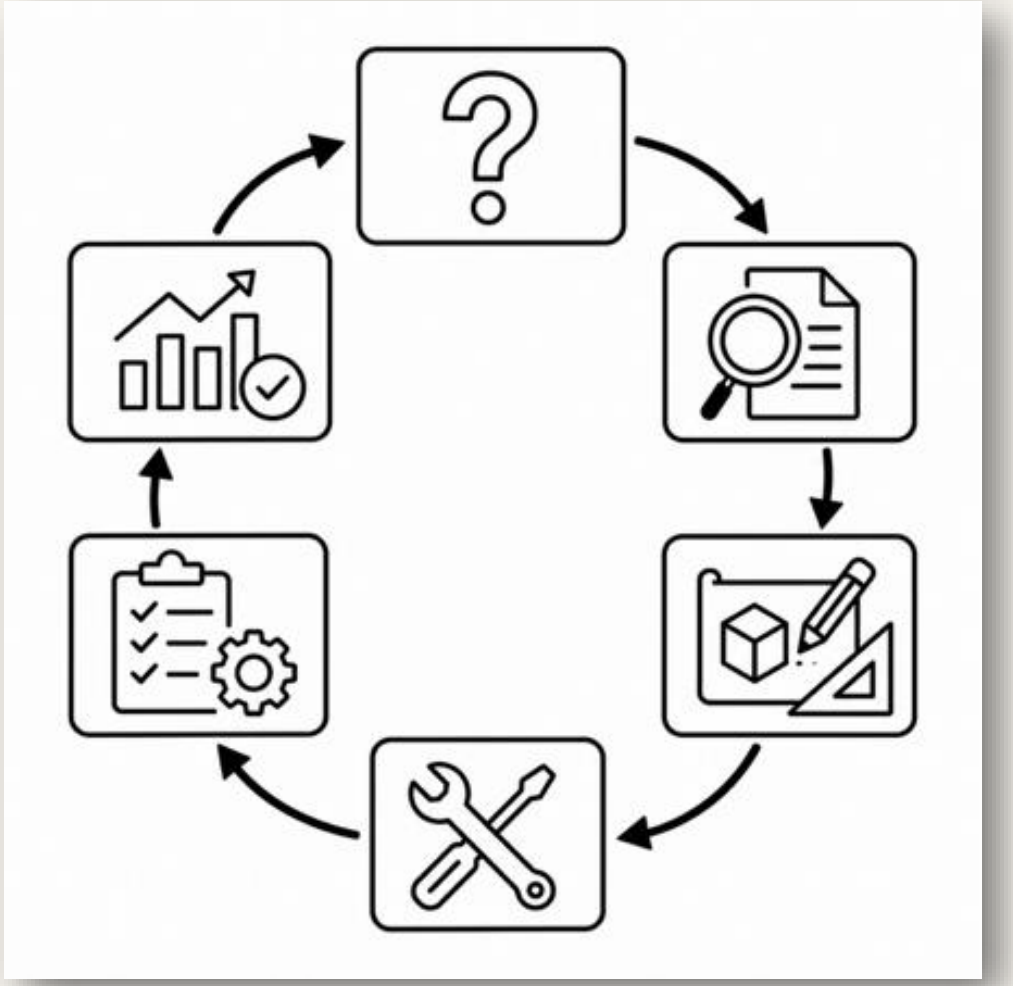
Engineering and Engineers

- [ ] I can **describe** what **engineering** is
- [ ] I can **explain** how engineers solve **real world problems**
- [ ] I can name the **7 branches of engineering** in N5
- [ ] I can describe **problems, solutions and constraints**
- [ ] I can explain the **difference** between **electrical** and **electronic** engineers

DIAGRAM

What is Engineering? - P4

research	find out information about the problem, users and constraints
design	plan a possible solution
simulate	model or test an idea before building it fully
implement	put the design into action by building, wiring, programming or installing
test	check if the solution works correctly and safely
control	make a system behave in the required way
evaluate	judge how well the solution works and suggest improvements



