Computing Technology Stage 5 (Year 9 or 10) – teacher support resource

**Modelling networks and social connections**

# Teacher support resource

**Teacher note:** this resource has been designed to facilitate the ready conversion into a student booklet by removing the answers within the response windows. Teacher notes can be deleted before distributing to students.

Student name:

Class:

Teacher:

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# Unit overview

In this unit, students will explore the concepts and technologies involved in connecting people and systems, with an emphasis on understanding how these systems improve communication, productivity and access to information.

Students will explore the fundamentals of computer networks, cybersecurity, the role of databases and smart home technologies in modern computing. They will also examine the social, ethical, and legal implications of these technologies, particularly in the context of social media and data privacy. The program includes both theoretical understanding and practical application, with students working on a project to design and implement a smart home model, alongside developing skills in data collection and database management.

During Weeks 1 to 4, students will gain foundational knowledge of systems, networking, and the impacts of social platforms, learning how to differentiate between functional and non-functional requirements, and exploring the principles of cybersecurity and network hardware. They will also study the architecture of smart home networks and Google’s database techniques for managing smart device data.

During Weeks 5 to 9, students will deepen their understanding of social networks, creating sociograms to represent relationships and engaging with the perspectives of Aboriginal and/or Torres Strait Islander kinship connections. They will also examine responsible practices for interacting with social networks.

During Weeks 10 to 15, students will apply their knowledge by designing, constructing, and testing a functional smart home model, integrating automated functionalities, and developing a deeper understanding of network management.

During Weeks 16 to 18, students will focus on data collection, privacy, and ethics, learning how to create and manage a relational database, model entities and relationships, and use SQL to query and analyse data.

During Weeks 19 to 20, students will research career opportunities in computing technology, focusing on roles that connect people and systems, and reflect on the social and ethical responsibilities associated with these technologies.

## Assessment task 1 overview

**Type of task**: develop a physical model and accompanying documentation for a smart home.

**Outcomes being assessed**:

A student:

* selects and applies safe, secure and responsible practices in the ethical use of data and computing technology **CT5-SAF-01**
* applies iterative processes to define problems and plan, design, develop and evaluate computing solutions **CT5-DPM-01**
* understands how innovation, enterprise and automation have inspired the evolution of computing technology **CT5-EVL-01**

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**Suggested weighting**: 100%

Design and implement a functional smart home model showcasing various automated functionalities that enhance daily living.

This task will include researching existing smart home technologies. Your smart home model will have a specific purpose such as energy efficiency, security, health, entertainment, accessibility and productivity. You will develop documentation that will show how the automated functions of the smart home aligned with this purpose.

By integrating microcontrollers and compatible devices, you will create a network that enables seamless interaction among components like sensors and actuators. The project will culminate in the construction, testing and demonstration of smart home solutions, along with your reflections on the design process and the challenges encountered.

## Submission details

The physical model will be demonstrated to the class and accompanying documentation submitted digitally.

## Steps to success

Table 1 – assessment preparation schedule

|  |  |
| --- | --- |
| Steps | What I need to do |
| Research smart home technologies | * Investigate existing smart home technologies and innovations |
| Develop a purpose | * Choose a purpose for your smart home network. Examples include energy efficiency, home security, health, entertainment, accessibility and productivity * Identify features and functions related to the theme and brainstorm potential automated processes |
| Define project requirements and consider non-functional requirements | * Define 3 automated functions for your smart home model * Specify the nodes in your network, their functions and the data communicated and the manual process that this function automates * Discuss non-functional requirements, including security considerations during data transmission and storage * Address potential issues impacting project development, such as time, resources and budget constraints |
| Define functional requirements | * Detail how the chosen functions will work within the smart home model * Define the role of each component in the network |
| Sketch and model a network | * Sketch and label a design for the physical model of your smart home * Create a network diagram illustrating the arrangement and connections of the technology in your smart home |
| Research and define a network | * Research technologies compatible with microcontrollers for collecting inputs and performing required outputs * Compose a list of equipment and parts required for the construction of the smart home |
| Prototype a network | * Design the code for the microcontroller * Use simulation software to create a prototype of the smart home network |
| Construct and implement a network | * Construct the physical model for your smart home * Source and create any physical resources needed for the system, for example microcontrollers, cables, sensors and actuators * Connect microcontrollers to additional sensors or actuators using wires or expansion boards |
| Test and evaluate | * Code and test each automated function and test in the online simulator * Upload the code to the microcontroller and conduct real-world testing |
| Demonstrate and reflect | * Demonstrate the smart home model to peers * Compile a report summarising challenges faced, solutions implemented and the overall learning experience |

## What is the teacher looking for?

To meet the requirements of this task, students need to demonstrate the following skills and knowledge:

1. Research

Conduct thorough research into smart home technologies, showing a clear understanding of functionality and innovations relevant to their model.

1. Purpose development

Develop a clear, focused purpose for their smart home model with well-defined features and automated processes that align with their chosen theme (for example, security or energy efficiency).

1. Project requirements and non-functional considerations

Define at least 3 automated functions for their model, including specifications of network nodes, data communication processes and attention to non-functional requirements, such as security, reliability and resource constraints.

1. Functional requirements

Clearly explain how each automated function works and define the role of each component, demonstrating a strong understanding of how functions contribute to the overall purpose.

1. Sketch and model a network

Create a detailed, coherent sketch and network diagram that accurately represents all components, their positions and connections, providing clarity on the network’s setup.

1. Research and design a network

Conduct thorough research on compatible technologies, producing a complete and accurate list of all necessary equipment and parts for constructing the smart home model.

1. Prototyping

Design functional code for the microcontroller and create a working prototype using simulation software, demonstrating a strong grasp of coding principles and troubleshooting.

1. Construct and implement a network

Build a functional model, integrating all components (sensors, actuators) to create a fully operational network that supports the defined automated functions.

1. Test and evaluate

Conduct comprehensive testing and evaluation for each function, making refinements to improve performance and ensure the network functions as intended.

1. Demonstrate and reflect

Present a clear, engaging demonstration of the smart home model and provide a reflective report that thoughtfully discusses challenges, solutions and learning experiences from the project.

# Glossary

Many of the following words will gather more meaning to you as you work through this booklet.

Each time you see a new word in bold throughout this workbook you can add its definition in the table below in case you need to refer back later.

|  |  |
| --- | --- |
| Word | Definition |
| Access control | Restricting access to systems or data to authorised users only. |
| Compression | Reducing the size of data for faster transmission or storage. |
| Cybersecurity | Protecting systems and data from unauthorised access or attacks. |
| Data types | Categories of data such as text, numbers, or images, used for specific purposes in computing. |
| Data visualisation | Representing data visually through charts, graphs, or maps to identify trends or patterns. |
| Database | A structured way to store and organise data for easy access and analysis. |
| End user | The person or group who will use a product or system. |
| Ethical responsibility | Ensuring technology is used in a way that respects people’s rights and values. |
| Functional requirements | Specific features or tasks a network must perform to meet its purpose. |
| Graph | A visual representation of connections between nodes (for example, a sociogram). |
| Input | Data or information provided to a system for processing. |
| IoT (Internet of Things) | A network of devices connected to the internet to share data and automate tasks. |
| Iterative design | A process of repeatedly refining and improving a solution based on feedback. |
| Legal responsibility | Following laws and regulations related to technology use and data protection. |
| Mitigation strategy | Actions or tools used to reduce the risk of vulnerabilities. |
| Network | A system of interconnected devices or people that share information or resources. |
| Network hardware | Physical devices like routers, switches, and cables that connect a network. |
| Network security | Measures taken to protect a network from threats like hacking or data theft. |
| Node | A device or point within a network, such as a computer, router, or phone. |
| Non-functional requirements | The qualities or attributes of a network, such as speed, security and usability. |
| Output | The result or product of a system’s processes. |
| Path | A route between 2 nodes in a network. |
| Privacy | Protecting personal information from being shared without consent. |
| Process | The actions or steps taken by a system to transform inputs into outputs. |
| Query | A request for specific data from a database using commands like SELECT, WHERE, and ORDER BY. |
| Social impact | The effect a technology or solution has on people and communities. |
| Sociogram | A graph that shows social connections between individuals or groups. |
| System | A group of components working together to achieve a specific purpose. |
| Test case | A set of conditions or inputs used to check if a system works as expected. |
| Use case | A scenario showing how users interact with a system to achieve a goal. |
| Vulnerability | A weakness in a system that can be exploited by a threat. |

**Teacher note:** for students with an English as an additional language or dialect (EAL/D) background, the glossary can be provided complete so that they have additional time to understand the key terms with bilingual dictionaries. The glossary can be provided to students in their preferred communication mode.

# The design and production process

Throughout your study of Computing Technology, you will learn about design processes and how to apply them. You will explore different types of design processes and learn how to apply them in your design project.

The design and production process:

* involves a sequence of organised steps which provide a solution to design needs and opportunities
* may take a few seconds or minutes, such as when you select what clothes to wear, or may take years as in the case with the design of a motor vehicle
* may involve one person or may involve many people
* may be simple or complex, depending on the task
* involves questioning (or evaluating) throughout the iterative process.

Figure 1 – flowchart of design and production process

Design and production process diagram.

A flowchart labelled 'Ongoing evaluation' with a 2-headed arrow indicating both directions. 
The steps of the flowchart are as follows:
1. Identifying and defining: identify and define the needs, opportunities and wants of a computing challenge, practise the technical skills, develop evaluation criteria. 
2. Researching and planning: research, generate and practise ideas, be creative and propose new approaches to problems, explore new design opportunities. 
3. Producing and implementing: build and implement ideas, apply a variety of skills and techniques to create products that meet set criteria, modify and iterate solutions. 
4. Testing and evaluating: test and evaluate solutions/products, evaluate quality and effectiveness against the criteria, make judgements throughout the solution and use these to refine the product.
After testing and evaluating is a big arrow called 'Review if required to improve' and it goes all the way back up to the first part of the flowchart, indicating a cycle.

## The purpose of connecting people and systems

Connecting people and systems is all about making communication, collaboration and access to information easier and more effective. When people are connected through networks like social media, messaging apps or online platforms, they can share ideas, solve problems together, and build relationships no matter where they are in the world. These systems also make it easy to find information, learn new skills, and stay updated on the latest news or trends.

Networking doesn’t just help individuals, it also drives innovation and tackles big challenges. By connecting people with different skills and perspectives, networks create opportunities for new ideas and inventions. They also make life more efficient by automating tasks and providing tools that simplify work, such as customer service chatbots or shared online workspaces. Importantly, connected systems promote inclusion by helping people overcome barriers, like remote learning tools for students in rural areas or assistive technologies for people with disabilities. Overall, networking helps people and systems work together to create solutions, build communities and make the world a more connected and responsive to needs.

**Activity 1:** [brainstorm](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/542?clearCache=3d32c820-442f-7d68-d3ca-b2add7a710e8) different systems people interact with daily.

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| **Sample answers:**  Social media, online banking, student portal, Spotify, online shopping. |

**Activity 2:** explain how these systems improve communication, productivity and access to information.

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| **Sample answer:**  Social media platforms like Facebook, Instagram and X improve **communication** by allowing users to instantly share messages, images and videos with friends and family around the world.  They also enable the formation of communities and groups, facilitating discussions on shared interests.  In terms of **productivity**, social media is used for networking, marketing and collaboration among businesses and professionals. It enhances **access to information** by providing real-time updates on news, events, and trends, allowing users to stay informed about current affairs. |

**Activity 3:** choose one system that was discussed above and research how it connects people and systems.

Identify its purpose, benefits and impact on users' daily lives by creating an infographic highlighting key points.

