Getting Ready for...

KS4 (GCSE) Computer Science

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Activities

1.   Systems architecture

Embedded computing is an important field of Computer Science.

- Can you name ten everyday objects – apart from PCs, laptops, smartphones, and tablets – that have embedded computers?

- Can you extend this knowledge to describe how each one allows a user to input data, what it might do with that input data, and how it outputs it back to the user?

2.   Programming fundamentals

Programming is at the heart of GCSE Computer Science, and you will learn several useful programming techniques. The most common language that secondary schools use on this course is Python.

- A great starting point is the Solo Learn website/ app: https://www.sololearn.com/ [SoloLearn Inc]

- Sign up and take the Python 3 tutorial Module 1: Basic Concepts. It covers simple operations, data types, input/output, string operations and working with variables.

- Each concept is covered by describing the theory alongside some coded examples, then there are some small code tasks to complete.

3.   Memory and Storage

The GCSE Computer Science course requires that you understand how decimal numbers are converted into binary, and vice versa.

- Can you convert the numbers 12, 24, 48 and 96 into binary form?

4.   Programming fundamentals

You will be required to write a project in a programming language such as Python, as well as understand operating system utilities such as encryption, where data is scrambled and only a key can decrypt it.

This project combines both GCSE topics with a Python project on elementary encryption:
https://projects.raspberrypi.org/en/projects/secret-messages
[Raspberry Pi Foundation]

- Work through this project and create a Caesar cipher in Python.

5.   Computer networks, connections and protocols

The typical home features an increasing number of digital devices which are connected to each other in a Local Area Network [LAN].

- Can you name ten networked devices in a typical home LAN?

These connect using wired or wireless media, sending data to, and receiving data from the Internet via a home router.

- Can you create a poster featuring each Internet-enabled device in your home? You should show how each device connects to the LAN, and how the LAN connects to the Internet.

6.   Algorithms

An important part of problem-solving is understanding how the problem can be broken down into smaller parts, so that each one can be more easily solved.

This is known as decomposition, a process where problems are broken into smaller pieces so that a computer can solve each one.

Consider an everyday kitchen task such as washing up. Developers of robots have found it incredibly challenging to program an android robot to wash up. There are numerous sub-tasks, such as handling different tools, picking up objects, recognising objects, and so on.

Perhaps the problem needs to be better decomposed?

- Can you decompose the process of washing up, and describe each smaller task?

7.   Network security

Modern networked computers are vulnerable to sophisticated cyber-attacks from hackers, who use trickery and software to intercept and steal data. The GCSE Computer Science course covers several methods of defending against such attacks.

An excellent first step is using secure passwords. For example, a password should be at least 8 characters, contain a series of uppercase and lowercase letters, as well as numbers and special characters.

One method is to have in mind a memorable sentence and use the first letter of each word, with a number and special character. For example, 'Computer Science is the greatest subject of them all' could produce a password of CSitgsota#12.

- Can you describe another good method of creating a memorable, safe password?

Password
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8.   Boolean logic

An enjoyable part of the Computer Science GCSE is understanding how computational logic is represented using logic diagrams and truth tables.

This involves understanding AND, OR and NOT gates. These all receive one or two inputs and produce one output. They can be combined to produce the complex circuitry inside all computers.

- Can you draw the symbols for AND, OR and NOT? Can you fill out the truth tables for AND, OR and NOT gates?

9.   Systems software

Systems software manages the hardware and software on a computer system and provides an interface between the user and the computer system.

One utility is known as encryption, which scrambles data and files so that they cannot be read even if the computer system is hacked. There are several encryption algorithms used by computers. One of these is the Caesar cipher.

- Can you describe how it encrypts data? Can you attempt to program it in Python?

10. Ethical, legal, cultural and environmental impacts of digital technology

It is important that young people consider how technology can harm as well as benefit humanity. The Computer Science GCSE features a unit where you consider the impact of various technologies on society.

• Consider any emerging technology – for example, drones, self-driving cars, new smartphones, virtual reality, and so on.

• Can you describe how it may benefit society? Can you also describe how it may harm society?