Identify the problem - P4

Your task

Pairs

Discuss the first

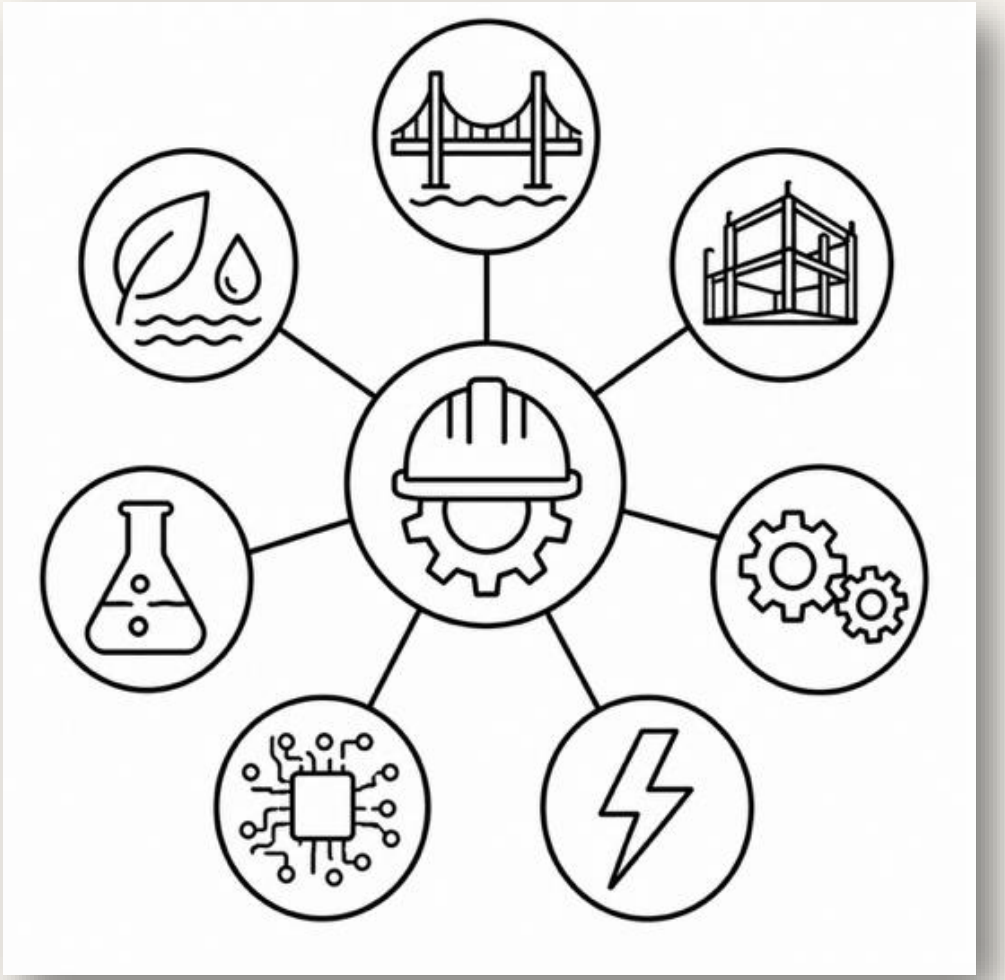
Fill in first row

Repeat for rest

DIAGRAM

Branches of Engineering - P5

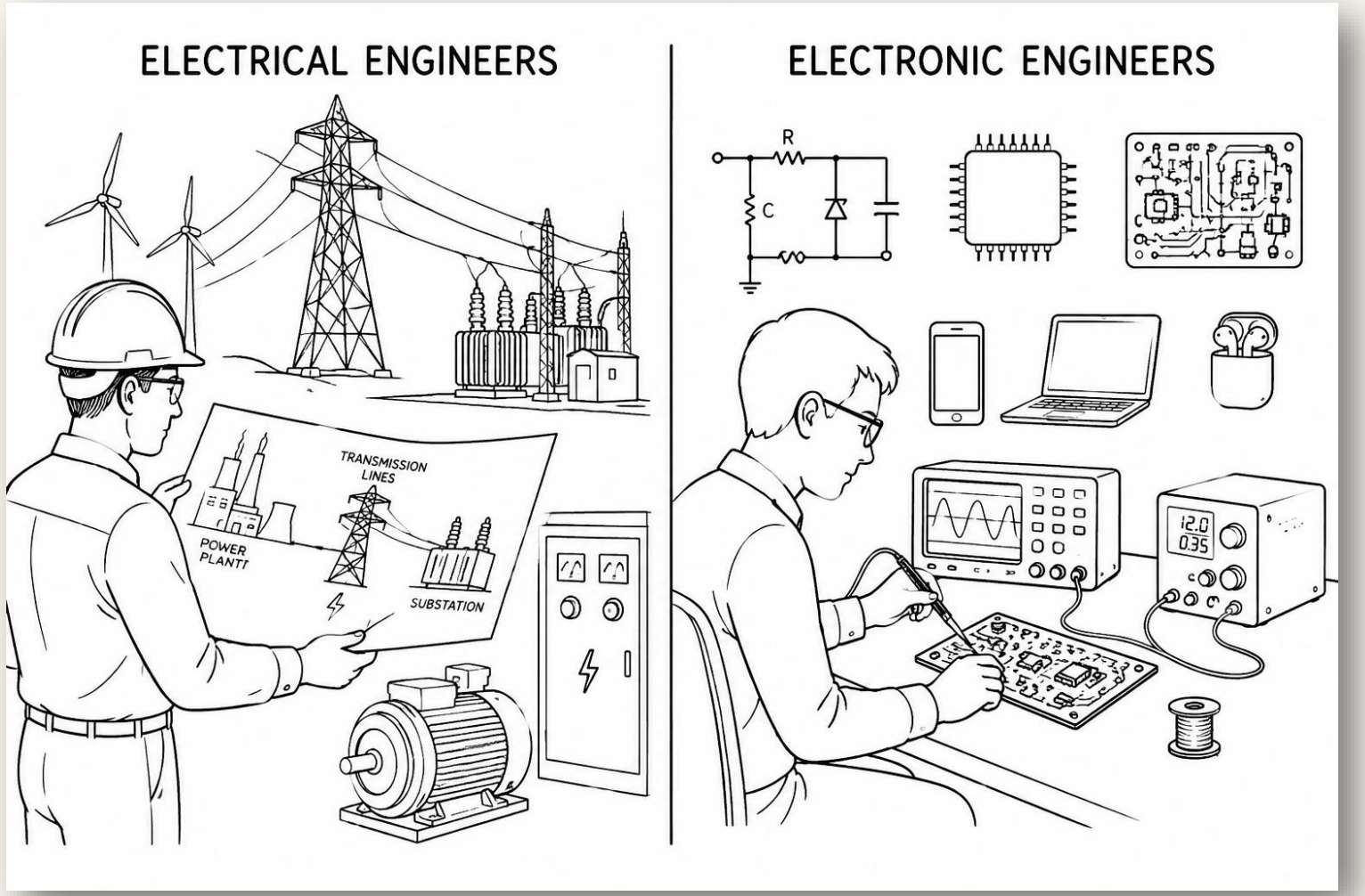
Civil engineering	Designs **infrastructure** such as roads, bridges, tunnels and flood defenses.
Structural engineering	Checks that **structures** can withstand forces and loads safely.
Mechanical engineering	Designs **moving** parts, machines and mechanical systems.
Electrical engineering	Works with electrical **power, wiring**, motors and large electrical systems.
Electronic engineering	Works with **circuits, sensors, signals** and control systems.
Chemical engineering	Works with **materials, fuels and chemical** processes.
Environmental engineering	**Reduces environmental damage** and improves sustainability.



DIAGRAM

Electronic vs Electrical - P5

Electrical engineer	Electronic engineer
Works mainly with electrical power.	Works mainly with electronic signals and control.
May work on wiring, motors, lighting and power supplies.	May work on sensors, circuit boards and microcontrollers.
Example: power supply for a factory.	Example: light sensor circuit for automatic lights.



Match the Engineer - p5

Your task

Match the engineers to their jobs

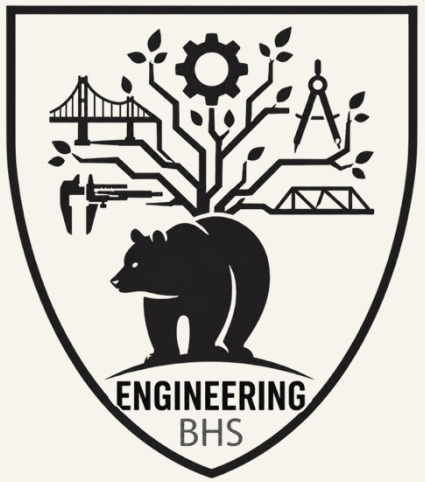
PLENARY

Engineers and Engineering

1	**describe** what engineering is	SC1
2	**explain** how engineers solve **real world problems**	SC2
3	**name** the **7 branches** of engineering in N5	SC3
4	**describe problems, solutions and constraints**	SC4
5	**explain** the **difference** between **electrical** and **electronic engineers**	SC5

1 – Engineering Contexts and Systems

One Project, Many Engineers



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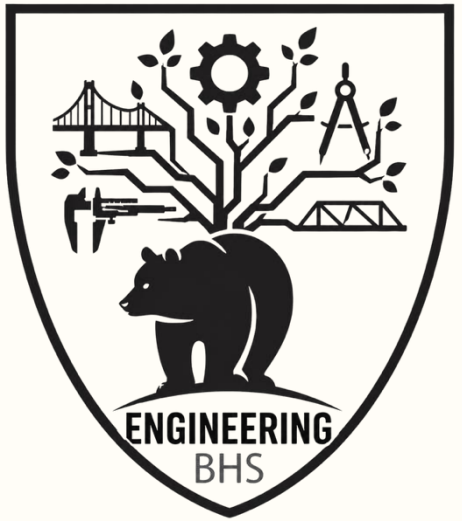
Today we are learning…

How **engineers** work together to solve problems



DAILY REVIEW

Show me Boards

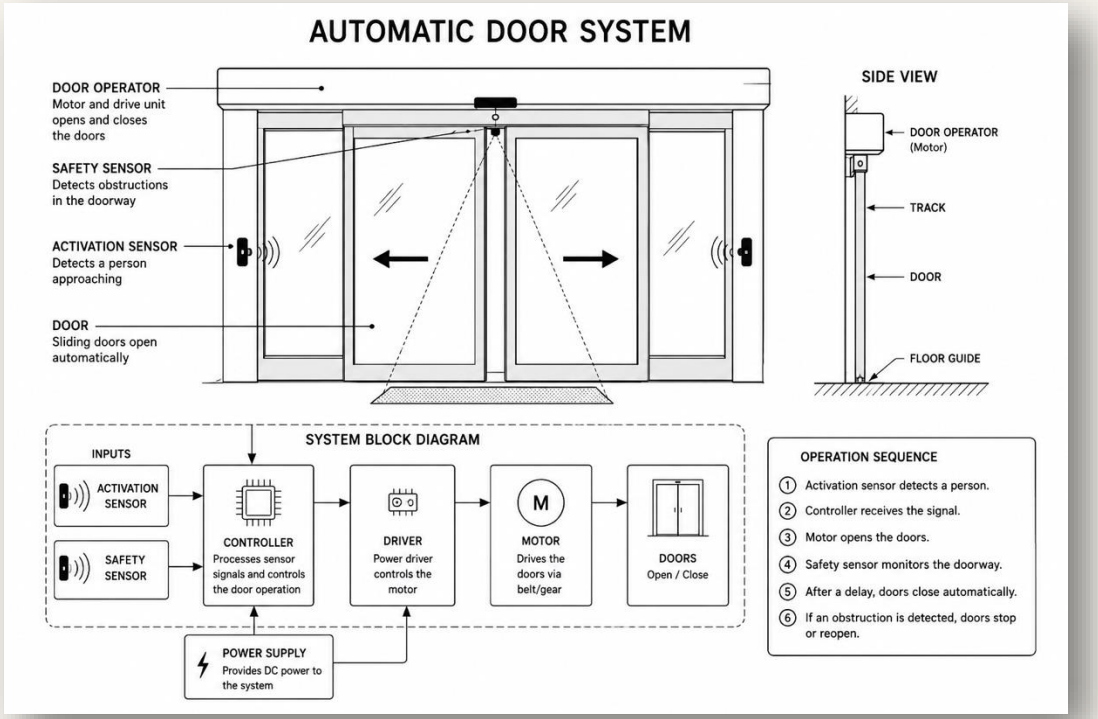
1. Name the 7 engineering ‘actions’ (e.g. research,…)
2. Name the 7 types of engineer
3. What is the difference between an electronic an electrical engineer
4. What types of engineer may work at EDF Torness PowerStation
5. What type of engineers may be involved in designing and building a new school?