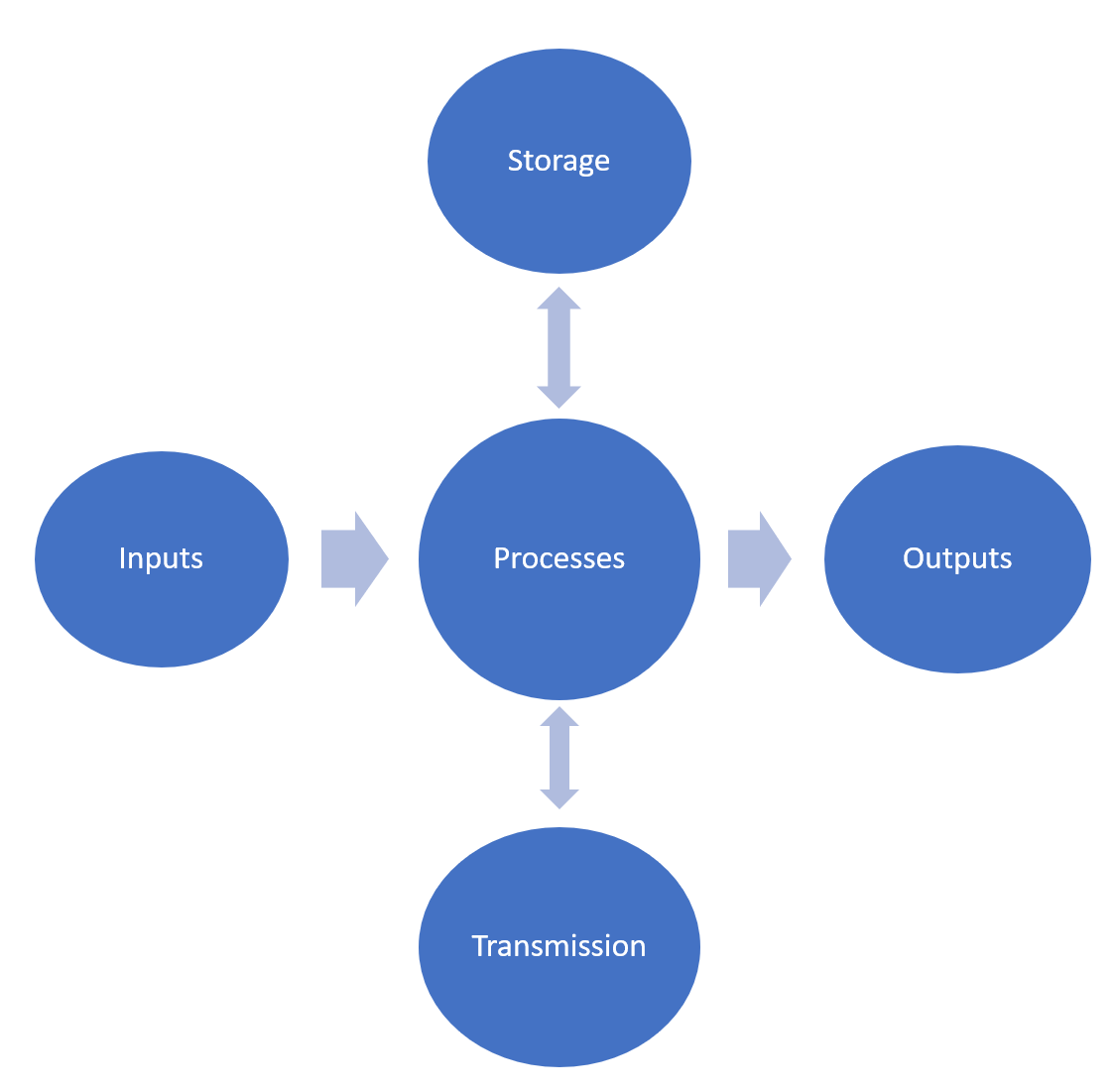
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| **Sample answers:**  Online shopping  **Purpose**  Online shopping sites connect buyers and sellers digitally, allowing users to purchase products and services from anywhere.  E-commerce provides a platform where users can browse, compare and order products without visiting physical stores.  **Benefits**   * 24/7 accessibility: users can shop anytime, eliminating the constraints of store hours * Wide product variety: offers a vast range of products from different categories, giving users more choices * Personalisation: customised shopping experiences through recommendations and targeted ads based on user preferences and past behaviours * Efficiency: automates order processing, payments and delivery, streamlining the entire shopping experience   **Impact on users' daily lives**   * Time-saving: reduces the time spent traveling and shopping in physical stores, allowing users to focus on other activities * Access to global markets: connects users to products from around the world, expanding their options beyond local markets * Improved decision-making: users can read reviews, compare prices and make informed choices about what to buy * Impact on economy: encourages cashless transactions and contributes to the growth of e-commerce, influencing consumer habits   **Connecting people and systems**   * Users and sellers: links consumers with retailers globally, allowing direct transactions * Systems integration: combines inventory management, payment gateways and logistics systems to ensure smooth operation * Customer support: includes communication channels for order tracking, returns and customer service, enhancing user experience |

## Inputs, storage, processes and outputs in connecting people and systems

The concept of inputs, storage, transmission, processes and outputs in modelling networks and social connections refers to the fundamental elements that govern how these interactive experiences function.

* **Inputs** represent user actions or external data.
* **Storage** maintains the state and history of the system.
* **Transmission** deals with data exchange.
* **Processes** include computations and interactions within the system.
* **Outputs** manifest as visible or audible feedback to users.

Figure 2 – system components



**Activity 4:** [brainstorm](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/542?clearCache=3d32c820-442f-7d68-d3ca-b2add7a710e8) different input, storage and output methods.

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| **Sample answer:**  Messaging app   * Input: typing a message * Storage: cloud servers * Process: sending and receiving data * Output: delivered message |

**Activity 5:** create a flow diagram of a popular system showing input, storage, processing and output.

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### Define a real-world problem or need that can be solved by connecting people

**Activity 6:** in small groups, you are to choose a specific system (for example online shopping, weather apps or booking platforms) and map out the inputs, processes, storage methods, and outputs.

Each group will present how their chosen system connects users, with an emphasis on the flow of data and interactions between different components.

## Functional and non-functional requirements

Functional requirements are features or functions that enable users to accomplish their tasks (user requirements).

Non-functional requirements are how the system should perform (user expectation).

As a class read about [functional and non-functional requirements](https://www.altexsoft.com/blog/business/functional-and-non-functional-requirements-specification-and-types/#:~:text=Functional%20requirements%20define%20what%20a,also%20known%20as%20quality%20attributes.) and watch [non-functional requirements (9:28).](https://www.youtube.com/watch?v=fc-5HJPBZMQ)

**Activity 7:** after reading and watching the video, research and define the following terms in relation to modelling networks and social connections.

1. What is a functional requirement?

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| **Sample answer:**  Functional requirements are the specific features and capabilities that the app or system must have to support networking and social connections.  For example, the system must allow users to create and manage profiles that display their interests and connection preferences. The system must enable users to search for and connect with others based on shared interests or professional goals. |

1. What is a non-functional requirement?

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| **Sample answer:**  The quality attributes of the app, such as security, performance and user experience.  For example, with performance, the system must handle high traffic efficiently, with minimal delays. With security the system must ensure data privacy compliance. |

1. What are use cases?

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| **Sample answer:**  Use cases are scenarios that describe how users will interact with the app or system to achieve specific networking or social connection goals.  They outline the steps users take and the expected outcomes.  For example, a use case could involve a user sending a connection request to a colleague, the recipient accepting the request, and both users being able to share updates and messages. |

1. What are test cases?

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| **Sample answer:**  Test cases are specific scenarios and conditions used to ensure that the app supports networking and social connections as expected. They validate the system's functionality under various circumstances.  For example, a test case could verify whether the app allows a user to successfully send and receive a connection request. Another test case could check if a user can search for others using filters like location, shared interests, or professional skills. |

**Activity 8:** working in small groups, consider the following scenarios and identify the functional and non-functional requirements of the scenario.

Table 2 – functional and non-functional requirements

|  |  |  |
| --- | --- | --- |
| Scenario | Functional requirements | Non-functional requirements |
| Online banking app | **Sample answers:**   * Allow users to view account balances * Allow users to transfer funds between accounts | **Sample answer:**   * Security: the system must have a secure login and encryption to protect user data |
| E-commerce website | **Sample answers:**   * Allow users to add items to a shopping cart * Allow users to make payments for purchases | **Sample answer:**   * Performance: the website should load quickly and handle many concurrent users |
| Social media apps | **Sample answers:**   * Users must be able to create accounts, log in, and log out securely * Users can create, edit, and delete their profiles, including personal information and profile pictures | **Sample answer:**   * Security: user data must be protected through encryption, secure authentication, and compliance with data protection regulations |
| Online learning platform | **Sample answers:**   * Students and teachers can create accounts with personal information and login credentials * Teachers can create and publish courses with lessons, assignments, quizzes and resources | **Sample answer:**   * Performance: the platform should load quickly and handle concurrent user interactions without slowdowns |

## Social impacts and ethical and legal responsibilities in connecting people and systems

As a class, discuss the ways networking systems and social platforms help solve real-world problems in professional and social contexts.

**Activity 9:** take note of some examples in the space below.

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| **Sample answers:**  LinkedIn for professional networking, Slack for team collaboration, school communication platforms. |



**Activity 10:** complete a [Think, Pair, Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) activity about real-world problems related to networking and social connections.

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| **Sample answers:**  Challenges in remote collaboration, community engagement or networking for career growth. |

**Activity 11:** select one networking-related problem you believe **could be** solved with an enterprise information system that connects people and resources. Focus on breaking down the problem into manageable parts including:

* the primary objective of the system (for example, facilitating communication, supporting job seekers)
* the types of users (for example, students, professionals, community members)
* required steps for connecting users (for example, data collection, user authentication, content sharing).

You can document your findings as a concept map, table or any other appropriate format.

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| **Sample answer:**  **Problem**  A community organisation wants to create a platform to connect local volunteers with charities and non-profits that need assistance. Currently, these organisations struggle to find volunteers, and people interested in volunteering lack an easy way to discover local opportunities that match their skills and availability.  **Solution concept**  An enterprise information system called VolunteerConnect could connect people interested in volunteering with non-profits and charities that need help.  **Breakdown of the solution**  **Primary objective of the system**   * Facilitate communication between volunteers and organisations * Help volunteers find suitable opportunities based on skills, interests and location * Enable organisations to manage volunteer applications and communication   **Types of users**   * Volunteers: individuals looking to contribute to their community, who may have specific skills (for example, IT, teaching, medical aid) * Non-profit organisations: local charities, non-profits, and community groups in need of volunteers for specific events, ongoing roles, or projects * Administrators: community organisation staff managing the platform to ensure data accuracy and approve organisations or volunteer profiles   **Required steps for connecting users**   * Data collection: collect information on volunteers (skills, interests, location, availability) and non-profits (mission, volunteer needs, events) * User authentication: allow users to create accounts and verify identities, ensuring trusted connections * Content sharing: non-profits can post volunteer opportunities with details, and volunteers can browse or search for roles that match their preferences * Application process: volunteers can apply for roles directly through the platform, and organisations can accept or reject applications and communicate with applicants * Feedback and reviews: volunteers and organisations can leave feedback to improve future interactions and create a sense of accountability |

As a class, discuss examples where networking systems and social platforms have had both positive and negative impacts.

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| **Sample answers:**  Enhanced professional networking on LinkedIn versus privacy issues on social media. |

**Activity 12:** in groups, you will be assigned a different social networking or social platform.

Each group researches the following:

**Social impacts**

* How does the system impact communication and collaboration?
* Are there any drawbacks (for example, screen time, misinformation)?

**Ethical issues**

* How does the system handle user data and privacy?
* Are there transparency or bias concerns?

**Legal responsibilities**

* What laws (for example, data protection regulations) apply to this platform?

**Teacher note:** this could be completed as a [Think, Pair, Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) activity or simple a discussion after some research individually or collaboratively.

## Common network hardware for wired, wireless and mobile networks

**Activity 13:** research and complete the questions relating to the understanding the fundamental concepts of computer networks before moving into wired, wireless and mobile networks.

