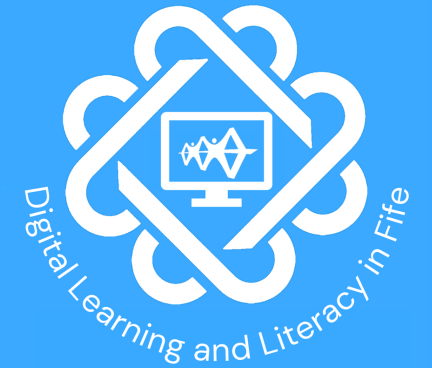


# Computing Science Overview Early to Fourth Level



# Understanding the world through computational thinking



Experiences and Outcomes	Benchmarks
<p>I can explore computational thinking processes involved in a variety of everyday tasks and can identify patterns in objects or information.</p> <p>TCH 0-13a</p>	<ul style="list-style-type: none"> <li>Identifies and sequences the main steps in an everyday task to create instructions/an algorithm for example, washing hands.</li> <li>Classifies objects and groups them into simple categories for examples, groups toy bricks according to colour.</li> <li>Identifies patterns, similarities and differences in objects or information such as colour, size and temperature and simple relationships between them.</li> </ul>
<p>I can explore and comment on processes in the world around me making use of core computational thinking concepts and can organise information in a logical way.</p> <p>TCH 1-13a</p>	<ul style="list-style-type: none"> <li>Follows sequences of instructions/algorithms from everyday situations for example, recipes or directions, including those with selection and repetition.</li> <li>Identifies steps in a process and describes precisely the effect of each step.</li> <li>Makes decisions based on logical thinking including IF, AND, OR and NOT for example, collecting balls in the gym hall but NOT basketballs, line up if you are left-handed OR have green eyes.</li> <li>Collects, groups and orders information in a logical, organised way using my own and others' criteria (MNU 1-20a and b).</li> </ul>
<p>I understand the operation of a process and its outcome. I can structure related items of information.</p> <p>TCH 2-13a</p>	<ul style="list-style-type: none"> <li>Compares activities consisting of a single sequence of steps with those consisting of multiple parallel steps, for example, making tomato sauce and cooking pasta to be served at the same time.</li> <li>Identifies algorithms/instructions that include repeated groups of instructions a fixed number of times and/or loops until a condition is met.</li> <li>Identifies when a process is not predictable because it has a random element for example, a board game which uses dice.</li> <li>Structures related items of information for example, a family tree (MNU 2- 20b).</li> <li>Uses a recognised set of instructions/ an algorithm to sort real worlds objects for examples, books in a library or trading cards.</li> </ul>
<p>I can describe different fundamental information processes and how they communicate and can identify their use in solving different problems.</p> <p>TCH 3-13a</p> <p>I am developing my understanding of information and can use an information model to describe particular aspects of a real world system. TCH 3-13b</p>	<ul style="list-style-type: none"> <li>Recognises and describes information systems with communicating processes which occur in the world around me.</li> <li>Explains the difference between parallel processes and those that communicate with each other.</li> <li>Demonstrates an understanding of the basic principles of compression and encryption of information.</li> <li>Identifies a set of characteristics describing a collection of related items that enable each item to be individually identified.</li> <li>Identifies the use of common algorithms such as sorting and searching as part of larger processes.</li> </ul>
<p>I can describe in detail the processes used in real world solutions, compare these processes against alternative solutions and justify which is the most appropriate. TCH 4-13a</p> <p>I can informally compare algorithms for correctness and efficiency. TCH 4-13b</p>	<ul style="list-style-type: none"> <li>Identifies the transfer of information through complex systems involving both computers and physical artefacts, for example, airline check-in, parcel tracking and delivery.</li> <li>Describes instances of human decision making as an information process, for example, deciding which check-out queue to pick, which route to take to school, how to prepare family dinner / a school event.</li> <li>Compares alternative algorithms for the same problem and understands that there are different ways of defining "better" solutions depending on the problem context for example, is speed or space more valuable in this context?</li> </ul>