SUCCESS CRITERIA

One Project, Many Engineers

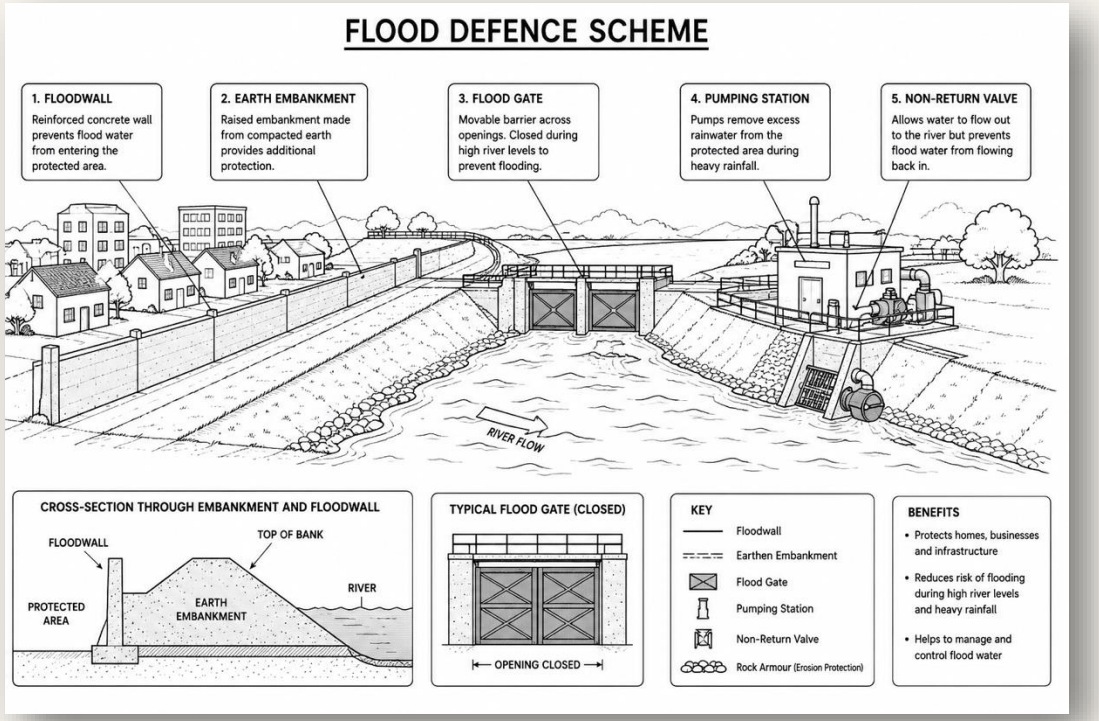
- [ ] I can **give** examples of where **engineers** work together
- [ ] I can **describe** what each type of **engineer** does in a project
- [ ] I can answer exam style practice questions
- [ ] I can work in an '**engineering** team'
- [ ] I can **describe** a real life **engineering** project

Automatic Door



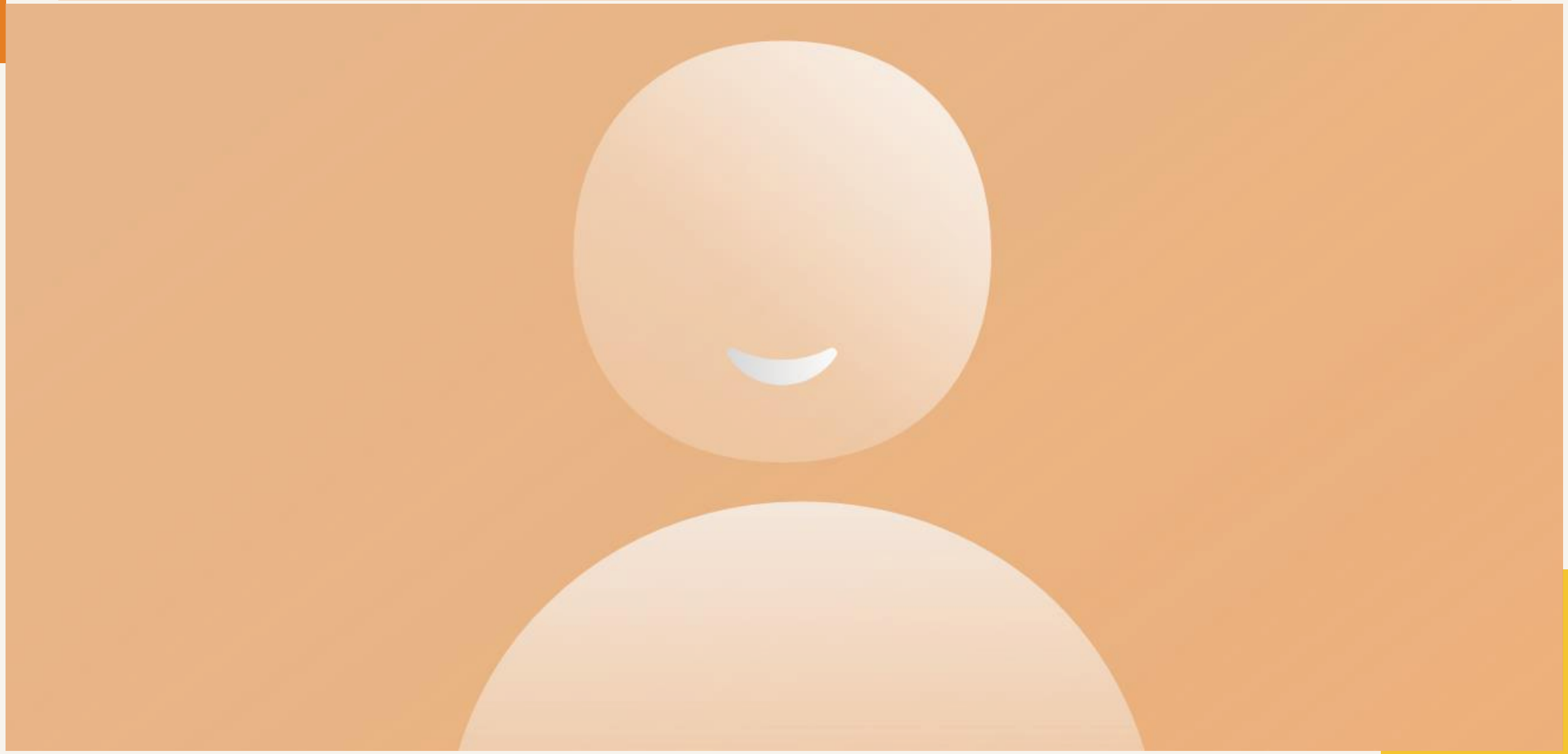
Engineer	What they may do	Why this matters
Mechanical engineer	Design the moving parts of the door.	The door must open smoothly and safely.
Electrical engineer	Plan the power supply and wiring.	The system must receive electrical energy safely.
Electronic engineer	Design the sensor and control circuit.	The door must detect a person and open automatically.