1. Define a ‘node’ in the context of a computer network.

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| **Sample answer:**  A node in a computer network is any device that is connected to the network and can send, receive, or forward information. Examples of nodes include computers, printers, routers and servers. |

1. Explain the concept of connections between nodes in a computer network. Outline the 2 main types of connections, provide an example of each.

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| **Sample answer:**  Connections between nodes in a computer network allow devices to share information. The 2 main types of connections are wired and wireless.   * Wired connection   This uses physical cables, such as Ethernet cables, to connect devices. For example, a computer connected to a router via an Ethernet cable.   * Wireless connection   This uses radio waves to connect devices without physical cables. For example, a smartphone connected to Wi-Fi. |

1. Define the different structures of a network including centralised, decentralised, distributed, mesh and star network.

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| **Sample answer:**   * Centralised network   All data and control flow through a single central node. Example: a server-client network where one server manages all devices.   * Decentralised network   Multiple central nodes exist, and each can manage its own group of devices. Example: peer-to-peer networks like file-sharing systems.   * Distributed network   Data and control are spread across all nodes, with no single point of failure. Example: blockchain networks.   * Mesh network   Every node is connected to several other nodes, creating multiple pathways for data. Example: smart home networks.   * Star network   All nodes are connected to a central hub or switch. Example: office networks where computers connect to a central server. |

1. What is meant by the term ‘topology’ in the context of computer networks? Describe the difference between a bus and star topology.

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| **Sample answer:**  **Topology** refers to the arrangement of nodes and connections in a computer network. It shows how devices are physically or logically linked.   * Bus topology   All nodes are connected to a single communication line, like a cable. Data is transmitted in both directions along this line. A failure in the main cable affects the entire network.   * Star topology   All nodes are connected to a central hub. If one connection fails, it doesn’t affect the others, but if the hub fails, the entire network stops working. |

1. What is a protocol? How are protocols related to communication in computer networks?

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| **Sample answer:**  A protocol is a set of rules and standards that define how data is transmitted and received in a network. Protocols ensure that devices can communicate and understand each other. For example, protocols manage tasks like formatting data, error checking, and deciding how data is sent. Without protocols, communication in computer networks would not work. |

1. Name 3 common protocols used in computer networks.

|  |
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| **Sample answer:**   * HTTP (Hypertext Transfer Protocol)   Used for accessing websites and transferring web pages.   * FTP (File Transfer Protocol)   Used to transfer files between computers on a network.   * TCP/IP (Transmission Control Protocol/Internet Protocol)   Ensures reliable communication and routing of data across networks like the internet. |



**Activity 14:** select a real-world social network (for example, a school, a sports team or a popular social media platform) and identify key people (nodes) and their connections (edges).

**Activity 15:** draw a graph to represent the network visually and discuss how the structure of each network affects communication or relationships (for example, a centralised versus decentralised network).

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**Activity 16:** imagine you are setting up a small home network with a computer, smartphone and a printer. Describe the possible connections between these nodes and propose a suitable topology for this network.

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| **Sample answers:**  **Possible connections**   1. Computer to router   The computer can connect to the home router using an Ethernet cable for a stable and high-speed connection. This wired connection is ideal for tasks that require reliable internet access, such as video streaming or online gaming.   1. Smartphone to router   The smartphone can connect to the same router via Wi-Fi. This wireless connection allows for mobility, enabling users to access the internet from anywhere within the range of the Wi-Fi signal.   1. Printer to router   The printer can also connect to the router in one of 2 ways:   * Wired connection   If the printer has an Ethernet port, it can be connected directly to the router using an Ethernet cable.   * Wireless connection   If the printer supports Wi-Fi, it can connect wirelessly to the router, allowing any device on the network to send print jobs to it.  **Proposed topology**  For this small home network, a **star topology** is the most suitable choice.  **Characteristics of star topology:**   * Central device: the router acts as the central hub, connecting all devices in the network. * Direct connections: each device (computer, smartphone, printer) connects directly to the router, allowing easy communication and troubleshooting. * Scalability: if additional devices need to be added in the future, such as more smartphones or tablets, they can easily connect to the router without disrupting the existing setup. |

### Case study: modernising power with the Smart Grid

The smart grid is a next-generation electricity distribution system designed to improve the efficiency, reliability, and sustainability of energy delivery. It integrates microcontrollers and other intelligent devices to monitor and manage electricity usage, creating a more adaptable and responsive power network.

**Microcontrollers – core network nodes**

Microcontrollers serve as the essential nodes within this network. Each microcontroller is a compact computer with a central processing unit (CPU), memory, timing elements, input/output options, and an analogue-to-digital converter (ADC). These devices play a central role in monitoring, controlling, and communicating within the grid infrastructure.

**Components using microcontrollers in the Smart Grid**

1. Smart meters

Smart meters, installed in homes and businesses, monitor and measure energy usage digitally. Equipped with microcontrollers and communication modules, these devices offer real-time insights into electricity consumption, allowing customers and utility companies to interact directly. This two-way communication enables utilities to manage demand effectively, provide accurate billing, and allow customers to adjust their usage patterns.

1. Distribution automation devices

Automation devices, integrated with microcontrollers, are key to maintaining an efficient distribution system. These devices control and monitor electricity flow, allowing for quick detection of faults. In case of an issue, these devices can isolate sections and restore power without manual intervention, thus improving reliability and reducing outage times.

1. Grid sensors

Grid sensors, fitted with microcontrollers, are placed throughout the electrical network to gather data on the grid’s health and stability. These sensors relay information to control centres, helping utilities identify potential issues, anticipate disruptions, and take preventive measures to ensure smooth grid operation.

**Data exchange and communication in the Smart Grid**

Communication networks play a vital role in linking microcontrollers across the grid. These networks may use wired connections, like power line communication (PLC) or wireless options such as Wi-Fi, cellular networks or dedicated radio frequencies. Through these connections, microcontrollers can transmit data and receive commands from centralised control systems. These control centres analyse data from various grid points, using algorithms to balance electricity supply and demand, optimise distribution, and support the integration of renewable energy sources.

**Cybersecurity in the Smart Grid**

With increased connectivity, the smart grid faces various cybersecurity risks, including unauthorised access, malware, and denial of service (DoS) attacks. Ensuring grid security is essential to avoid widespread disruptions, financial losses, and potential safety hazards. Protecting customer data is also crucial, as smart meters handle sensitive information regarding electricity usage. Key measures for cybersecurity include enforcing strict access controls, encrypting data, segmenting the network, deploying intrusion detection systems, conducting regular security audits, and providing cybersecurity training for employees.

**Activity 17:** answer a set of comprehension questions.

1. Define the role of microcontrollers in the smart grid and describe their components.

|  |
| --- |
| **Sample answer:**  Microcontrollers act as core nodes in the smart grid, enabling monitoring, control, and communication within the system. They help manage electricity flow and ensure the grid operates efficiently. A microcontroller consists of a central processing unit (CPU), memory, timing elements, input/output interfaces, and an analogue-to-digital converter (ADC). |

1. What functions do smart meters, distribution automation devices and grid sensors serve in the smart grid?

|  |
| --- |
| **Sample answer:**   * Smart meters measure and monitor energy usage in real-time, provide accurate billing and enable two-way communication between customers and utility companies. * Distribution automation devices control and monitor electricity flow, detect faults, isolate problem areas, and restore power automatically to enhance reliability. * Grid sensors collect data on grid stability and health, helping utilities identify and prevent potential issues. |

1. Explain the types of communication networks used within the smart grid and their purpose.

|  |
| --- |
| **Sample answer:**  Communication networks in the smart grid include wired options like power line communication (PLC) and wireless technologies such as Wi-Fi, cellular networks, and dedicated radio frequencies. These networks connect microcontrollers, allowing data exchange and remote management. They enable control centres to analyse grid data, balance supply and demand, optimise distribution, and integrate renewable energy sources. |

1. Identify potential cybersecurity threats to the smart grid and suggest strategies to mitigate these risks.

|  |
| --- |
| **Sample answer:**  Potential threats include unauthorised access, malware, and denial of service (DoS) attacks. To mitigate these risks, measures such as enforcing access controls, encrypting data, segmenting networks, deploying intrusion detection systems, conducting security audits, and providing staff cybersecurity training can be implemented. |

1. Discuss how protecting customer data is managed within a smart grid system.

|  |
| --- |
| **Sample answer:**  Protecting customer data involves implementing encryption to secure sensitive information, enforcing strict access controls to prevent unauthorised access, and conducting regular security audits to identify vulnerabilities. Additionally, utilities educate employees on data privacy and comply with regulations to ensure proper handling of customer information. |

## Common network security vulnerabilities and the mitigation strategies

**Activity 18:** complete the [Grok Academy – Monitoring and Securing Networks](https://groklearning.com/course/cyber-msn-2024/) course.

Students will learn about:

* how experts monitor their networks and protect them from external threats
* the tools cybersecurity professionals use to monitor system traffic
* the real-world tools and techniques employed to maintain network security
* insights from experts about their roles in the cybersecurity process.

### Network hardware

As a class, watch [The Internet: Wires, Cables & Wi-fi](https://youtu.be/ZhEf7e4kopM) (6:41).

**Activity 19:** research and complete the table below on common network hardware.

Table 3 – common network hardware

|  |  |  |
| --- | --- | --- |
| Name | Purpose in network connectivity | Image |
| Routers | **Sample answer:**   * Directs data between different networks, such as from a local area network (LAN) to the internet | A black router with three antennas. |
| Switches | **Sample answer:**   * Connects multiple devices within a local network (LAN), allowing communication between them * Manages data traffic efficiently by directing data only to the device that needs it | A close-up of a network switch. |
| Access points | **Sample answer:**   * Provides wireless connectivity to devices within a network, extending the range of Wi-Fi signals * Acts as a bridge between wired networks and wireless devices, enabling devices to join the network wirelessly | A white Wireless Access Point. |
| Network cables (Ethernet) | **Sample answer:**   * Physically connects devices to the network, providing stable and fast data transfer * Transmits data between devices and routers or switches in a wired network setup | A blue network cable. |
| Mobile network towers | **Sample answer:**   * Transmits wireless signals for mobile phones and devices, connecting them to the broader mobile network * Provides coverage for cellular data and voice communication over large geographical areas | A close-up of a mobile phone tower. |

## Features of graph theory to model computer networks

**Activity 20:** work in groups to create a network map that shows how devices are connected within a home or school. Include both wired and wireless elements for a realistic setup.

**Instructions**

1. Gather materials
2. Use blank paper and markers.
3. Draw or use icons for network components like routers, switches, access points, cables and mobile towers.
4. Plan your network
5. Decide if you’re mapping a home network or a school network.
6. Choose devices you want to include, like laptops, phones, desktop computers, printers and smart TVs.
7. Map out wired connections
8. Identify where routers, switches, and network cables (Ethernet) are needed.
9. Show devices connected with Ethernet cables (for example, desktop computers, printers).
10. Map out wireless connections
11. Place access points where devices will connect wirelessly, like laptops, tablets, or phones.
12. Draw lines or use Wi-Fi icons to show which devices connect to the access point.
13. Add mobile network elements
14. Show where mobile devices connect to mobile network towers (use icons or symbols for towers).
15. Draw arrows from mobile devices to the tower, representing cellular data connections.
16. Label each component
17. Clearly label each device and connection type on your map.
18. Indicate if the connection is wired (solid lines) or wireless (dotted lines or Wi-Fi icons).