# Understanding and analysing computer technology



Experiences and Outcomes	Benchmarks
<p>I understand that sequences of instructions are used to control computing technology. TCH 0-14a</p> <p>I can experiment with and identify uses of a range of computing technology in the world around me. TCH 0-14b</p>	<ul style="list-style-type: none"> <li>• Demonstrates an understanding of how symbols can represent process and information.</li> <li>• Predicts what a device or person will do when presented with a sequence of instructions for example, arrows drawn on paper.</li> <li>• Identifies computing devices in the world (including those hidden in appliances and objects such as automatic doors).</li> </ul>
<p>I understand the instructions of a visual programming language and can predict the outcome of a program written using the language. TCH 1-14a</p> <p>I understand how computers process information. TCH 1-14b</p>	<ul style="list-style-type: none"> <li>• Demonstrates an understanding of the meaning of individual instructions when using a visual programming language (including sequences, fixed repetition and selection).</li> <li>• Explains and predicts what a program in a visual programming language will do when it runs for example, what audio, visual or movement effect will result.</li> <li>• Demonstrates an understanding that computers take information as input, process and store that information and output the results.</li> </ul>
<p>I can explain core programming language concepts in appropriate technical language. TCH 2-14a</p> <p>I understand how information is stored and how key components of computing technology connect and interact through networks. TCH 2-14b</p>	<ul style="list-style-type: none"> <li>• Explains the meaning of individual instructions (including variables and conditional repetition) in a visual programming language.</li> <li>• Predicts what a complete program in a visual programming language will do when it runs, including how the properties of objects for example, position, direction and appearance change as the program runs through each instruction.</li> <li>• Explains and predicts how parallel activities interact.</li> <li>• Demonstrates an understanding that all computer data is represented in binary for example, numbers, text, black and white graphics.</li> <li>• Describes the purpose of the processor, memory and storage and the relationship between them.</li> <li>• Demonstrates an understanding of how networks are connected and used to communicate and share information, for example the internet.</li> </ul>
<p>I understand language constructs for representing structured Information. TCH 3-14a</p> <p>I can describe the structure and operation of computing systems which have multiple software and hardware levels that interact with each other. TCH 3-14b</p>	<ul style="list-style-type: none"> <li>• Understands that the same information could be represented in more than one representational system.</li> <li>• Understands that different information could be represented in exactly the same representation.</li> <li>• Demonstrates an understanding of structured information in programs, databases or webpages.</li> <li>• Describes the effect of mark-up language on the appearance of a webpage, and understand that this may be different on different devices.</li> <li>• Demonstrates an understanding of the von Neumann architecture and how machine code instructions are stored and executed within a computer system.</li> <li>• Reads and explains code extracts including those with variables and data structures.</li> <li>• Demonstrate an understanding of how computers communicate and share information over networks including the concepts of sender, receiver, address and packets.</li> <li>• Understands simple compression and encryption techniques used in computing technology.</li> </ul>
<p>I understand constructs and data structures in a textual programming language. TCH 4-14a</p> <p>I can explain the overall operation and architecture of a digitally created solution. TCH 4-14b</p> <p>I understand the relationship between high level language and the operation of computer. TCH 4-14c</p>	<ul style="list-style-type: none"> <li>• Understands basic control constructs such as sequence, selection repetition, variables and numerical calculations in a textual language.</li> <li>• Demonstrates an understanding of how visual instructions and textual instructions for the same construct are related.</li> <li>• Identifies and explains syntax errors in a program written in a textual language.</li> <li>• Demonstrates an understanding of representations of data structures in a textual language.</li> <li>• Demonstrates an understanding of how computers represent and manipulate information in a range of formats.</li> <li>• Demonstrates an understanding of program plans expressed in accepted design representations for example pseudocode, storyboarding, structure diagram, data flow diagram, flow chart.</li> <li>• Demonstrates an understanding of the underling technical concepts of some specific facets of modern complex technologies for example, online payment systems and satnav.</li> <li>• Demonstrates an understanding that computers translate information processes between different levels of abstraction.</li> </ul>