Flood Defence

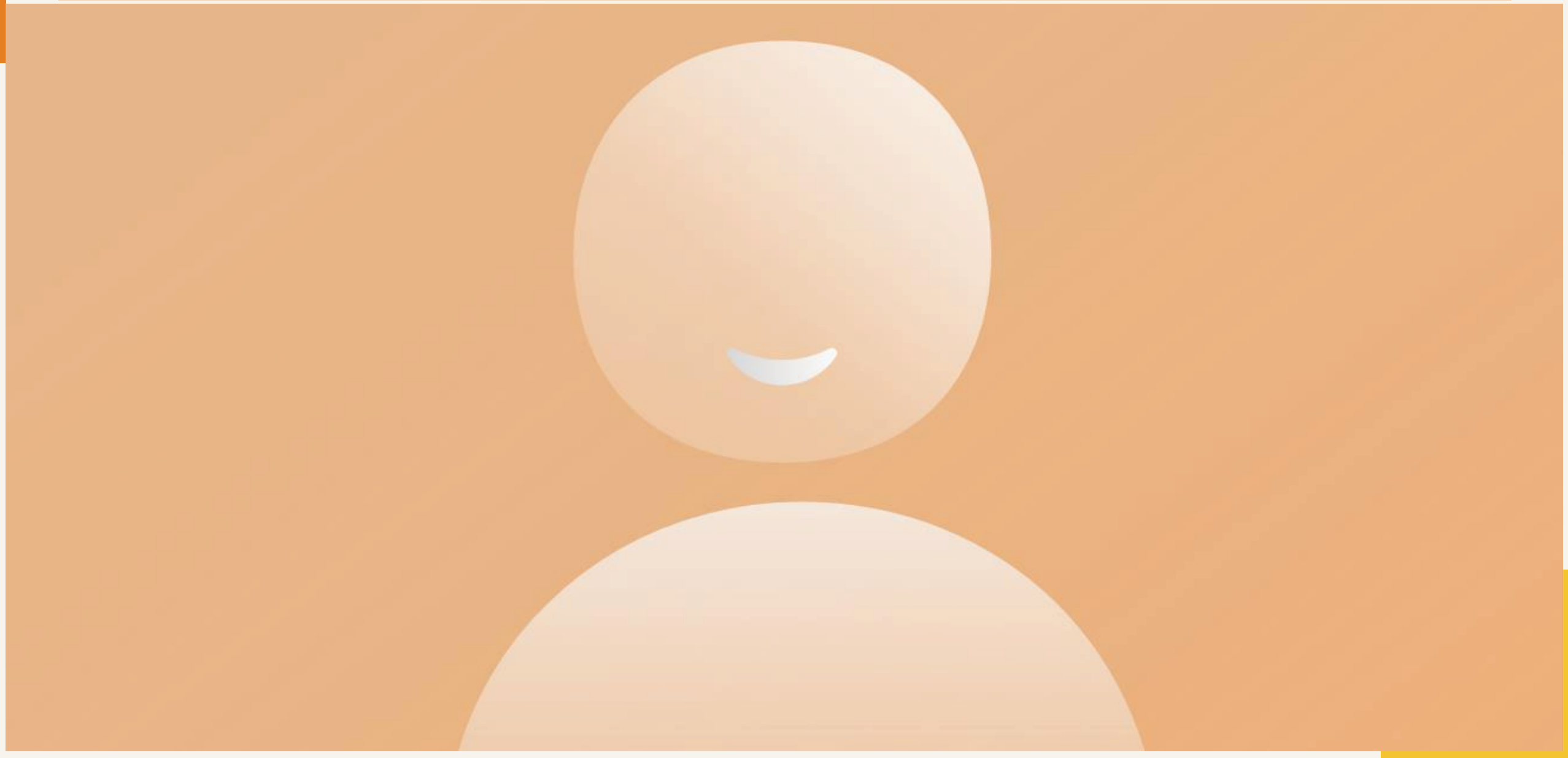


Engineer	What they might do	Why this matters
Civil engineer	Plan the layout of the flood defenses and drainage.	The scheme must protect the town from flooding.
Structural engineer	Check that walls, barriers or supports can withstand water forces.	The defenses must stay strong and stable.
Environmental engineer	Consider effects on rivers, habitats and pollution.	The scheme should reduce environmental damage.

Task - Page 6



Practice - Page 7



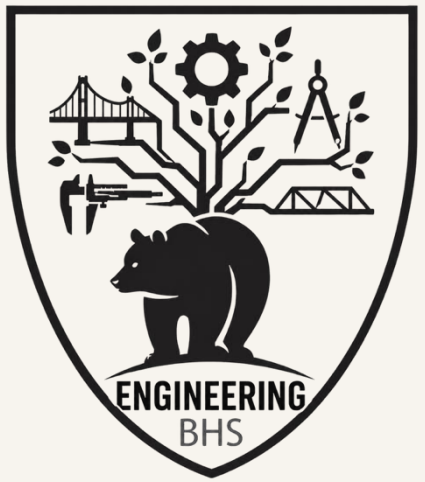
PLENARY

Plenary - One Project, Many Engineers

1	**Name** three branches of **engineering** involved in an automatic door.	SC1
2	Which **engineer** designs the sensor and control circuit?	SC2
3	Which **engineer** plans the wiring and power supply?	SC3
4	**Give** one branch of **engineering** involved in a flood defence scheme.	SC4
5	Why do **engineers** from different branches work together on a project?	SC5

1 – Engineering Contexts and Systems

Engineering Contexts and Impacts



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DAILY REVIEW

Daily Review - Show Me Boards

1. What is engineering?
2. Name 7 branches of engineering.
3. What is the difference between an electrical and electronic engineer?
4. Give one example of an engineering project.
5. What do we mean by a constraint in engineering?

Today we are learning…

To understand **engineering contexts** and the social, economic and **environmental impacts** of **engineering solutions**.

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SUCCESS CRITERIA

Engineering Contexts and Impacts

- ☐ I can **describe** what is meant by an **engineering context**
- ☐ I can **identify** a problem or need from a **context**
- ☐ I can **describe** positive and **negative social impacts**
- ☐ I can **describe** positive and **negative economic impacts**
- ☐ I can **describe** positive and **negative environmental impacts**

Engineering Contexts - P9

An **engineering context** is the situation an **engineering** problem belongs to.

Every **engineering** problem has: a problem or need, a possible solution, and **constraints**.

Examples of contexts: flooding, energy use, transport, accessibility, water supply.

Examples of Engineering Contexts

A town floods after heavy rain – flood defences, drainage, river monitoring.

A school wastes energy – automatic lighting and heating **control systems**.

A rural area has poor transport – better bus routes, electric buses, improved roads.

Social, Economic and Environmental Impacts - P10

Social impact – how people, communities, health, safety or quality of life are affected.

Economic impact – how money, jobs, businesses, costs or local services are affected.

Environmental impact – how nature, resources, pollution, energy use or waste are affected.

Impacts can be positive or negative.

NOTES

Positive and Negative Impacts

Most **engineering solutions** have a mix of positive and **negative impacts.**

Positive examples

A new bridge makes travel safer and easier.
A factory creates new jobs.
A wind turbine reduces fossil fuel use.

Negative examples

Construction noise disturbs residents.
The project is expensive to build.
Wildlife or landscape may be affected.

Tasks

1. Card Sort
2. Engineering Dragons Den
3. The Mayor's Decision
4. Section 2 in booklet

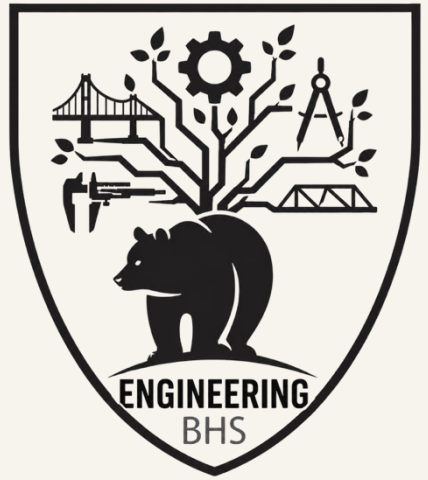
PLENARY

Plenary - Contexts and Impacts

1	What is an **engineering context**?	SC1
2	**Give** one **social impact** of automatic doors at a school.	SC2
3	**Give** one **economic impact** of building a new bridge.	SC3
4	**Give** one **environmental impact** of a wind farm.	SC4
5	Can an **engineering solution** have both positive and **negative impacts**?	SC5

1 – Engineering Contexts and Systems

Explaining Engineering Impacts



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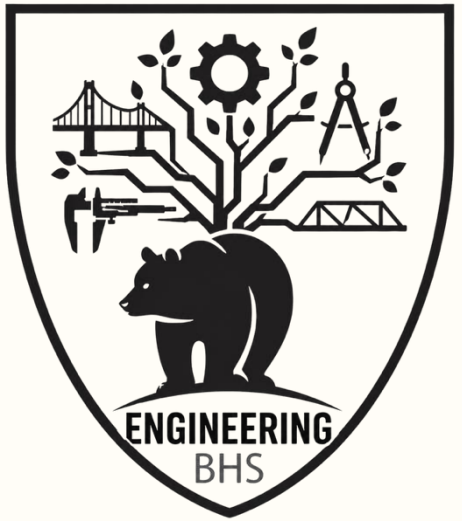
Today we are learning…

To **explain engineering** impacts using a clear **what + why** answer structure.



Daily Review - Show Me Boards

1. Name the three types of impact.
2. Give one positive social impact.
3. Give one negative economic impact.
4. Give one positive environmental impact.
5. What is an engineering context?

SUCCESS CRITERIA

Explaining Engineering Impacts

- ☐ I can use the **what + why** answer structure
- ☐ I can **explain** a **social impact** in full
- ☐ I can **explain** an **economic impact** in full
- ☐ I can **explain** an **environmental impact** in full
- ☐ I can improve a weak answer using **what + why**

What + Why Answer Structure

What – say what the impact is.

Why – say why it matters or how it happens.

Use full sentences and **engineering** vocabulary.

Match the type of impact asked for in the question.

NOTES

Social Impact – Model Answer

Question: **Explain** one **positive social impact** of automatic doors at a school entrance.

Weak answer

It is good for people.

Model answer (**what + why**)

Automatic doors help wheelchair users enter the school easily, because they open without needing to be pushed.

NOTES

Economic Impact – Model Answer

Question: **Explain** one **positive economic impact** of efficient motors in a factory.

Weak answer

It saves money.

Model answer (**what + why**)

Efficient motors use less electricity, so the factory pays lower energy bills and saves money each year.