**Discussion questions**

1. What purpose does each component serve in your network map? Write one sentence for each component.

|  |
| --- |
| **Sample answers:**  A school network setup including a router, switch, access point, network cables, desktop computers, laptops, tablets and a mobile tower for devices using cellular data.   * A router directs data between the school’s local network and the internet, ensuring that each device can access online resources. * A switch connects multiple wired devices (like desktop computers and printers) within the network, allowing them to communicate efficiently. * An access point provides Wi-Fi connectivity for wireless devices such as laptops and tablets within the school. * Network cables (Ethernet) connect desktop computers and printers to the network, providing a stable and high-speed connection. * A mobile tower allows mobile phones to connect to the network via cellular data, especially useful when Wi-Fi isn’t available. |

1. How do wired connections differ from wireless connections in terms of stability and speed?

|  |
| --- |
| **Sample answer:**  Wired connections are generally more stable and provide faster data transfer speeds because they are not affected by physical obstacles or interference, whereas wireless connections can be less stable due to distance from the access point, walls or other wireless networks causing interference. |

1. Why might certain devices (for example, printers or desktop computers) prefer a wired connection over wireless?

|  |
| --- |
| **Sample answer:**  Printers and desktop computers may prefer wired connections for their reliability and faster data speeds, especially when transferring large files or supporting multiple users in a school environment, as this reduces lag and minimises the risk of connection drops. |

**Extension question**

Identify one potential vulnerability in your network and suggest a way to protect against it.

|  |
| --- |
| **Sample answer:**  A vulnerability is that unsecured Wi-Fi access points could allow unauthorised users to connect to the school’s network, potentially accessing sensitive information or disrupting network services.  A mitigation strategy could be to secure the Wi-Fi network by enabling strong encryption (for example, Wi-Fi Protected Access (WPA3)), setting a complex password and restricting access to only authorised devices to ensure that only permitted users can connect. |

**Teacher note:** the activity could be extended to use a tool like Cisco Packet Tracer to allow students to ‘build’ a network, connect different devices and simulate wired and wireless connections, instead of doing it on paper.

The following courses may be used in the teaching of networks and IoT and can be used to extend students’ understanding:

* [Getting Started with Cisco Packet Tracer](https://skillsforall.com/course/getting-started-cisco-packet-tracer?courseLang=en-US) (2 hours)
* [Exploring Networking with Cisco Packet Tracer](https://skillsforall.com/course/exploring-networking-cisco-packet-tracer?courseLang=en-US) (3 hours)
* [Exploring Internet of Things with Cisco Packet Tracer](https://skillsforall.com/course/exploring-iot-cisco-packet-tracer?courseLang=en-US) (3 hours).

## Network security vulnerabilities and mitigation strategies

**Activity 21:** research and complete the table below on common vulnerabilities and mitigation strategies.

Table 4 – common vulnerabilities and mitigation strategies

|  |  |  |
| --- | --- | --- |
| Name | Vulnerability | Mitigation strategy |
| Weak passwords | **Sample answer:**  Weak passwords are easy for attackers to guess or crack, allowing unauthorised access to accounts and sensitive data. | **Sample answer:**  Use strong passwords that include a combination of uppercase and lowercase letters, numbers, and symbols, and avoid using common words or personal information. Enforce regular password changes and consider using a password manager. |
| Unencrypted data | **Sample answer:**  Data that is not encrypted can be intercepted and read by attackers, especially when transmitted over public networks. | **Sample answer:**  Enable encryption for data in transit (using HTTPS for web traffic) and for data stored on devices, to protect sensitive information from being accessed if intercepted or stolen. |
| Malware | **Sample answer:**  Malware, including viruses, spyware and ransomware, can damage devices, steal data, or give attackers control over systems. | **Sample answer:**  Install and regularly update antivirus software and anti-malware programs to detect and remove malicious software. Avoid downloading software from untrusted sources and educate users about phishing and other malware delivery tactics. |
| Unsecured Wi-Fi networks | **Sample answer:**  An unsecured Wi-Fi network can allow unauthorised users to access the network, which could lead to data theft or unauthorised activity on the network. | **Sample answer:**  Secure Wi-Fi networks by enabling WPA3 encryption, setting a strong password, and disabling public access. Consider hiding the network service set identifier (SSID) and limiting access to authorised devices only. |

**Activity 22:** research a specific vulnerability including 2 examples of incidents where this vulnerability was exploited and present their findings to class.

|  |
| --- |
| **Sample answer:**  **Weak passwords**  **Example incident:**  In 2012, LinkedIn experienced a major security breach due to weak passwords. Attackers accessed a database containing over 117 million LinkedIn user passwords. Many users had chosen simple passwords like ‘123456’ or ‘password’, which were easily cracked by hackers. The breach resulted in user data being sold online and highlighted the risks associated with weak passwords.  **Key findings:**   * **Why it happened:** many users relied on weak, common passwords that attackers could easily guess or crack using brute-force attacks. * **Impact:** the breach led to millions of compromised accounts, exposing users to identity theft and data leaks. * **Lesson learned:** this incident shows the importance of using strong, complex passwords. LinkedIn responded by enforcing stronger password policies and implementing two-factor authentication to increase account security. |

**Activity 22:** choose one of the scenarios below and create a network security plan using the information provided.

Table 5 – network security plan scenarios

|  |  |  |
| --- | --- | --- |
| Scenario | Potential threats | Objective |
| 1. Small accounting firm   A local accounting firm with 5 employees, handling sensitive financial data for clients. The firm uses cloud storage for documents and connects via a private Wi-Fi network. | * Weak passwords on employee accounts * Unsecured Wi-Fi allowing unauthorised access * Malware or ransomware targeting financial data | Create a security plan that addresses these vulnerabilities, including password policies, network encryption and antivirus protection. |
| 1. High school computer lab   A school computer lab used by students for research and projects, with desktop computers connected to a school network and internet access. | * Malware from student downloads or USB drives * Unauthorised access to sensitive school files * Software on lab computers that has not been regularly patched with security updates | Develop a plan to secure the lab environment, including antivirus installation, user access controls, and updating software regularly. |
| 1. Medical clinic   A small medical clinic with a few doctors and administrative staff, storing patient records electronically on a local server. Staff access records over the clinic’s private Wi-Fi network. | * Weak encryption on patient data storage * Potential for ransomware encrypting patient records * Phishing attacks targeting staff | Design a security plan that secures patient records through encryption, provides malware protection, and educates staff on phishing prevention. |
| 1. Graphic design studio   A team of graphic designers working in an open office with a mix of desktop and laptop computers, often transferring large design files over the network. | * Unencrypted data transfers that can be intercepted * Lack of access controls for confidential client files * Employees downloading files from untrusted sources, risking malware | Create a security plan that includes encryption for file transfers, access control for client data, and secure download policies. |
| 1. Online tutoring centre   A small business that provides online tutoring sessions. Tutors and students connect via a virtual classroom platform, and student records are stored on a cloud-based system. | * Weak passwords for tutor accounts, risking unauthorised access * Unsecured video sessions susceptible to ‘zoombombing’ or hacking * Data breaches exposing student information | Develop a security plan that strengthens account protection, secures video sessions and ensures student data privacy. |

## Understanding network architecture for smart homes

**Introduction to network architecture**

As a class, read [What does a network architect do?](https://www.careerexplorer.com/careers/network-architect/)

Facilitate a class discussion on the role of a network architect in designing systems that connect people and devices.

**Exploring smart home networks**

As a class, watch [What is a Smart Home or Smart Building? (1:30)](https://youtu.be/IC0mkHh7MaA?si=Tbo70zmXFoKbKOwG)

**Activity 23:** define the following smart home devices and how they communicate in a smart home network in the table below.

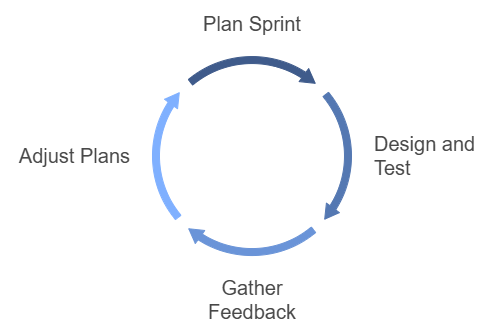
Table 6 – smart home devices

|  |  |  |
| --- | --- | --- |
| Feature | Definition | How it communicates |
| Smart lights | **Sample answer:**  Automated lighting systems that can be controlled remotely or programmed to change based on time or occupancy. | **Sample answer:**  Smart lighting typically communicates over Wi-Fi, allowing for integration with home networks and mobile apps. Some systems use Zigbee or Z-Wave, which are low-power wireless protocols designed for home automation, enabling devices to connect directly to a hub without needing a constant internet connection. |
| Thermostats | **Sample answer:**  A device that learns user preferences and adjusts heating and cooling systems automatically for energy efficiency. | **Sample answer:**  Smart thermostats connect via Wi-Fi to communicate with smartphones and other smart devices. They can also use Zigbee or Z-Wave for integration with home automation ecosystems, allowing them to receive commands and send data about temperature and energy usage. |
| Security cameras | **Sample answer:**  Cameras that provide real-time video feeds and alerts for monitoring home security. | **Sample answer:**  These cameras typically connect to home Wi-Fi networks, allowing users to access live feeds and recorded footage through mobile apps. Some models may use Ethernet for wired connections, providing a more stable connection for high-definition video streaming. |
| Smart door locks | **Sample answer:**  Keyless locks that can be controlled remotely, allowing for secure access and monitoring. | **Sample answer:**  Smart door locks usually operate over Bluetooth for local control and Wi-Fi for remote access. This allows users to lock or unlock doors via mobile apps and receive notifications about door status. |
| Smart doorbell | **Sample answer:**  A doorbell that includes a video camera and allows homeowners to see and communicate with visitors remotely. | **Sample answer:**  Smart doorbells connect to home Wi-Fi networks to stream video and audio to users' smartphones. They may also employ cloud services for storing video footage and sending notifications. |
| Smart appliances (for example, refrigerators, ovens) | **Sample answer:**  Household appliances that can be controlled remotely and provide status updates and alerts. | **Sample answer:**  Smart appliances connect to home Wi-Fi networks, enabling users to monitor and control them via mobile apps. They may also support protocols like Zigbee or Z-Wave for integration with other smart devices. |

## Iterative project management in network design

Iterative project management is a way of working on projects that focuses on making improvements step by step. In network architecture, this means using a method called Agile, where teams break their work into short cycles called sprints. During each sprint, the team designs and tests a part of the network. After each sprint, they gather feedback from users or stakeholders, which helps them understand what works well and what needs to be changed. This feedback loop allows teams to adjust their plans and make better decisions, leading to a network design that is more effective and meets the needs of smart home technologies. This approach helps ensure that the final product is practical and user-friendly.

Figure 3 – iterative network design cycle



**Activity 24:** explain the terms in the table below regarding network project management.

Table 7 – network project management terms

|  |  |
| --- | --- |
| Term | Role in network project management |
| Agile | **Sample answer:**  A way of managing projects that focuses on being flexible and responsive to change. Instead of planning everything at once, teams work in smaller steps, allowing them to adjust their plans based on what they learn as they go. This is especially helpful in network projects, where new ideas or challenges may come up. |
| Sprint | **Sample answer:**  A short, focused period of work, usually lasting 1–4 weeks, where a team works on specific tasks or features of a project. In network project management, each sprint allows the team to develop a part of the network, test it, and then move on to the next part. This helps keep the project moving forward and makes it easier to manage. |
| Feedback loop | **Sample answer:**  The process of getting input or opinions from users or team members after completing a sprint. This feedback helps the team understand what worked well and what didn’t. By using this information, the team can make improvements in the next sprint, ensuring that the project better meets the needs of users and stays on track. |

**Activity 25:** complete a[Think, Pair, Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) activity.

* **Think** about how you would define the following in your own words: authentication and authorisation.
* **Pair** with the person next to you, how do your definitions differ?
* **Share** and report your definitions to the class.

Discuss the importance of access control in smart home networks.