# Designing, building and testing computing solutions



Experiences and Outcomes	Benchmarks
<p>I can develop a sequence of instructions and run them using programmable devices or equivalent. TCH 0-15a</p>	<ul style="list-style-type: none"> <li>• Designs a simple sequence of instructions/algorithm for programmable device to carry out a task for example, directional instructions: forwards/backwards.</li> <li>• Identifies and corrects errors in a set of instructions.</li> </ul>
<p>I can demonstrate a range of basic problem solving skills by building simple programs to carry out a given task, using an appropriate language. TCH 1-15a</p>	<ul style="list-style-type: none"> <li>• Simplifies problems by breaking them down into smaller more manageable parts.</li> <li>• Constructs a sequence of instructions to solve a task, explaining the expected output from each step and how each contributes towards solving the task.</li> <li>• Creates programs to carry out activities (using selection and fixed repetition) in an visual programming language.</li> <li>• Identifies when a program does not do what was intended and can correct errors/bugs.</li> <li>• Evaluates solutions/programs and suggests improvements.</li> </ul>
<p>I can create, develop and evaluate computing solutions in response to a design challenge. TCH 2-15a</p>	<ul style="list-style-type: none"> <li>• Creates programs in a visual programming language including variables and conditional repetition.</li> <li>• Identifies patterns in problem solving and reuses aspects of previous solutions appropriately for example, reuse code for a timer, score counter or controlling arrow keys.</li> <li>• Identifies any mismatches between the task description and the programmed solution, and indicates how to fix them.</li> </ul>
<p>I can select appropriate development tools to design, build, evaluate and refine computing solutions based on requirements. TCH 3-15a</p>	<ul style="list-style-type: none"> <li>• Designs and builds a program using a visual language combining constructs and using multiple variables.</li> <li>• Represents and manipulates structured information in programs, or databases for example, works with a list data structure in a visual language, or a flat file database.</li> <li>• Interprets a problem statement, and identifies processes and information to create a physical computing and/or software solution.</li> <li>• Can find and correct errors in program logic.</li> <li>• Groups related instructions into named subprograms (in a visual language).</li> <li>• Writes code in which there is communication between parallel processes (in a visual language).</li> <li>• Writes code which receives and responds to real world inputs (in a visual language).</li> <li>• Designs and builds web pages using appropriate mark-up languages.</li> </ul>
<p>I can select appropriate development tools to design, build, evaluate and refine computing solutions to process and present information whilst making reasoned arguments to justify my decisions. TCH 4-15a</p>	<ul style="list-style-type: none"> <li>• Analyses problem specifications across a range of contexts, identifying key requirements.</li> <li>• Writes a program in a textual language which uses variables and constructs such as sequence, selection and repetition.</li> <li>• Creates a design using accepted design notations for example, pseudocode storyboarding, structure diagram, data flow diagram, flow chart.</li> <li>• Develops a relational database to represent structured information.</li> <li>• Debugs code and can distinguish between the nature of identified errors e.g. syntax and logic.</li> <li>• Writes test and evaluation reports.</li> <li>• Can make use of logical operators – AND, OR, NOT.</li> <li>• Writes a program in a textual language which uses variables within instructions instead of specific values where appropriate.</li> <li>• Designs appropriate data structures to represent information in a textual language.</li> <li>• Selects an appropriate platform on which to develop a physical and/or software solution from a requirements specification.</li> <li>• Compares common algorithms for example, those for sorting and searching, and justify which would be most appropriate for a given problem.</li> <li>• Design and build web pages which includes interactivity.</li> </ul>