NOTES

Environmental Impact – Model Answer

Question: **Explain** one **positive environmental impact** of electric buses.

Weak answer

They are better for the environment.

Model answer (**what + why**)

Electric buses produce no exhaust emissions,
so they reduce air pollution and lower greenhouse gas emissions.

Task - Improve This Answer

Your task

Look at the weak answers on the booklet page.
Rewrite each one using the what + why structure.
Use full sentences and an engineering reason.

CHECKPOINT

Section 2 Practice - Part 1

1. **State** what is meant by an **engineering context**.

2. **Identify** one **engineering solution** that could help with traffic congestion and poor air quality.

3. **Describe** one **positive social impact** of installing automatic doors at a school entrance.

CHECKPOINT

Section 2 Practice - Part 2

4. **Describe** one **negative economic impact** of building a new road bridge.

5. **Explain** one **positive environmental impact** of using electric buses instead of diesel.

6. **Explain** one **positive economic impact** of efficient motors in a factory.

CHECKPOINT

Section 2 Practice - Part 3

7. A wind farm is built near a village. **Explain** one **positive impact** of this **engineering solution**.

8. A wind farm is built near a village. **Explain** one **negative impact** of this **engineering solution**.

9. Choose one solution from the booklet. **Explain** it using **what + why**.

PLENARY

Plenary - Explaining Impacts

Show me boards. One short answer per question.

1. What does the **what + why** structure mean? — SC1
2. **Give** one **engineering** reason for an **economic impact.** — SC2
3. **Give** one **engineering** reason for an **environmental impact.** — SC3
4. Why is the answer 'it is good' too weak? — SC4
5. Should **explain** answers be in full sentences? (yes/no) — SC5

1 – Engineering Contexts and Systems

Sustainability and Climate Change

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Today we are learning…

To understand how **engineering** can reduce harm and provide more **sustainable** solutions to **real-world problems**.

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DAILY REVIEW

Daily Review - Show Me Boards

One short answer per question.

1. Name the three types of impact.

2. What does what + why mean?

3. Give one negative environmental impact of a road project.

4. Give one positive economic impact of efficient motors.

5. What is an engineering constraint?

SUCCESS CRITERIA

Sustainability and Climate Change

- ☐ I can **describe** how **engineering** can tackle climate change
- ☐ I can **explain** what makes a solution more **sustainable**
- ☐ I can **give** examples of **renewable energy** and **energy saving**
- ☐ I can **describe** ways **engineers** reduce waste
- ☐ I can suggest improvements to make a design more **sustainable**

Engineering and Climate Change - P15

Engineering solutions can help reduce the causes and impacts of climate change.

Examples: **renewable energy**, more efficient machines, better building insulation, electric transport, recycling.

Engineers also design defences for the impacts of climate change, such as flood barriers.

Task - Engineering and Climate Change (P15)

Your task

For each engineering solution in the table:
- describe how it could help tackle climate change.
Use one full sentence per row.

Sustainable Engineering Solutions - P16

A **sustainable** solution meets needs today without harming the future.

Sustainable engineering aims to:

- use less energy
- use **renewable energy**
- use materials that can be recycled
- produce less waste and pollution

NOTES

Examples of Sustainable Engineering

Engineers can make solutions more **sustainable** in many ways.

Renewable / **energy saving**

Wind turbines and solar panels
LED lighting and efficient motors
Better insulation in buildings

Reducing waste

Recyclable materials
Designs that last longer
Reusing components

Task – Make It More Sustainable (P16)

Your task

For each design in the table:
- identify the problem.
- suggest a more sustainable improvement.

Use full sentences with an engineering reason.

PLENARY

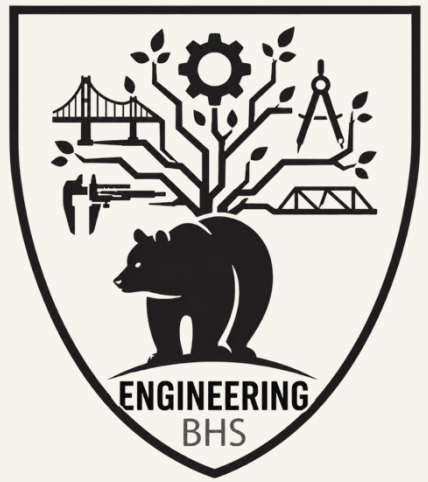
Plenary - Sustainability

Show me boards. One short answer per question.

1	What does **sustainable** mean?	SC1
2	**Name** one **renewable energy** source.	SC2
3	**Give** one way **engineers** reduce wasted energy in a building.	SC3
4	Why does using recyclable materials help the environment?	SC4
5	**Name** one **engineering solution** that helps tackle climate change.	SC5

1 – Engineering Contexts and Systems

Emerging Technologies



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Today we are learning…

To understand how **emerging technologies** can improve **engineering solutions** and to weigh up their advantages and disadvantages.

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DAILY REVIEW

Daily Review - Show Me Boards

One short answer per question.

1. What does sustainable mean?
2. Give one renewable energy source.
3. Give one way engineers reduce wasted energy.
4. Give one way to make a product more sustainable.
5. Name one engineering solution that helps tackle climate change.

SUCCESS CRITERIA

Emerging Technologies

- [ ] I can **describe** what an **emerging technology** is
- [ ] I can **explain** how an **emerging technology** improves an **engineering solution**
- [ ] I can **give** one advantage and one disadvantage of an **emerging technology**
- [ ] I can use a reliable source to research an **emerging technology**
- [ ] I can answer Section 3 practice questions

Emerging Technologies - P17

An **emerging technology** is a new or developing technology that could change how **engineering** problems are solved.

Examples include AI, smart sensors, robotics, drones, 3D printing, electric vehicles and battery storage.

They can make solutions safer, faster, cleaner, more reliable or cheaper to run.

NOTES

Advantages and Disadvantages

New technology brings opportunities and risks. Both must be considered.

Possible advantages

Improved accuracy and reliability
Reduced energy use or waste
Better safety and monitoring
Faster or lower-cost production

Possible disadvantages

Expensive to set up
Unfamiliar – needs training
Can fail or be hacked
May replace existing jobs

Use Reliable Sources

Wikipedia is a useful starting point only.

Always check at least one other reliable source:

- company or university website
- **engineering** organisation
- news article from a trusted publisher

Avoid social media posts as your only source.

Task - Research an Emerging Technology (P17)

Your task

Choose one emerging technology.
Complete the booklet research table.
Find: problem solved, social / economic / environmental impacts, one advantage and one disadvantage.

CHECKPOINT

Section 3 Practice - Part 1

1. **State** what is meant by a **sustainable engineering solution.**

2. **Identify** one **engineering solution** that could help tackle climate change.

3. **Describe** one way **engineers** can reduce wasted energy in a building.

CHECKPOINT

Section 3 Practice - Part 2

4. **Describe** one **emerging technology** used in **engineering.**

5. **Explain** why **renewable energy** makes a solution more **sustainable.**

6. **Explain** one **positive environmental impact** of efficient motors in a factory.

CHECKPOINT

Section 3 Practice - Part 3

7. A council installs smart sensors in a flood defence **system**. **Explain** how this could improve the solution.

8. **Give** one advantage of replacing diesel buses with electric buses.

9. **Give** one disadvantage of replacing diesel buses with electric buses.

PLENARY

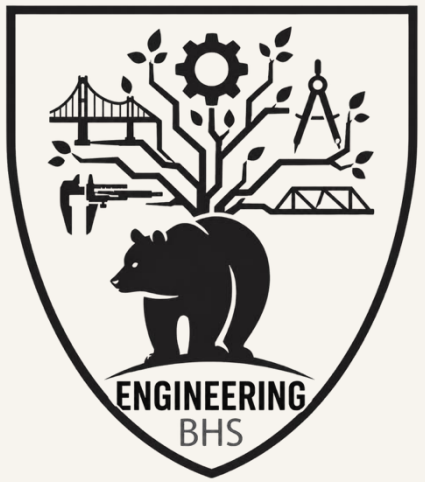
Plenary - Emerging Technologies

Show me boards. One short answer per question.