**Activity 26:** research and answer the following questions.

1. Define firewalls and explain their importance in protecting networks.

|  |
| --- |
| **Sample answer:**  Firewalls are security devices or software that monitor and control incoming and outgoing network traffic based on predetermined rules. They act as a barrier between a trusted internal network and untrusted external networks, such as the internet. Firewalls are important because they prevent unauthorised access, block malicious traffic and help protect networks from attacks like malware and hacking attempts. |

1. Define encryption and explain its role in securing data transmission.

|  |
| --- |
| **Sample answer:**  Encryption is a method of converting data into a coded format to prevent unauthorised access during transmission. It ensures that only authorised parties with the correct decryption key can read the information. Encryption is crucial for securing data transmission as it protects sensitive information, such as passwords and personal details, from being intercepted by cybercriminals. |

1. Describe common threats to smart home networks and suggest how they can be mitigated.

|  |
| --- |
| **Sample answer:**  Common threats to smart home networks include unauthorised access, malware attacks and weak passwords. These can compromise connected devices like cameras or smart locks. Mitigation strategies include:   * using strong, unique passwords for each device * keeping devices and software updated with the latest security patches * installing firewalls to filter traffic * enabling encryption for wireless networks * regularly monitoring connected devices for suspicious activity. |

**Activity 27:** smart home network diagram

Using an online tool like [Lucidchart](https://www.lucidchart.com/pages/), or hand drawn on paper, create a network diagram that illustrates the connections between various smart home devices and how they communicate within the network.

1. **Choose your smart home devices**

Select at least 5 different smart home devices, plus a smart hub to include in your diagram. Make sure to consider a variety of types to show how they work together.

1. **List of required components**

Ensure your diagram includes the following components:

* smart hub: this is the central device that connects and communicates with all other smart devices
* smart lighting: include at least one smart light bulb or lighting system
* smart thermostat: represent a device that controls heating and cooling
* smart security camera: show a camera that monitors the home for security purposes
* smart door lock: include a keyless entry system to demonstrate home security
* smart doorbell: add a video doorbell that allows communication with visitors
* smart appliance: choose one smart appliance (for example, refrigerator, washing machine) to illustrate the integration of everyday devices
* internet connection: clearly indicate how the entire system connects to the internet (for example, via wi-fi)
* communication protocols: label the communication methods used between devices (for example, Wi-Fi, Zigbee, Z-Wave).

1. **Draw the diagram**
2. Start by placing the smart hub in the centre of your diagram.
3. Draw lines to connect the smart hub to each of the other devices you have chosen.
4. Use arrows to indicate the direction of communication if necessary (for example, if a device sends data to the hub).
5. Clearly label each device and the type of communication protocol used for each connection.
6. **Add details**

* Include any additional features you think are relevant, such as the power source for devices or any sensors they may have (for example, motion sensors for security cameras)
* Make sure your diagram is neat and easy to read
* Use different colours or shapes to differentiate between types of devices or communication methods

## Case study: Google Nest

Google Nest is a smart home product line that includes devices like smart thermostats, security cameras, smoke detectors and doorbells. To provide users with a seamless experience and valuable insights, Google employs advanced database management techniques using SQL queries to analyse and manage the vast amounts of data generated by these devices.

Through effective data management and analysis using SQL techniques, Google Nest not only improves user experience with personalised insights but also optimises device performance. This data-driven approach helps users make informed decisions about their smart home systems, ultimately leading to increased satisfaction and energy efficiency.

**Teacher note:** many applications running on Compute Engine, App Engine and other services in Google Cloud use Cloud SQL for database storage. SQL is still widely used for querying relational databases, where data is stored in rows and tables that are linked in various ways. One table record may link to one other or to many others, or many table records may be related to many records in another table.

**Data collection and storage**

Every Google Nest device collects data continuously. For instance, the Nest Thermostat monitors temperature settings, energy usage, and user preferences. This data is sent to Google’s cloud database, where it is stored and organised. The database can contain millions of records, including historical temperatures, user interactions and device statuses.

**Using database queries**

We will examine how SQL (Structured Query Language) can be used to filter, sort, and analyse this data.

Here are some ways they apply specific SQL techniques.

1. SELECT clause

To retrieve specific data points, such as the average temperature over a week or the highest energy usage recorded in a month, using the SELECT clause. For example, a query might be:

SELECT AVG(temperature)

FROM ThermostatData

WHERE date BETWEEN '2023-01-10' AND '2023-07-10'

1. WHERE clause

The WHERE clause helps filter data to focus on specific conditions. For instance, if a user wants to see how often their thermostat was set to ‘Eco Mode’, you can run a query like:

SELECT \*

FROM ThermostatData

WHERE mode = 'Eco'

1. ORDER BY clause

By using the ORDER BY clause, you can sort the data to highlight trends. For example, sorting energy usage data from highest to lowest helps identify peak usage times:

SELECT energy\_usage

FROM EnergyData ORDER BY energy\_usage DESC

1. LIMIT clause

The LIMIT clause allows you to restrict the number of results returned by a query. This is useful for generating reports, such as displaying the top 5 days with the highest energy consumption:

SELECT \*

FROM EnergyData ORDER BY energy\_usage DESC LIMIT 5

**Insights and UX**

By analysing the data collected from Google Nest devices using these SQL techniques, you can provide valuable insights to users. For example, users receive personalised reports that show how their heating and cooling habits affect energy usage and costs. They might receive notifications about unusual activity detected by their security cameras, or reminders to change the battery in their smoke detectors.

Additionally, the company can use this data to improve device functionality through machine learning. For example, if data shows that users frequently adjust their thermostat settings at certain times of day, the Nest Thermostat can learn these patterns and begin to adjust itself automatically, enhancing user convenience and comfort.

**Activity 28:** case study questions

Reflect on the case study information and provide answers to the following questions:

1. What types of devices are included in the Google Nest product line?

|  |
| --- |
| **Sample answer:**  Google Nest includes devices like smart thermostats, security cameras, smoke detectors and doorbells. |

1. How does the Nest Thermostat collect and use data? Provide 2 examples.

|  |
| --- |
| **Sample answer:**  The Nest Thermostat collects data on temperature settings and energy usage. For example, it monitors how often the user adjusts the temperature and records energy consumption patterns. |

1. What is SQL, and why is it important?

|  |
| --- |
| **Sample answer:**  SQL (Structured Query Language) is a programming language used to manage and manipulate databases. It is important when used to filter, sort, and analyse the vast amounts of data collected from devices. |

1. Explain how the SELECT clause is used in SQL queries with an example from the case study.

|  |
| --- |
| **Sample answer:**  The SELECT clause is used to retrieve specific data points from a database. For example, the query SELECT AVG(temperature) FROM ThermostatData WHERE date BETWEEN '2023-01-10' AND '2023-07-10' retrieves the average temperature recorded during the first week of October 2023. |

1. How does the ORDER BY clause analyse energy usage data?

|  |
| --- |
| **Sample answer:**  The ORDER BY clause is used to sort energy usage data from highest to lowest. For instance, the query SELECT energy\_usage FROM EnergyData ORDER BY energy\_usage DESC helps identify peak usage times. |

1. What insights can users gain from the data collected by Google Nest devices? Provide 2 examples.

|  |
| --- |
| **Sample answer:**  Users can gain insights such as personalised reports on their heating and cooling habits, showing how these habits affect energy usage and costs. Additionally, they may receive notifications about unusual activity detected by their security cameras. |

**Activity 29:** fill in the blanks

Complete the sentences using the terms from the word bank.

**Word bank:** (WHERE, SELECT, ORDER BY, storage, LIMIT)

Google Nest devices continuously collect data, which is sent to Google’s cloud database for \_\_\_\_\_\_\_\_\_\_.

The \_\_\_\_\_\_\_\_\_\_ clause allows Google to retrieve specific data points from the database.

To filter results based on certain conditions, Google uses the \_\_\_\_\_\_\_\_\_\_ clause in its queries.

By applying the \_\_\_\_\_\_\_\_\_\_ clause, Google can sort data to identify trends in energy usage.

The \_\_\_\_\_\_\_\_\_\_ clause is useful for limiting the number of results returned by a query.

|  |
| --- |
| **Sample answer:**  Google Nest devices continuously collect data, which is sent to Google’s cloud database for **storage**.  The **SELECT** clause allows Google to retrieve specific data points from the database.  To filter results based on certain conditions, Google uses the **WHERE** clause in its queries.  By applying the **ORDER BY** clause, Google can sort data to identify trends in energy usage.  The **LIMIT** clause is useful for limiting the number of results returned by a query. |

**Activity 30:** true or false

Read each statement and write true or false.

1. Google Nest devices do not collect data continuously.
2. The LIMIT clause can be used to display only the top 5 days with the highest energy consumption.
3. SQL is used exclusively for data entry, not for data analysis.
4. Users receive notifications about unusual activity based on the data collected from their security cameras.
5. The ORDER BY clause can be used to sort data alphabetically only.

|  |
| --- |
| **Sample answers:**   1. Google Nest devices do not collect data continuously. **False** 2. The LIMIT clause can be used to display only the top 5 days with the highest energy consumption. **True** 3. SQL is used exclusively for data entry, not for data analysis. **False** 4. Users receive notifications about unusual activity based on the data collected from their security cameras. **True** 5. The ORDER BY clause can be used to sort data alphabetically only. **False** |

**Activity 31:** practical application scenario

Write an SQL query to find the average energy usage during a specific month.

Include the following details in your response:

1. The SQL query you would write.
2. A brief explanation of what the query does.

|  |
| --- |
| **Sample answer:**   1. SELECT AVG(energy\_usage) FROM EnergyData WHERE month = '10-2023' 2. This query calculates the average energy usage recorded in the month of October 2023 by filtering the EnergyData table based on the specified month. |

## Model entities, events and relationships within a network

As a class discuss what is a social network, entities, relationships and events?

**Activity 32:** describe a social network, entities, relationships and events.

|  |
| --- |
| **Sample answer:**  A **social network** is a structure that allows people to connect and interact with each other. In this era, the term social network is almost exclusively used to describe the digital platforms that use the Internet and web to facilitate these connections. Examples of popular social networks include Facebook, Instagram, Snapchat, YouTube, LinkedIn and Pinterest.  An **entity** in a social network is typically a person, group or organisation that has a presence. In digital social networks entities are typically identified by their username, profile image and profile information. Entities can join groups, post content, comment on posts and interact with other entities within the network. They can also form relationships with other entities and follow or be followed by them.  A **relationship** in a social network refers to a connection or association between 2 or more individuals within the network. This connection can be based on various factors such as shared interests, common affiliations, personal interactions or even online engagement. Relationships can be categorised in many ways, such as friends, family, acquaintances, followers or colleagues, depending on the nature and depth of the connection.  In a network an **event** typically refers to a significant occurrence or activity that takes place within the network. An event can be initiated by an individual or other entity within the network and may involve interactions, changes or updates that affect the network or its members. Examples of events in a network can include a new member joining the network, a group discussion taking place, a message being sent or received, a post being shared, a comment being made, a like or dislike being registered or any other activity that involves engagement or participation within the network. |

## Sociograms

A sociogram is a visual representation of the relationships in a social network.

A sociogram model can be used to identify key individuals or groups within the network

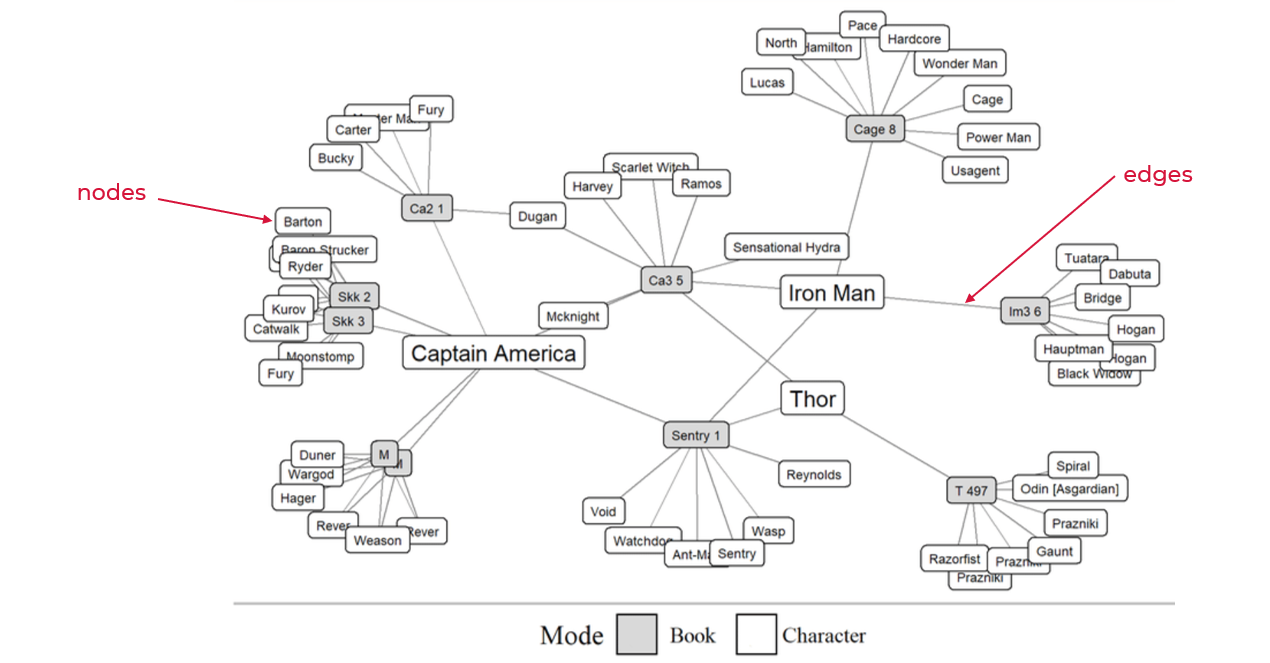
For example, counting the number of relationships (edges) a member (node) has may indicate their importance or influence they have upon this network

This can be used to help understand how information, ideas, and resources flow through the network.