# Early Level Computing Science



Curriculum Organiser	Experiences and Outcomes	Benchmarks
Understanding the world through computational thinking	I can explore computational thinking processes involved in a variety of everyday tasks and can identify patterns in objects or information. TCH 0-13a	<ul style="list-style-type: none"> <li>Identifies and sequences the main steps in an everyday task to create instructions/an algorithm for example, washing hands.</li> <li>Classifies objects and groups them into simple categories for examples, groups toy bricks according to colour.</li> <li>Identifies patterns, similarities and differences in objects or information such as colour, size and temperature and simple relationships between them.</li> </ul>
Understanding and analysing computer technology	<p>I understand that sequences of instructions are used to control computing technology. TCH 0-14a</p> <p>I can experiment with and identify uses of a range of computing technology in the world around me. TCH 0-14b</p>	<ul style="list-style-type: none"> <li>Demonstrates an understanding of how symbols can represent process and information.</li> <li>Predicts what a device or person will do when presented with a sequence of instructions for example, arrows drawn on paper.</li> <li>Identifies computing devices in the world (including those hidden in appliances and objects such as automatic doors).</li> </ul>
Designing, building and testing computing solutions	I can develop a sequence of instructions and run them using programmable devices or equivalent. TCH 0-15a	<ul style="list-style-type: none"> <li>Designs a simple sequence of instructions/algorithm for programmable device to carry out a task for example, directional instructions: forwards/backwards.</li> <li>Identifies and corrects errors in a set of instructions.</li> </ul>

# First Level Computing Science



Curriculum Organiser	Experiences and Outcomes	Benchmarks
Understanding the world through computational thinking	I can explore and comment on processes in the world around me making use of core computational thinking concepts and can organise information in a logical way. TCH 1-13a	<ul style="list-style-type: none"> <li>• Follows sequences of instructions/algorithms from everyday situations for example, recipes or directions, including those with selection and repetition.</li> <li>• Identifies steps in a process and describes precisely the effect of each step.</li> <li>• Makes decisions based on logical thinking including IF, AND, OR and NOT for example, collecting balls in the gym hall but NOT basketballs, line up if you are left-handed OR have green eyes.</li> <li>• Collects, groups and orders information in a logical, organised way using my own and others' criteria (MNU 1-20a and b).</li> </ul>
Understanding and analysing computer technology	<p>I understand the instructions of a visual programming language and can predict the outcome of a program written using the language. TCH 1-14a</p> <p>I understand how computers process information. TCH 1-14b</p>	<ul style="list-style-type: none"> <li>• Demonstrates an understanding of the meaning of individual instructions when using a visual programming language (including sequences, fixed repetition and selection).</li> <li>• Explains and predicts what a program in a visual programming language will do when it runs for example, what audio, visual or movement effect will result.</li> <li>• Demonstrates an understanding that computers take information as input, process and store that information and output the results.</li> </ul>
Designing, building and testing computing solutions	I can demonstrate a range of basic problem solving skills by building simple programs to carry out a given task, using an appropriate language. TCH 1-15a	<ul style="list-style-type: none"> <li>• Simplifies problems by breaking them down into smaller more manageable parts.</li> <li>• Constructs a sequence of instructions to solve a task, explaining the expected output from each step and how each contributes towards solving the task.</li> <li>• Creates programs to carry out activities (using selection and fixed repetition) in a visual programming language.</li> <li>• Identifies when a program does not do what was intended and can correct errors/bugs.</li> <li>• Evaluates solutions/programs and suggests improvements.</li> </ul>