1. What is an **emerging technology**? — SC1
2. **Give** one example of an **emerging technology**. — SC2
3. **Give** one advantage of an **emerging technology**. — SC3
4. **Give** one disadvantage of an **emerging technology**. — SC4
5. Why must research come from reliable sources? — SC5

1 – Engineering Contexts and Systems

The Systems Approach



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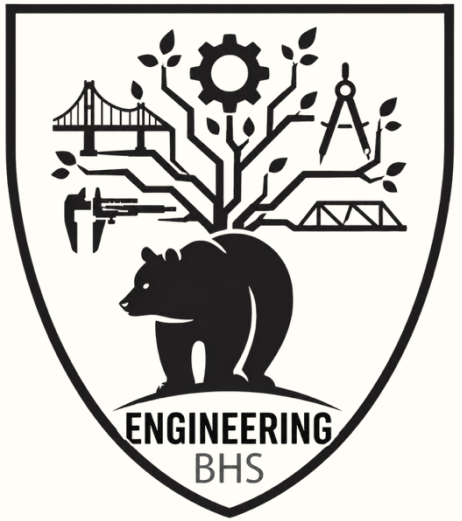
Today we are learning…

To **describe** an engineered **system** using input, process and output, and to **identify** input and **output devices**.



DAILY REVIEW

Daily Review - Show Me Boards

One short answer per question.

1. What is engineering?
2. Name one emerging technology.
3. Give one positive environmental impact of a wind farm.
4. Give one negative impact of building a new road bridge.
5. What does sustainable mean?

SUCCESS CRITERIA

The Systems Approach

- [ ] I can **describe** what is meant by a **system**
- [ ] I can **identify** input, process and output
- [ ] I can **draw** and **label** a simple **system** diagram
- [ ] I can **identify** input and **output devices**
- [ ] I can **describe** a real engineered **system** using the **systems approach**

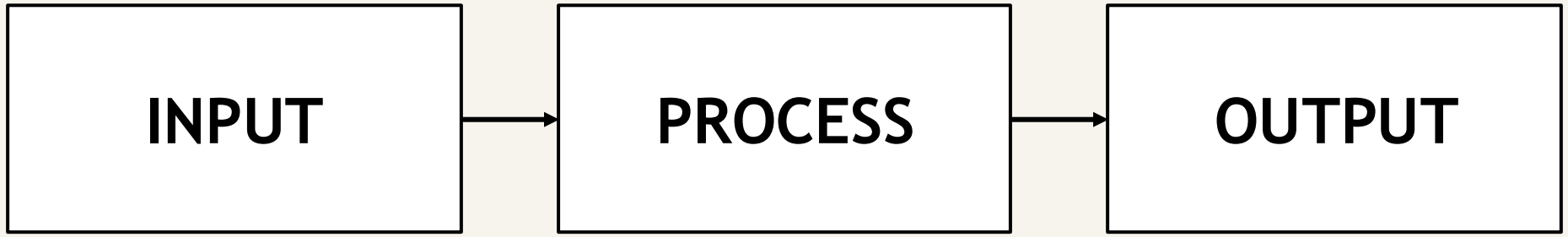
What is a System? - P19

A **system** is a group of parts working together to carry out a task.

Engineers break products and machines into smaller parts using the **systems approach**.

This makes **systems** easier to understand, design, test and improve.

Input → Process → Output



switch / sensor

control / circuit

lamp / motor / buzzer

NOTES

Examples of Engineered Systems

Each example can be described as input → process → output.

Doorbell

Input: button pressed
Process: control circuit
Output: bell sounds

Electric kettle

Input: switch on
Process: heating circuit
Output: water heats up

Input and Output Devices - P20

An **input device** takes a real-world signal into the **system** (e.g. switch, sensor).

An **output device** produces a real-world action from the **system** (e.g. lamp, buzzer, motor).

The **system boundary** is a line showing what is included inside the **system** being studied.

Task - Input and Output Devices (P20)

Your task

Complete the table in your booklet.
For each situation, choose:
- a suitable input device
- a suitable output device

Task - Describe the System (P21)

Your task

For each system, draw a labelled systems diagram.

1. Traffic lights
2. School bell
3. Electric toothbrush

Show input → process → output clearly.

PLENARY

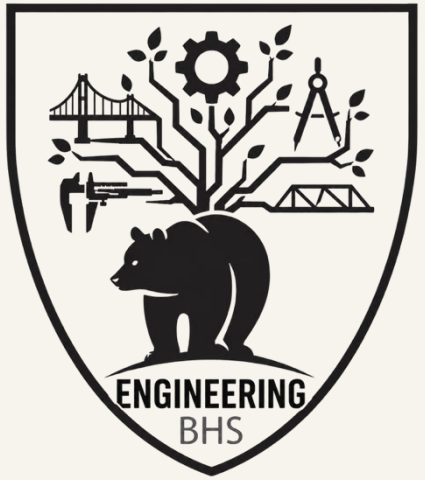
Plenary - The Systems Approach

Show me boards. One short answer per question.

1. What is a **system**? — SC1
2. What is the input of a doorbell? — SC2
3. What is the output of an electric kettle? — SC3
4. **Give** one example of an **input device**. — SC4
5. **Give** one example of an **output device**. — SC5

1 – Engineering Contexts and Systems

Sub-systems



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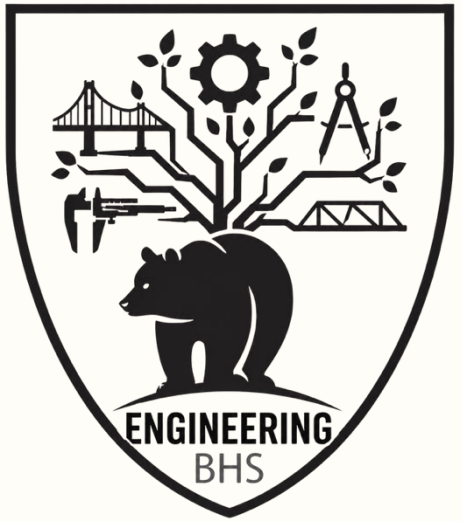
Today we are learning…

To **identify sub-systems** within a larger **system** and to **draw sub-system** diagrams.



DAILY REVIEW

Daily Review - Show Me Boards

One short answer per question.

1. What is a system?
2. What is the input of a doorbell?
3. Give one input device.
4. Give one output device.
5. What does the systems approach mean?

SUCCESS CRITERIA

Sub-systems

- [ ] I can **describe** what a **sub-system** is
- [ ] I can **identify sub-systems** within a larger **system**
- [ ] I can **describe** how **sub-systems** interact
- [ ] I can **draw** a labelled **sub-system** diagram
- [ ] I can answer Section 4 practice questions

What is a Sub-system? - P22

A **sub-system** is a smaller part of a larger **system**.

Sub-systems interact when the output of one becomes the input of another.

This means one part of the **system** affects another part.

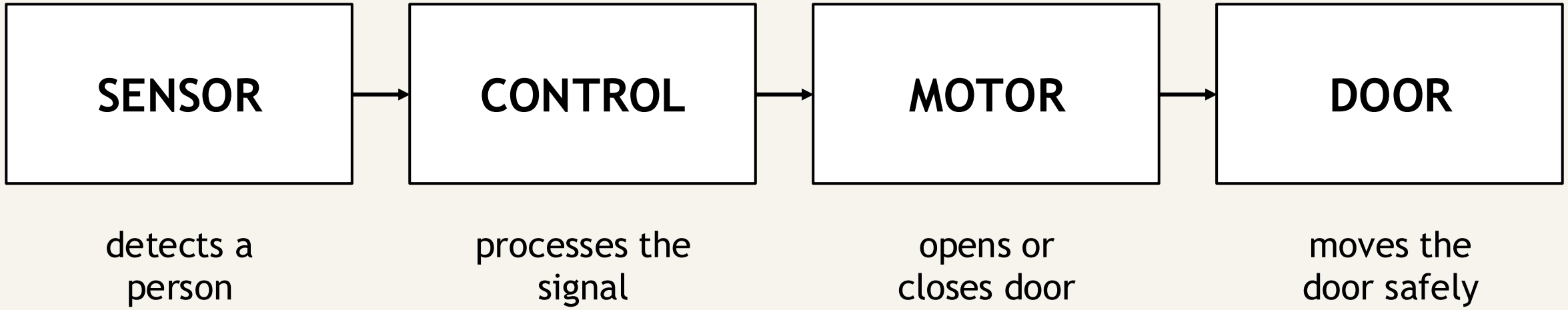
NOTES

Automatic Door - Sub-systems

Each **sub-system** has a clear job. They work together to open the door.

Sub-systems	Function
Sensor **sub-system**	detects a person near the door
Control **sub-system**	processes the signal from the sensor
Motor **sub-system**	opens or closes the door
Door mechanism	moves the door safely

Automatic Door – Sub-system Diagram



Task – Draw a Sub-system Diagram (P22)

Your task

Choose one system: washing machine, wind turbine or school heating.
Draw the **sub-system** diagram.
Use boxes for each sub-system and arrows for how they interact.

CHECKPOINT

Section 4 Practice - Part 1

1. **State** what is meant by a **system**.

2. **Identify** the input, process and output of an electric kettle.