**What is a sociogram model?**

* A sociogram model is a visual representation and analysis tool used to study social relationships within a group or community.
* It was initially developed by psychologist Jacob L. Moreno in the 1930s as a part of his sociometry theory.
* The sociogram model has undergone various developments and applications over the years, and its evaluation would depend on its specific use case and context.

Figure 4 – sociogram of character-book ties within 10 comic books of the Marvel Universe collaboration network



‘[BiRank: Fast and Flexible Ranking on Bipartite Networks with R and Python](https://www.researchgate.net/figure/Sociogram-of-character-book-ties-within-10-comic-books-of-the-Marvel-Universe_fig2_342860839)’ by [Yang et al.](https://www.researchgate.net/figure/Sociogram-of-character-book-ties-within-10-comic-books-of-the-Marvel-Universe_fig2_342860839/actions#reference) is licensed under [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/).

**Activity 33:** use [EdrawMax](https://www.edrawmax.com/online-sociogram-maker.html) to create a sociogram following the instructions below.

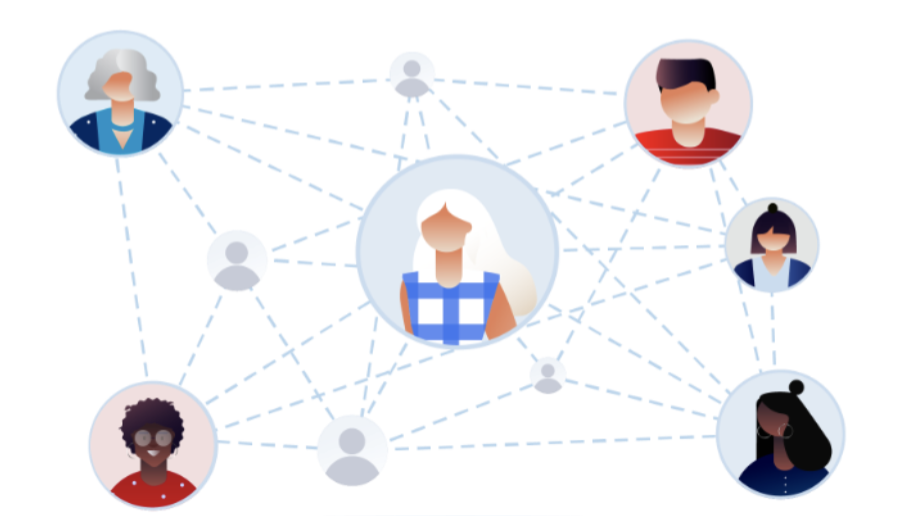
**Instructions**

1. Draw a circle in the centre to represent yourself.
2. Draw other circles around the centre to represent friends, family, classmates and so on.
3. Connect the circles with lines to show your relationships (for example, friends, family).
4. Label the lines with the type of relationship (for example, friend, sibling).

**Example**

* Centre: you
* Surrounding circles: mum, dad, best friend, teacher, classmate
* Lines: friend, family, teacher-student

Figure 5 - sociogram example



Calculate node degree and paths between nodes

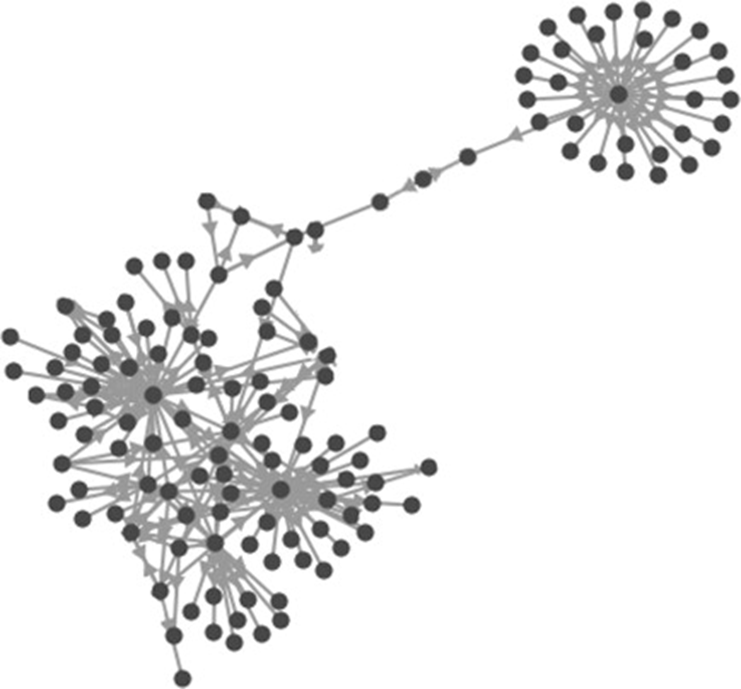
Node degree and paths between nodes are fundamental measures in analysing social networks as graphs.

The node degree represents the number of connections of each node, indicating its centrality within the network.

Paths between nodes help understand the flow of communication, identify influential individuals, and evaluate the efficiency of information dissemination within the social network.

Both metrics play a crucial role in uncovering the underlying structure and dynamics of social relationships in a graph representation.

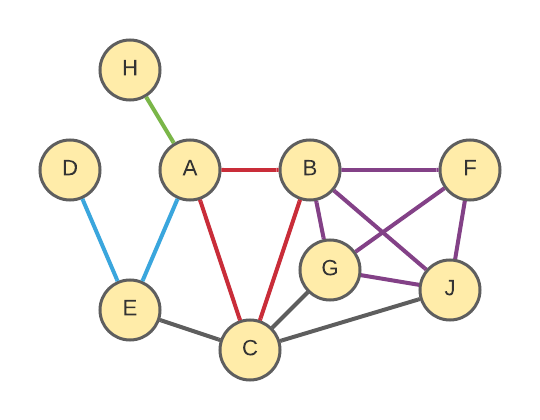
Figure 6 – node degree



**What is node degree?**

* The node degree is the number of edges connected to a node in the graph.
* To calculate the node degree for each node in an undirected graph, you simply count the number of edges connected to each node.
* In a directed graph, you count the incoming edges for indegree and the outgoing edges for outdegree.
* The degree of a node is a measure of its **centrality** within the network. Nodes with a higher degree are more connected and often play more critical roles in **transmitting information** or **influencing the flow** of communication within the network.
* In social networks, nodes with high degrees may represent influential individuals or hubs of communication.

Figure 7 – paths



**What are paths?**

* A path between 2 nodes in a graph is a sequence of edges that connects them.
* The length of a path is the number of edges it contains. For example, if node A is connected to node B, which is connected to node C, there is a path of length 2 from A to C (A > B > C).
* Paths between nodes can be analysed to understand how information or influence spreads through the social network.
* Longer paths may indicate a less direct or efficient flow of communication, while shorter paths can signify direct and strong connections.
* The shortest path between 2 nodes is of particular interest and is commonly known as the ‘shortest path length’. This metric is essential in understanding how closely connected 2 individuals are in a social network.
* ‘shortest path length’ helps identify potential influencers or key intermediaries who can efficiently disseminate information or influence the behaviour of others.

**Activity 34:** examine the sociogram you created in the previous activity. Calculate the node degree and paths between nodes and explain their meaning.

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**Activity 35:** modelling a school computer network

A school computer network has the following requirements:

1. There are 5 computers, 2 printers, one server, and one switch.
2. Every computer should be connected to the switch.
3. The printers should be accessible by all computers via the switch.
4. The server should connect to the switch for data access.

**Represent the network as a graph**

Draw nodes for each device:

* Switch (Sw) in the centre
* Computers (C1, C2, C3, C4, C5) around it
* Printers (P1, P2) and Server (Se) connected to the Switch.

Connect the nodes using edges based on the requirements.

**Analyse the graph**

Examine the degree of nodes and count the connections for each node.

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| **Sample answer:**  The switch (Sw) has a degree of 8 (connected to 5 computers, 2 printers, and 1 server).  Each computer has a degree of 1 (connected to the switch). |

Discuss the shortest path for data transfer.

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| **Sample answer:**  To print a file from C1 to P1, the shortest path is C1 → Sw → P1. |

**Optimise the network**

What happens if the router fails? (Discuss redundancy, such as adding a second router.)

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| **Sample answer:**  If the router fails, all devices connected to it lose network access, disrupting communication, internet services and internal system operations. In a single-router setup, this can cause complete downtime until the router is replaced or repaired.  To prevent this, organisations implement network redundancy by:   * adding a second router (failover redundancy) to ensure continuous network availability with minimal disruption * using load balancing routers which distributes traffic across multiple routers to prevent overload and failure * implementing mesh networking so multiple interconnected routers reroute traffic dynamically to maintain connectivity. |

**Create variations**

Design alternative network layouts, such as:

* a mesh network where some computers connect directly to each other
* a hierarchical network with multiple routers.

## Responsible use of social networks

**Activity 36:** [brainstorm](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/542?clearCache=3d32c820-442f-7d68-d3ca-b2add7a710e8) and list 3 tips for using social networks responsibly and explain why they are important.

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| **Sample answer:**  **Protect your privacy tip**  Regularly review and adjust your privacy settings on social media platforms. Be mindful of what personal information you share publicly.  **Importance**  Protecting your privacy helps safeguard your personal information from potential misuse. It reduces the risk of identity theft, harassment and unwanted attention. Being cautious about what you share can also help maintain your professional reputation, especially in educational settings.  **Think before you post tip**  Before sharing content, consider how it may be perceived by others and the potential consequences. Ask yourself if it aligns with your values and the standards of professionalism expected in your role.  **Importance**  This practice promotes thoughtful communication and can prevent misunderstandings or conflicts. Posts can be permanent and widely shared, so taking a moment to reflect can help avoid damaging your reputation or the reputation of your workplace.  **Engage respectfully tip**  When interacting with others on social networks, practice kindness and respect. Avoid engaging in negative discussions or arguments and be mindful of the tone of your comments.  **Importance**  Respectful engagement fosters a positive online community and sets a good example for students and peers. It helps to create a supportive environment that encourages constructive dialogue rather than conflict, which is particularly important in educational contexts. |

## Explore network and social connections considering the perspectives of diverse groups

**Aboriginal and/or Torres Strait Islander kinship connections**

Graph theory is a valuable tool for understanding the complex relationships and cultural practices within Aboriginal and/or Torres Strait Islandercommunities. By mapping out kinship, social interactions and Country, researchers can gain a better understanding of the intricate systems that are essential to many Aboriginal and/or Torres Strait Islander cultures.