# Second Level Computing Science



Curriculum Organiser	Experiences and Outcomes	Benchmarks
Understanding the world through computational thinking	I understand the operation of a process and its outcome. I can structure related items of information. TCH 2-13a	<ul style="list-style-type: none"> <li>• Compares activities consisting of a single sequence of steps with those consisting of multiple parallel steps, for example, making tomato sauce and cooking pasta to be served at the same time.</li> <li>• Identifies algorithms/instructions that include repeated groups of instructions a fixed number of times and/or loops until a condition is met.</li> <li>• Identifies when a process is not predictable because it has a random element for example, a board game which uses dice.</li> <li>• Structures related items of information for example, a family tree (MNU 2- 20b).</li> <li>• Uses a recognised set of instructions/ an algorithm to sort real worlds objects for examples, books in a library or trading cards.</li> </ul>
Understanding and analysing computer technology	<p>I can explain core programming language concepts in appropriate technical language. TCH 2-14a</p> <p>I understand how information is stored and how key components of computing technology connect and interact through networks. TCH 2-14b</p>	<ul style="list-style-type: none"> <li>• Explains the meaning of individual instructions (including variables and conditional repetition) in a visual programming language.</li> <li>• Predicts what a complete program in a visual programming language will do when it runs, including how the properties of objects for example, position, direction and appearance change as the program runs through each instruction.</li> <li>• Explains and predicts how parallel activities interact.</li> <li>• Demonstrates an understanding that all computer data is represented in binary for example, numbers, text, black and white graphics.</li> <li>• Describes the purpose of the processor, memory and storage and the relationship between them.</li> <li>• Demonstrates an understanding of how networks are connected and used to communicate and share information, for example the internet.</li> </ul>
Designing, building and testing computing solutions	I can create, develop and evaluate computing solutions in response to a design challenge. TCH 2-15a	<ul style="list-style-type: none"> <li>• Creates programs in a visual programming language including variables and conditional repetition.</li> <li>• Identifies patterns in problem solving and reuses aspects of previous solutions appropriately for example, reuse code for a timer, score counter or controlling arrow keys.</li> <li>• Identifies any mismatches between the task description and the programmed solution, and indicates how to fix them.</li> </ul>

# Third Level Computing Science



Curriculum Organiser	Experiences and Outcomes	Benchmarks
<p>Understanding the world through computational thinking</p>	<p>I can describe different fundamental information processes and how they communicate and can identify their use in solving different problems. TCH 3-13a</p> <p>I am developing my understanding of information and can use an information model to describe particular aspects of a real world system. TCH 3-13b</p>	<ul style="list-style-type: none"> <li>• Recognises and describes information systems with communicating processes which occur in the world around me.</li> <li>• Explains the difference between parallel processes and those that communicate with each other.</li> <li>• Demonstrates an understanding of the basic principles of compression and encryption of information.</li> <li>• Identifies a set of characteristics describing a collection of related items that enable each item to be individually identified.</li> <li>• Identifies the use of common algorithms such as sorting and searching as part of larger processes.</li> </ul>
<p>Understanding and analysing computer technology</p>	<p>I understand language constructs for representing structured Information. TCH 3-14a</p> <p>I can describe the structure and operation of computing systems which have multiple software and hardware levels that interact with each other. TCH 3-14b</p>	<ul style="list-style-type: none"> <li>• Understands that the same information could be represented in more than one representational system.</li> <li>• Understands that different information could be represented in exactly the same representation.</li> <li>• Demonstrates an understanding of structured information in programs, databases or webpages.</li> <li>• Describes the effect of mark-up language on the appearance of a webpage, and understand that this may be different on different devices.</li> <li>• Demonstrates an understanding of the von Neumann architecture and how machine code instructions are stored and executed within a computer system.</li> <li>• Reads and explains code extracts including those with variables and data structures.</li> <li>• Demonstrate an understanding of how computers communicate and share information over networks including the concepts of sender, receiver, address and packets.</li> <li>• Understands simple compression and encryption techniques used in computing technology.</li> </ul>
<p>Designing, building and testing computing solutions</p>	<p>I can select appropriate development tools to design, build, evaluate and refine computing solutions based on requirements. TCH 3-15a</p>	<ul style="list-style-type: none"> <li>• Designs and builds a program using a visual language combining constructs and using multiple variables.</li> <li>• Represents and manipulates structured information in programs, or databases for example, works with a list data structure in a visual language, or a flat file database.</li> <li>• Interprets a problem statement, and identifies processes and information to create a physical computing and/or software solution.</li> <li>• Can find and correct errors in program logic.</li> <li>• Groups related instructions into named subprograms (in a visual language).</li> <li>• Writes code in which there is communication between parallel processes (in a visual language).</li> <li>• Writes code which receives and responds to real world inputs (in a visual language).</li> <li>• Designs and builds web pages using appropriate mark-up languages.</li> </ul>