3. **Describe** the operation of a doorbell using the **systems approach**.

CHECKPOINT

Section 4 Practice - Part 2

4. **Explain** why **engineers** use **system** diagrams.

5. **State** what is meant by a **sub-system**.

6. **Describe** two **sub-systems** found in a washing machine.

CHECKPOINT

Section 4 Practice - Part 3

7. **Explain** how **sub-systems** interact in an automatic door **system.**

8. **Draw** a labelled **sub-system** diagram for an automatic door.

9. **Describe** the difference between a real-world input and an **input device**.

PLENARY

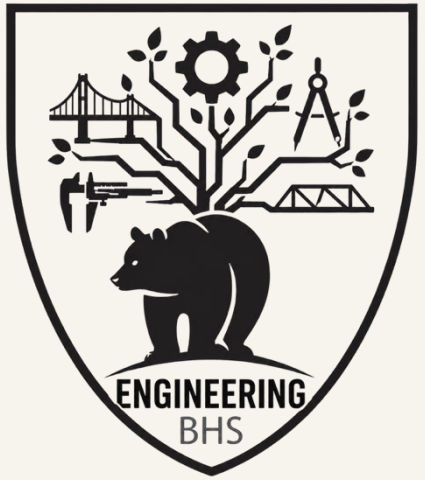
Plenary - Sub-systems

Show me boards. One short answer per question.

1. What is a **sub-system**? — SC1
2. What does the sensor **sub-system** do in an automatic door? — SC2
3. How do **sub-systems** interact? — SC3
4. **Name** one **sub-system** in a washing machine. — SC4
5. How do you show interaction in a **sub-system** diagram? — SC5

1 – Engineering Contexts and Systems

Control Systems



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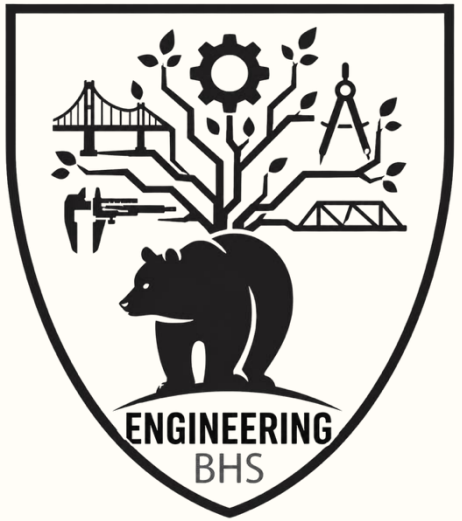
Today we are learning…

To **describe** what control means and to **identify open-loop**, manual and **automatic control**.



DAILY REVIEW

Daily Review - Show Me Boards

One short answer per question.

1. What is a sub-system?

2. What is the input of an automatic door?

3. Name two sub-systems in a washing machine.

4. What does it mean if sub-systems interact?

5. Give one input device and one output device.

SUCCESS CRITERIA

Control Systems

- [ ] I can **describe** what a **control system** does
- [ ] I can **identify** manual and **automatic control**
- [ ] I can **describe** what is being controlled
- [ ] I can **describe open-loop control**
- [ ] I can **draw** an **open-loop control** diagram

What is Control? - P25

A **control system** makes a **system** operate in the required way.

Control is used to keep **systems** safe, reliable and efficient.

Control may switch on or off, keep something at a set level, control speed, temperature or movement.

NOTES

Manual and Automatic Control

Control can be carried out by a person or by technology.

Manual control

A person switches a light on.
A person turns a tap off when full.
A person presses a button to open a door.

Automatic control

A thermostat switches heating on / off.
A motion sensor switches a light on.
A washing machine controls the wash cycle.

Task – Manual or Automatic? (P26)

Your task

For each example in the table, decide:
- manual control, or
- automatic control.

Be ready to explain your choice.

Open-loop Control - P27

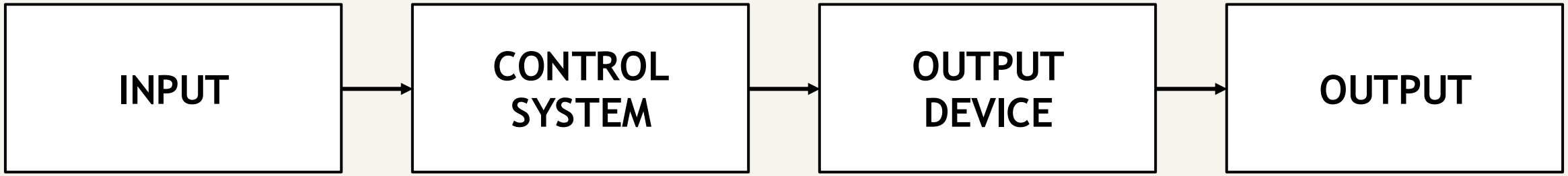
An **open-loop control system** produces an output but does not check or monitor it.

There is no **feedback**.

The **system** cannot self-correct if something changes.

Examples: light switch, hairdryer, toaster on a timer.

Open-loop Control Diagram



Task - Open-loop Control (P27)

Your task

For each system in the booklet table:
- give the input
- give the output
- say why it is open-loop.

PLENARY

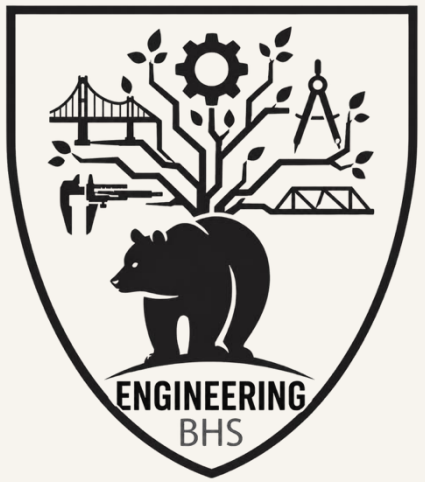
Plenary - Control Systems

Show me boards. One short answer per question.

1. What does a **control system** do? — SC1
2. **Give** one example of **manual control**. — SC2
3. **Give** one example of **automatic control**. — SC3
4. What is **open-loop control**? — SC4
5. Why can an **open-loop system** not self-correct? — SC5

1 – Engineering Contexts and Systems

Feedback and Closed-loop Control



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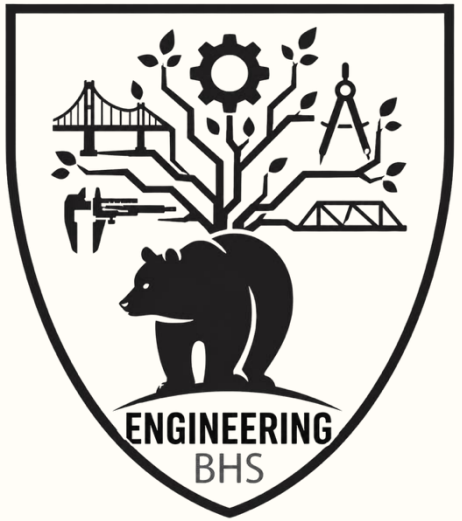
Today we are learning…

To **describe feedback**, **set value**, **actual value** and error in a **closed-loop control system**.



Daily Review - Show Me Boards

One short answer per question.

1. What does a control system do?
2. Give one example of manual control.
3. Give one example of automatic control.
4. What is open-loop control?
5. Give one example of an open-loop system.

SUCCESS CRITERIA

Feedback and Closed-loop Control

- [ ] I can **describe feedback** in a **control system**
- [ ] I can **explain set value**, **actual value** and error
- [ ] I can **describe** how an **error detector** works
- [ ] I can **describe closed-loop control** with an example
- [ ] I can **draw** a labelled **closed-loop control** diagram

Feedback - P29

Feedback is information sent back to the **control system** about the output.

Feedback allows the **system** to check whether the output is correct.

Feedback is used in **closed-loop control systems**.

NOTES

Key Words for Closed-loop Control

These four words are needed in National 5 answers.

Set value

The value the **system** is trying to reach.
Example: 20 °C on a thermostat.

Actual value

The real value being measured.
Example: 16 °C in the room.

NOTES

Error and Error Detector

The **control system** uses the error to decide what to do.

Error

The difference between **set value** and **actual value**.
Example: 20 - 16 = 4 °C too cold.

Error detector

The part that compares **set value** and **actual value**.
If they are different, the **system** acts to reduce the error.