**Understanding relationships in First Nations communities**

Aboriginal and/or Torres Strait Islander kinship is a system that describes how people are connected and interact with each other in Aboriginal and/or Torres Strait Islander communities across Australia. It involves complex relationships between individuals, families, and the community as a whole. Kinship helps define everyone’s roles and responsibilities, guiding how people treat one another and how they share resources and duties. This system includes both biological relationships, like family ties, and non-biological ones, such as those formed through marriage or adoption. Kinship is a vital part of Aboriginal and/or Torres Strait Islander culture and history, influencing their social values and ways of living.

**Kinship connections as a social network**

In Aboriginal and/or Torres Strait Islander communities, kinship connections represent a type of social network that does not rely on technology. These connections are an essential part of many Aboriginal and/or Torres Strait Islander cultures and are often very detailed and complex, with specific roles and responsibilities for each person. Researchers have used graph theory, a method for analysing relationships, to better understand these important cultural networks.

**Exploring kinship networks**

One-way researchers have studied kinship networks is through graph theory, which helps visualise and analyse how individuals are connected. For example, a study focused on the Yanyuwa people in northern Australia mapped out their intricate relationships. The findings showed that the Yanyuwa kinship system was highly interconnected, highlighting the importance of mutual support and shared responsibilities among community members.

**Studying social networks**

Graph theory has also been used to look at the social networks within Aboriginal and/or Torres Strait Islander communities. In a study of the Warlpiri people in Central Australia, researchers examined how community board members interacted with one another. They discovered that the Warlpiri social network had clusters of relationships, with certain individuals playing key roles and having a significant influence on the community.

**Land management and cultural identity**

Researchers have applied graph theory to explore how Aboriginal and/or Torres Strait Islander people manage their land. In one study, they analysed the networks of Aboriginal rangers responsible for looking after natural resources on their traditional lands. The results showed that the rangers' connections were deeply tied to their cultural identity and values, and these relationships were crucial for successful land management.

**Activity 37:** understanding kinship through storytelling

Start by watching an Aboriginal and/or Torres Strait Islander story, for example, [Tiddalik the Frog (6:07)](https://www.youtube.com/watch?v=bs-qUWomHtM).

Read how the [Awabakal](https://awabakallanguage.org.au/tiddalik-the-greedy-frog) people connect to the story.

1. Who are the main characters in the story?

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| **Sample answer:**  The main characters in Tiddalik the Frog are Tiddalik, a very thirsty frog and various animals such as the kangaroo, the emu, the snake and the platypus. Each animal plays a role in trying to resolve Tiddalik's problem of drinking all the water in the land. |

1. What is the central problem or conflict in the story?

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| **Sample answer:**  The central problem in the story is that Tiddalik drinks all the water from the rivers and ponds, causing a severe drought. This creates a conflict because the other animals in the land are suffering due to the lack of water, which affects their survival and wellbeing. |

1. How do the characters demonstrate the importance of kinship and relationships?

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| **Sample answer:**  The characters demonstrate the importance of kinship and relationships by working together to find a solution to the drought caused by Tiddalik. The animals collaborate and come up with a plan to make Tiddalik laugh, hoping that he will spit out the water he has consumed. This shows their interconnectedness and the value of supporting one another in times of crisis. |

1. What lesson or moral does the story convey about community and sharing?

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| **Sample answer:**  The moral of the story conveys the importance of community and sharing resources. It teaches that when individuals take more than they need, it can negatively impact the entire community. The story encourages cooperation and the idea that everyone must work together to ensure that resources, like water, are shared fairly among all. |

1. Can you identify any specific cultural elements or symbols represented in the story?

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| **Sample answer:**  One specific cultural element in Tiddalik the Frog is the representation of animals that hold significant roles in Aboriginal culture. The story symbolises the relationship between humans and nature, highlighting the responsibility to care for the environment. Tiddalik himself can be seen as a symbol of excess and the consequences of not sharing, which reflects broader cultural values around sustainability and community well-being in Aboriginal cultures. |

**Activity 38:** cloze passage

Fill in the blanks using words from the word bank provided below.

**Word bank: kinship, community, relationships, sharing, responsibility**

In Aboriginal and/or Torres Strait Islander cultures, stories often highlight the importance of \_\_\_\_\_\_\_\_\_\_. These stories demonstrate how individuals within a \_\_\_\_\_\_\_\_\_\_ work together to solve problems. For example, in Tiddalik the Frog, the animals must learn to cooperate and practise \_\_\_\_\_\_\_\_\_\_ to restore water to their land. Kinship ties define the \_\_\_\_\_\_\_\_\_\_ of each character, showing how they support one another in times of need. Through storytelling, cultural values are passed down, reinforcing the significance of \_\_\_\_\_\_\_\_\_\_ among families and communities.

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| **Sample answer:**  In Aboriginal and/or Torres Strait Islander cultures, stories often highlight the importance of **kinship**. These stories demonstrate how individuals within a **community** work together to solve problems. In Tiddalik the Frog, the animals must learn to cooperate and practise **sharing** to restore water to their land. Kinship ties define the **responsibility** of each character, showing how they support one another in times of need. Through storytelling, cultural values are passed down, reinforcing the significance of **relationships** among families and communities. |

**Activity 39:** research task – kinship storytelling

Now that you have explored a story and its meaning, choose one of the following tasks to research:

1. **Story analysis**

Select one of the following stories:

**The Rainbow Serpent**

This is one of the most well-known Aboriginal stories that varies across different communities. It often emphasises the connection between the land, water, and its people, highlighting the importance of kinship ties and the relationships between families and their environment. The Rainbow Serpent is also a symbol of creation and nurturing, representing the interconnectedness of all living things.

**The Emu and the Jabiru**

This story features an emu and a jabiru (a type of stork) who are friends. They go on a journey together, highlighting the importance of friendship and kinship bonds. The story teaches lessons about loyalty, support and the strength of community relationships.

**The Two Brothers**

This story tells of 2 brothers who embark on a journey and face various challenges together. Their relationship and the bonds of brotherhood are central to the narrative, illustrating themes of loyalty, conflict resolution and the significance of family ties.

Research and write a one-page analysis that includes:

* a summary of the story
* an exploration of the kinship themes within the story
* how the characters demonstrate their relationships and responsibilities to one another
* the cultural significance of the story within Aboriginal culture.

1. **Create your own kinship story**

Inspired by the stories you have read, write your own original story that highlights kinship and relationships. In your story:

* **include characters that represent different roles within a family or community**
* **illustrate a problem that the characters must solve together, showcasing their relationships and responsibilities**
* **conclude with a moral or lesson that reflects the importance of kinship.**

1. **Visual representation**

Create a digital visual poster or comic strip that illustrates one of the stories. Make sure to include:

* key scenes that highlight kinship and relationships
* descriptions of how the characters interact and support one another
* a brief summary of the story's lesson or moral.

## Creating a smart home network model

Figure 8 – smart home model

A small house with a red roof that houses a micro:bit and emulates a smart home.


**Teacher note:** students can learn to use and code the BBC micro:bit v2 with [Microsoft MakeCode](https://makecode.microbit.org/) which has many instructional videos and tutorials and software to interface with the microcontroller.

The [stem.T4L Learning Library](https://schoolsnsw.sharepoint.com/sites/STEMShareLibrary/SitePages/MC-Kit.aspx) has resources for Stage 3 and Stage 4 that your students may have completed. The Microcontroller Unit (MCU) is available for all department schools to borrow. This could be coupled with the Elecfreaks Smart Home kits which need a BCC micro:bit v2 to operate.

Suppliers have products available for purchase such as [ELECFREAKS Smart Home Material Pack](https://littlebirdelectronics.com.au/products/elecfreaks-smart-home-material-pack?_pos=1&_sid=a5f5a5586&_ss=r) and [ELECFREAKS Classroom Smart Home Kit](https://littlebirdelectronics.com.au/products/elecfreaks-classroom-smart-home-kit?_pos=17&_sid=a5f5a5586&_ss=r) that work with the [BBC micro:bit v2 Board](https://littlebirdelectronics.com.au/products/micro-bit-v2-board-1588b60b-2f74-47ed-945a-fcac1f01a808?_pos=11&_sid=d1f6ea145&_ss=r) (as pictured above).

In addition to the booklet that comes with the ELECFREAKS product, there is an [ELECFREAKS Wiki](https://www.elecfreaks.com/learn-en/microbitKit/smart_home_kit/smart_home_kit.html) which unpacks the steps involved in developing the Smart Home material pack and classroom kit.

# Supporting documentation scaffold

## Initial research and theme selection

Investigate an existing smart home product as inspiration. Summarise the chosen system's name, purpose, users, inputs, processes, storage and outputs.

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| --- | --- |
| Smart home product component | Summary |
| System name |  |
| Purpose |  |
| Users |  |
| Inputs |  |
| Processes |  |
| Storage |  |
| Outputs |  |

## Develop the purpose

Choose a purpose for the smart home (for example, energy efficiency, home security, health, entertainment, accessibility or productivity).

Identify features and functions related to the theme, brainstorming potential automated processes.

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| --- | --- | --- | --- |
| Steps | Instructions | Example/guidance | Answer |
| 1. Choose a purpose | Select a main focus for your smart home model, such as energy efficiency, home security, health, entertainment, accessibility or productivity. | Example: for *energy efficiency*, your network could aim to reduce energy consumption through automated lighting or temperature adjustments. |  |
| 2. Identify features and functions | List at least 3 key features that support your chosen purpose. For each feature, brainstorm possible automated processes. | Example: for *security*:   * automated locks * motion-detecting lights * remote surveillance access. | 1.  2.  3. |
| 3. Brainstorm benefits | Explain why these features are important. Consider benefits like improved quality of life, cost savings or environmental impact. | Example: automated lighting saves energy by turning lights off when not in use, reducing energy costs. |  |
| 4. Summarise purpose | Write a summary describing the overall purpose and features of your smart home. | Example: the purpose of this smart home is to enhance home security through automated locks, motion-sensor lights and remote surveillance, providing peace of mind and protection for residents. |  |

## Define functional requirements

Detail how the chosen functions will work within the smart home model and define the role of each component in the network.

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| Task description | Instructions | Answer |
| Automated functions | Identify the 3 automated functions you plan to implement in your smart home model that align with your chosen purpose. | 1.  2.  3. |
| Define nodes and functions | For each automated function, specify the nodes involved (for example sensors, cameras, lights) and describe their roles and the type of data they will communicate. |  |
| Explain data communication | Describe how data will flow between nodes in each function. Identify any data processing needed for actions (for example sensor data to microcontroller to activate response). |  |
| Outline manual process replacement | Briefly describe the manual process each function automates and how automation benefits the system. |  |
| Identify security considerations | Address potential security issues for each function, such as data protection or access controls, to maintain privacy and integrity in the network. |  |

## Project requirements and non-functional constraints

Address potential issues impacting project development, such as time, resources and budget constraints.