# Fourth Level Computing Science



Curriculum Organiser	Experiences and Outcomes	Benchmarks
<p>Understanding the world through computational thinking</p>	<p>I can describe in detail the processes used in real world solutions, compare these processes against alternative solutions and justify which is the most appropriate. TCH 4-13a</p> <p>I can informally compare algorithms for correctness and efficiency. TCH 4-13b</p>	<ul style="list-style-type: none"> <li>Identifies the transfer of information through complex systems involving both computers and physical artefacts, for example, airline check-in, parcel tracking and delivery.</li> <li>Describes instances of human decision making as an information process, for example, deciding which check-out queue to pick, which route to take to school, how to prepare family dinner / a school event.</li> <li>Compares alternative algorithms for the same problem and understands that there are different ways of defining “better” solutions depending on the problem context for example, is speed or space more valuable in this context?</li> </ul>
<p>Understanding and analysing computer technology</p>	<p>I understand constructs and data structures in a textual programming language. TCH 4-14a</p> <p>I can explain the overall operation and architecture of a digitally created solution. TCH 4-14b</p> <p>I understand the relationship between high level language and the operation of computer. TCH 4-14c</p>	<ul style="list-style-type: none"> <li>Understands basic control constructs such as sequence, selection repetition, variables and numerical calculations in a textual language.</li> <li>Demonstrates an understanding of how visual instructions and textual instructions for the same construct are related.</li> <li>Identifies and explains syntax errors in a program written in a textual language.</li> <li>Demonstrates an understanding of representations of data structures in a textual language.</li> <li>Demonstrates an understanding of how computers represent and manipulate information in a range of formats.</li> <li>Demonstrates an understanding of program plans expressed in accepted design representations for example pseudocode, storyboarding, structure diagram, data flow diagram, flow chart.</li> <li>Demonstrates an understanding of the underlying technical concepts of some specific facets of modern complex technologies for example, online payment systems and satnav.</li> <li>Demonstrates an understanding that computers translate information processes between different levels of abstraction.</li> </ul>
<p>Designing, building and testing computing solutions</p>	<p>I can select appropriate development tools to design, build, evaluate and refine computing solutions to process and present information whilst making reasoned arguments to justify my decisions. TCH 4-15a</p>	<ul style="list-style-type: none"> <li>Analyses problem specifications across a range of contexts, identifying key requirements.</li> <li>Writes a program in a textual language which uses variables and constructs such as sequence, selection and repetition.</li> <li>Creates a design using accepted design notations for example, pseudocode storyboarding, structure diagram, data flow diagram, flow chart.</li> <li>Develops a relational database to represent structured information.</li> <li>Debugs code and can distinguish between the nature of identified errors e.g. syntax and logic.</li> <li>Writes test and evaluation reports.</li> <li>Can make use of logical operators – AND, OR, NOT.</li> <li>Writes a program in a textual language which uses variables within instructions instead of specific values where appropriate.</li> <li>Designs appropriate data structures to represent information in a textual language.</li> <li>Selects an appropriate platform on which to develop a physical and/or software solution from a requirements specification.</li> <li>Compares common algorithms for example, those for sorting and searching, and justify which would be most appropriate for a given problem.</li> <li>Design and build web pages which includes interactivity.</li> </ul>