Closed-loop Control - Central Heating

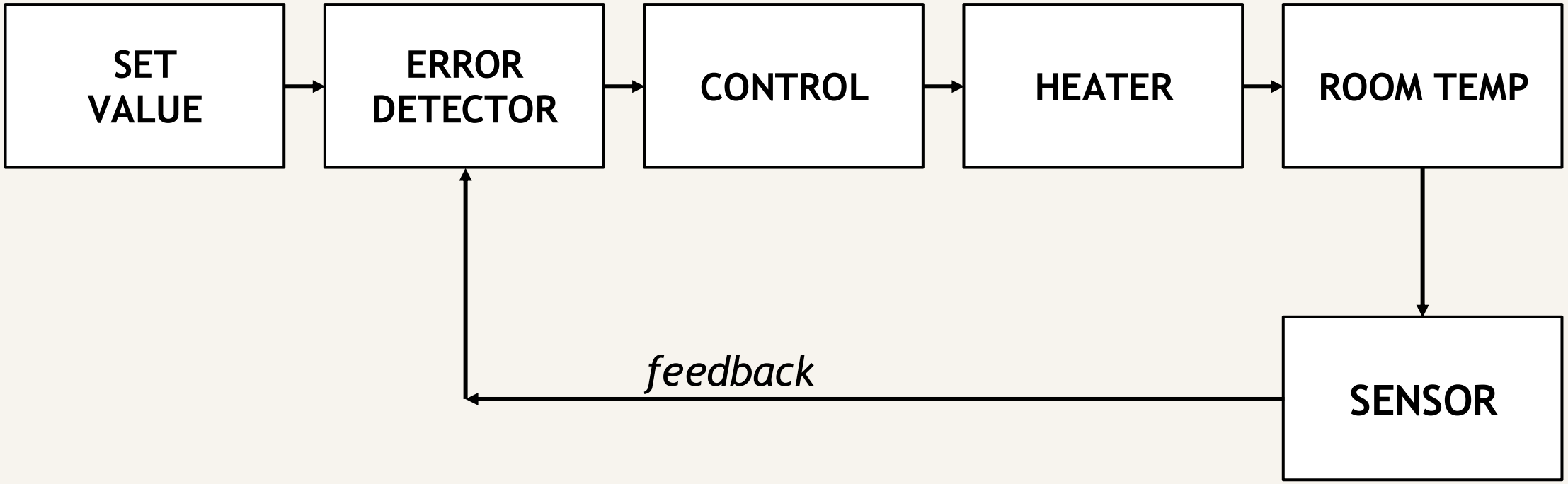
Set value: 20 °C selected on the thermostat.

Sensor: thermostat measures actual room temperature.

Error detector: compares the two values.

Response: heating switches on if the room is too cold; off when **set value** is reached.

Closed-loop Control - Central Heating



Task - Feedback (P30)

Your task

For each system in the table:
- identify the feedback that is sent back to the control system.
Use full sentences.

Task - Error Detection (P31)

Your task

For each situation, work out:
- the error
- the control action.

Worked example: 180 - 160 = 20 °C too cold; heater switches on.

Task - Draw Control Diagrams (P32)

Your task

1. Open-loop system
   - Hairdryer
2. Closed-loop system
   - Central Heating

Use boxes and arrows. Label set value, error detector, sensor and feedback.

CHECKPOINT

Section 5 Practice - Part 1

1. **State** what is meant by a **control system**.

2. **Identify** one example of **manual control**.

3. **Identify** one example of **automatic control**.

CHECKPOINT

Section 5 Practice - Part 2

4. **State** what is meant by **open-loop control**.

5. **State** what is meant by **closed-loop control**.

6. **Describe** the difference between **open-loop** and **closed-loop control**.

CHECKPOINT

Section 5 Practice - Part 3

7. A room heater uses a thermostat. **Explain** why this is **closed-loop control**.

8. A toaster heats bread for a fixed time. **Explain** why this is **open-loop control**.

9. **Describe** a central heating **system** using: **set value**, thermostat, **feedback**, **control system**, heating.

CHECKPOINT

Section 5 Practice - Part 4

10. **Draw** a labelled **closed-loop control** diagram for a central heating **system**.

Include **set value**, **error detector**, control, heater, room temperature and sensor.

Show the **feedback** arrow clearly.

PLENARY

Plenary - Closed-loop Control

Show me boards. One short answer per question.

1. What is **feedback**? — SC1
2. What does the **error detector** do? — SC2
3. What is the **set value**? — SC3
4. What is the **actual value**? — SC4
5. What is the difference between **open-loop** and **closed-loop**? — SC5

1 – Engineering Contexts and Systems

Knowledge Organiser and Revision

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Today we are learning…

To revise the key ideas, vocabulary and exam answers for Booklet 1 – **Engineering Contexts** and **Systems**.

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DAILY REVIEW

Daily Review - Show Me Boards

One short answer per question.

1. What is engineering?
2. Name three branches of engineering.
3. What is the systems approach?
4. What does feedback mean?
5. What is the difference between open-loop and closed-loop?

SUCCESS CRITERIA

Revision Lesson

- [ ] I can recall key definitions
- [ ] I can **name** the branches of **engineering**
- [ ] I can compare **open-loop** and **closed-loop**
- [ ] I can spot common mistakes in answers
- [ ] I can answer mixed exam-style questions

NOTES

Key Definitions - 1

Use these definitions in exam answers.

Engineering

Using science, maths, technology and creativity to solve **real-world problems**.

Constraint

A limit on the design (cost, time, weight, safety, materials).

NOTES

Key Definitions - 2

Use these definitions in exam answers.

Social impact

Effect on people, communities and quality of life.

Economic impact

Effect on money, jobs, businesses and costs.

NOTES

Key Definitions - 3

Use these definitions in exam answers.

Environmental impact

Effect on nature, resources, pollution and energy use.

Sustainable

Meets needs today without harming the future.

NOTES

Key Definitions - 4

Use these definitions in exam answers.

System

A group of parts working together to carry out a task.

Sub-system

A smaller part of a larger **system**.

NOTES

Key Definitions - 5

Use these definitions in exam answers.

Open-loop control

Output is not monitored. No **feedback**.

Closed-loop control

Output is monitored. **Feedback** adjusts the **system**.

NOTES

Key Definitions - 6

Use these definitions in exam answers.

Set value / Actual value

Set value: value the **system** is trying to maintain.
Actual value: the real measured value.

Error / **Error detector**

Error: difference between **set value** and **actual value**.
Error detector: compares **set value** and **actual value**.

Branches of Engineering - Quick Reference

Civil – infrastructure (roads, bridges, drainage).

Structural – strength and stability of structures.

Mechanical – machines, mechanisms and moving parts.

Electrical – power, wiring and large electrical **systems**.

Electronic – circuits, sensors and signals.

Chemical – materials, fuels and chemical processes.

Environmental – reducing damage and improving **sustainability**.

NOTES

Open-loop vs Closed-loop

A common National 5 question. Know both columns.

Open-loop

No **feedback**.
Output not monitored.
Cannot self-correct.
Examples: light switch, toaster, hairdryer.

Closed-loop

Uses **feedback**.
Output monitored by a sensor.
Adjusts to reduce error.
Examples: central heating, oven, cruise control.

Common Mistakes

Confusing electrical and electronic **engineers**.

Saying 'good for the environment' instead of giving a reason.

Forgetting full sentences in **explain** answers.

Missing the **feedback** arrow on a **closed-loop** diagram.

Calling every **system** '**closed-loop**' – check for a sensor and **feedback**.

CHECKPOINT

Mixed Retrieval - Set 1

1. **Name** three branches of **engineering**.

2. **State** two **engineering** actions.

3. What is an **engineering context**?

CHECKPOINT

Mixed Retrieval - Set 2

4. **Name** the three types of impact.

5. **State** what **sustainable** means.

6. **Give** one **emerging technology**.

CHECKPOINT

Mixed Retrieval - Set 3

7. **Describe** input → process → output.

8. **State** what a **sub-system** is.

9. **Describe** the difference between **open-loop** and **closed-loop control**.

CHECKPOINT

Exam-style Practice – Part 1

1. **Explain** why **engineers** must consider **constraints** when designing a solution.

2. **Explain** one **positive environmental impact** of using electric buses.

3. **Describe** how **engineers** can reduce wasted energy in a building.

CHECKPOINT

Exam-style Practice – Part 2

4. **Describe** the operation of a doorbell using the **systems approach**.

5. **Explain** why a toaster on a timer is **open-loop control**.

6. **Draw** and **label** a **closed-loop control** diagram for a central heating **system**.

PLENARY

End-of-Topic Plenary

1	Define **engineering** in one sentence.	SC1
2	**Give** one social, one economic and one **environmental impact**.	SC2
3	What does **sustainable** mean?	SC3
4	**Describe** a **system** using input, process and output.	SC4
5	What is the difference between **open-loop** and **closed-loop**?	SC5