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| Task description | Instructions | Example/guidance | Answer |
| Identify time constraints | Describe any time limitations that may affect project completion. | Example: limited time for testing could impact how thoroughly each automated function is evaluated before the final presentation. |  |
| Consider resources constraints | List the resources available and note any limitations, such as availability of specific equipment or technical support. | Example: limited access to advanced sensors may require you to use basic models, potentially impacting the accuracy of automated functions. |  |
| Assess budget constraints | Outline your budget and determine if any desired components are too costly, requiring alternatives or simplifications. | Example: a low budget restricts you from using high-quality actuators, so you may use basic motors instead for automated door locks. |  |
| Plan for potential issues | Identify any foreseeable issues with development, such as potential technical difficulties or limited expertise in specific areas. | Example: limited knowledge of programming might lead to challenges in coding the microcontroller for specific automation functions. |  |

## Sketch and model a network

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| Steps | Process |
| 1. Create physical model sketch | Draw a labelled sketch of your smart home model, clearly showing all components and their positions. Include the layout of rooms or areas that require devices. |
| 1. Label components | Label each component in your sketch (for example, sensors, microcontrollers, lights) with its function and placement, indicating how it contributes to your purpose. |
| 1. Create a network diagram | Use a diagram format (such as flowchart symbols) to show the network’s arrangement, displaying connections between devices and data flow pathways. |
| 1. Define connections and dependencies | For each connection, note how components interact, including dependencies where one device relies on data or action from another. |
| 1. Ensure diagram completeness | Review your sketch and network diagram to ensure all necessary components and connections are represented clearly and consistently. |

## Research and define network

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| Steps | Instructions | Example/guidance | Answer |
| 1. Research compatible technologies | Investigate technologies compatible with the microcontroller that can collect inputs (for example sensors) and perform outputs (for example lights or alarms) suitable for your model. | Example: research different types of motion sensors and lighting actuators compatible with your microcontroller, considering factors like energy use and reliability. |  |
| 1. List required components | Based on your research, compile a list of all components needed to build your smart home model, including sensors, actuators, wiring and other essentials. | Example: list of required components:   * PIR motion sensor * LED lights * buzzer alarm * jumper wires * breadboard |  |
| 1. Justify component choices | For each component on your list, explain why it was chosen and how it aligns with your smart home’s purpose and functional requirements. | Example: PIR motion sensor was chosen for its reliability and low power consumption, aligning with energy-efficient objectives and functional needs for detecting movement. |  |
| 1. Identify data and power needs | Describe any data or power requirements for each component, including voltage or wiring needs to ensure proper functioning within the network. | Describe any data or power requirements for each component, including voltage or wiring needs to ensure proper functioning within the network. |  |
| 1. Evaluate feasibility | Review your list of components and network setup to assess feasibility based on constraints (for example budget, availability) and make any necessary adjustments. | Example: If budget constraints exist, consider substituting a different sensor or eliminating an optional feature that isn’t essential to the main purpose. |  |

## Reflection

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| Steps | Instructions | Example/guidance | Answer |
| 1. Summarise project goals | Briefly restate the main purpose of your smart home project, including the automated functions and how they align with the overall purpose. | Example: the smart home model aimed to enhance security by automating door locks, motion-triggered lights and remote monitoring. |  |
| 1. Describe key challenges | Identify the primary challenges faced during the project, including technical issues, resource constraints or time limitations. | Example: one major challenge was coding the microcontroller to handle multiple inputs simultaneously, which required troubleshooting and additional research. |  |
| 1. Explain solutions implemented | Discuss the solutions you applied to overcome challenges and any adjustments made to achieve project goals. | Example: to manage simultaneous inputs, we simplified the code logic and implemented a delay function to prevent sensor overlap. |  |
| 1. Evaluate success of each function | Reflect on the effectiveness of each automated function and whether it met the intended purpose, including areas that worked well and areas that may need improvement. | Example: the automated door lock function worked reliably, but the motion sensor’s range was limited, so it didn’t always detect movement effectively. |  |
| 1. Reflect on learning and skills | Summarise the skills or knowledge gained throughout the project, including any programming, design, or troubleshooting skills developed. | Example: this project improved my understanding of network communication and microcontroller programming, especially handling data from multiple input sensors. |  |
| 1. Suggest future improvements | Suggest ways to improve the smart home model or the project process in future versions. | Example: future improvements could include using higher-sensitivity sensors and optimising the code for faster response times. |  |

## Databases

As a class, discuss methods of data collection and the importance of privacy and personal identifying information (PII) and ethical considerations.

**Activity 40:** describe methods of data collection and the importance of privacy and PII and ethical considerations.

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| **Sample answer:**  **Methods of data collection**   * Surveys and questionnaires   One common method of data collection is through surveys, where participants answer questions on a specific topic. This method allows for quantitative data analysis. However, it’s important to ensure that the questions are designed to avoid leading or biased responses.   * Interviews   Conducting one-on-one or group interviews can yield qualitative data, providing deeper insights into participants' thoughts and feelings. Ethical consideration here includes ensuring participants are comfortable and that their responses will remain confidential.   * Observational studies   Researchers can gather data through direct observation of subjects in their natural environment. While this method can provide rich data, it raises questions about consent and the privacy of individuals being observed.   * Social media and online data mining   Data can be collected from social media platforms. However, ethical issues arise regarding users' expectations of privacy and whether consent is required for data usage.  **Importance of privacy and PII**   * Protecting privacy is crucial as it maintains the trust between researchers and participants. When individuals believe their personal information is secure, they are more likely to participate honestly and fully. * Personally identifiable information (PII) such as names, addresses and contact details must be handled with care. Unauthorised access or breaches can lead to identity theft or other harm to individuals.   **Ethical considerations**   * Informed consent   Before collecting data, researchers must obtain informed consent from participants, ensuring they understand the purpose of data collection, how it will be used, and their right to withdraw at any time.   * Anonymity and confidentiality   Researchers should anonymise data to protect participants' identities. This means removing any information that could potentially identify individuals in published results.   * Data minimisation   Collecting only the data that is necessary for the research purpose minimises the risk of misuse. Researchers should assess what information is truly needed and avoid collecting extraneous details.   * Potential harm   Researchers must consider the potential risks or harms that could arise from data collection (for example, emotional distress from discussing sensitive topics) and take steps to mitigate these risks. |

**Activity 41:** students design a survey or data collection method to gather information from their peers (for example, favourite subjects, extracurricular activities) while ensuring privacy. Collect data using Google Forms or another method.

After the collection of data, look at techniques for validating data, that is ensuring data types are accurate and checking for duplicates before moving this data into an online database.

As a class watch [Database Tutorial for Beginners (5:31)](https://www.youtube.com/watch?v=wR0jg0eQsZA) and [Relational Databases (3:48)](https://www.youtube.com/watch?v=oN3jBRGnPO4).

**Activity 42:** design a flat file database

Design a flat file database using the data collected through the above activity.

This could be completed on Microsoft Excel or into a relational database piece of software for example, Microsoft Access, MySQL, SQLite or any other suitable platform. Students should create a form, queries and reports from the data.

**Activity 43:** creating a relational database

Create a relational database on a topic of your choice, model the relationships between entities, and complete a set of actions including data entry, querying, and reporting.

**Part 1 – choose a topic and define entities**

**Topic selection**

Select a topic for your relational database.

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| **Sample answers:**   * Books and authors * Movies and actors * Sports teams and players * Events and attendees |

**Entity identification**

In pairs or small groups, [brainstorm](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/542?clearCache=3d32c820-442f-7d68-d3ca-b2add7a710e8) and list the key entities related to your chosen topic. For each entity, consider what data you need to collect.

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| **Sample answers:**  Example for ‘Movies and Actors’   * Entities: Movies, Actors, Genres * Data for Movies: MovieID, Title, ReleaseYear, GenreID * Data for Actors: ActorID, Name, BirthYear * Data for Genres: GenreID, GenreName |

## Model relationships

Identify primary keys (unique identifiers) and foreign keys (linking entities).

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| **Sample answers:**   * A Movie has many Actors (many-to-many relationship) * Each Movie belongs to one Genre (one-to-many relationship) |

**Part 2 – create the database, enter data and explore data**

**Database creation**

Create the relational database in the chosen software, defining tables based on their entities, including appropriate data types and constraints.

Ensure you are creating primary and foreign keys, with relationships.

**Data entry**

Manually enter sample data into the created tables, ensuring a minimum of 5–10 records for each entity. Think creatively and accurately about the data you enter.

**Data exploration**

Create forms, queries and reports to explore and display the data on their chosen topic.

Write and execute SQL queries to perform the following actions:

1. Select: retrieve all movies released after a certain year.

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| **Sample answer:**  SELECT Title FROM Movies WHERE ReleaseYear > 2000; |

1. Join: list all movies along with their genres.

|  |
| --- |
| **Sample answer:**  SELECT Movies.Title, Genres.GenreName FROM Movies JOIN Genres ON Movies.GenreID = Genres.GenreID; |

1. Count: count how many actors are in each movie.

|  |
| --- |
| **Sample answer:**  SELECT MovieID, COUNT(ActorID) as NumberOfActors FROM MovieActors GROUP BY MovieID; |

**Data validation**

Review your data for any inconsistencies or errors and make necessary corrections. Discuss the importance of data validation.

## Careers

**Activity 44:** fill in the below tables relating to various careers related to connecting people and systems.

Research the careers and current existing positions and their criteria from current employment websites such as [SEEK](https://www.seek.com.au/), [Indeed](https://au.indeed.com/) and [CareerOne](https://www.careerone.com.au/).

Table 8 – career research: Network Administrator

|  |  |
| --- | --- |
| Criteria | Response |
| Job title | Network Administrator |
| Job description |  |
| Training required and education path |  |
| Personal requirements |  |
| Outline of duties |  |
| Average income |  |

Table 9 – career research: Cybersecurity Analyst

|  |  |
| --- | --- |
| Criteria | Response |
| Job title | Cybersecurity Analyst |
| Job description |  |
| Training required |  |
| Personal requirements |  |
| Outline of duties |  |
| Average income |  |

Table 10 – career research: Systems Analyst

|  |  |
| --- | --- |
| Criteria | Response |
| Job title | Systems Analyst |
| Job description |  |
| Training required |  |
| Personal requirements |  |
| Outline of duties |  |
| Average income |  |

Table 11 – career research: Telecommunications Engineer

|  |  |
| --- | --- |
| Criteria | Response |
| Job title | Telecommunications Engineer |
| Job description |  |
| Training required |  |
| Personal requirements |  |
| Outline of duties |  |
| Average income |  |

Table 12 – IT Project Manager

|  |  |
| --- | --- |
| Criteria | Response |
| Job title | IT Project Manager |
| Job description |  |
| Training required |  |
| Personal requirements |  |
| Outline of duties |  |
| Average income |  |

Table 13 – career research: User Experience (UX) Designer

|  |  |
| --- | --- |
| Criteria | Response |
| Job title | User Experience (UX) Designer |
| Job description |  |
| Training required |  |
| Personal requirements |  |
| Outline of duties |  |
| Average income |  |

**As a class, watch** [CloudCraft (0:40)](https://www.youtube.com/watch?v=CWVDWJdMHwQ)**.**

CloudCraft is a new way for young people to understand datacentres and get excited about the technology that keeps the cloud running. Students learn about community, communication, and critical thinking as they play through situations that technicians, architects, engineers, environmental specialist and security personnel face daily.

**Activity 45:** CloudCraft missions

**Students complete a series of missions in** [CloudCraft](https://education.minecraft.net/en-us/lessons/cloudcraft) **from Minecraft Education.**

The missions are themed around the following areas:

* technician
* architect
* engineering
* security
* recycling.

Upon starting a mission students will be briefed via an animation explaining the problem each team needs help solving. After the scene is over, the player is teleported to the employee that needs help fixing the problem. That employee will tell the player about the task they need help with.

## Case study: social media

As a class discuss social media. Guide students to thinking about what are some positive and negative effects of social media on people’s lives?

Introduce the Online Safety Amendment (Social Media Minimum Age) Bill 2024.

* [BBC – Australia approves social media ban on under-16s](https://www.bbc.com/news/articles/c89vjj0lxx9o)
* [Children and teenagers under 16 to be banned from social media after parliament passes world-first laws](https://www.abc.net.au/news/2024-11-28/social-media-age-ban-passes-parliament/104647138)
* [Support for under-16 social media ban soars to 77% among Australians](https://au.yougov.com/politics/articles/51000-support-for-under-16-social-media-ban-soars-to-77-among-australians).

Use the above links to discuss how the ban affects people's ability to connect and communicate.

How does it affect communication, information access, and freedom of expression?

**Activity 46:** assess the ethical and legal responsibilities related to using social media in light of the ban.

**Instructions**

1. **Research**

Use the internet to gather information about the Australian social media ban. Look for news articles, opinion pieces and statistics.

1. **Discussion**

Share your findings and insights with a small group, to further student understanding.

1. **Analysis**

Write a short response using the [PEEL paragraph writing technique](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/625) addressing the following:

* Outline social connectivity and how social media connects people but can also lead to isolation.
* What are the social impacts of the social media ban?
* What ethical responsibilities do users have while using social media?
* What legal implications arise from actions taken on social media?

# References

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