Curriculum Mapping

Programming with Alice 2

Notes to the Instructor:

This document contains two components.

1. Curriculum Map (In table format, alphabetized by column 1)

The table maps columns 1 and 2 (typical Alice curriculum topics and example programming exercises) to columns 3, 4, 5, and 6 (well-known curricula & pedagogy). The CSTA and Code.org curricula are listed in a single column because the Code.org curriculum encompasses, more or less, the CSTA curriculum. Please note that topics listed column 1 are ALPHABETICALLY ordered, NOT necessarily in the order in which the topics would be presented in the classroom.

2. Typical Alice 2 Course Outline

The outline is color-tagged – major topic is in **blue**, subtopics in **green**, and curriculum concepts in **red**. Please note that topics in this course outline are, more or less, in the order in which the topics might be presented in the classroom. We realize that some variation in topics is common and that some topics are covered to varying depths, depending on the objectives of the course and the grade level of the students.

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Alice Curriculum Mapping

Programming with Alice	Example Activity	CSTA & Code.org	Computational Thinking Concept	National curriculum in England KS 1-3	Common Core
Algorithm Design	Design a storyboard for creating an animation in a short video. Create a "to-do list" that summarizes the actions in sequence.	Algorithms	Algorithms	Understand what an algorithm is and how it is implemented in a program. Use logical reasoning to explain how some simple algorithms work.	Math, College & Career Readiness
Animation of Automation	Use Alice to build a 3D virtual world and create animation of a robot working on an assembly line	Community, Global, and Ethical Impacts	Automation	Design, use, and evaluate computational abstractions that model the state and behavior of real-world problems and physical systems.	College and Career Readiness, Writing
Classes & Objects	Create a method for an ice skater object. Save the object as a new class. Add new instances of the saved class to the world.	Computing Practice & Programming	Data representation	Understand how data of various types (including text, sounds, and pictures) can be represented.	College and Career Readiness, Writing
Collaboration	Students participate in a group animation project, from design to completion.	Collaboration			College and Career Readiness, Writing

Concurrency	**Use "do together" to create multiple threads. (For example, an ice skater may simultaneously lift their right leg and also push with their left foot, so as to skate forward on a frozen lake.)**	**Computational Thinking**	**Parallelization**	**Design, create, and debug a program that accomplishes a specific goal, including controlling or simulating a physical system**	**Writing for technical subjects**
Communication	**Use comments in a program to document the intent of the programmer; identify variables and parameters, and indicate beginning and ending state of a procedure. Demo an animation project to other students in a group.**	**Communication**		**Use logical reasoning to explain how some simple algorithms work.**	**College and Career Readiness, Speaking and Listening**
Computers and Communication Devices	**Use external thumb drive or network account to save program code and contribute to a group project.**	**Computers and Communication Devices**		**Understand the hardware and software components that make up a computer system and how they communicate with one another and with other systems.**	**College and Career Readiness, Writing**
Create a virtual world	**Use objects (people, animals, vehicles, etc.) in a virtual world to represent data and the actions performed by those objects.**	**Creativity, Abstraction**	**Abstraction**	**Design, use, and evaluate computational abstractions that model the state and behavior of real-world problems and physical systems.**	**Math**
Conditional control	**Use an "if…else" control structure in an interactive animation. (For example, if the person clicks on a piano key, the sound of that key is played.)**	**Computing Practice & Programming**	**Control Structures**	**Use sequence, selection, and repetition in programs**	**Math**

Creativity	**Create a virtual world, populate with characters and props. Write a story and create an animation to tell the story.**	**Creativity**		**Design, create, and debug a program that accomplishes a specific goal, including controlling or simulating a physical system**	
Data analysis	**Create a bar chart animation that shows the building height versus the seconds to drop the ball.**	**Data**	**Data analysis**	**Undertake creative projects that involve selecting, using, and combining multiple applications, preferably across a range of devices, to achieve challenging goals, including collecting and analyzing data and meeting the needs of known users**	**Math, Reading for Technical Subjects**
Data collection	**Run the ball drop animation 10 times where the ball is dropped from buildings of different heights. Record the number of seconds the ball takes to hit the ground each time.**	**Data**	**Data collection**	**Undertake creative projects that involve selecting, using, and combining multiple applications, preferably across a range of devices, to achieve challenging goals, including collecting and analyzing data and meeting the needs of known users**	**Math, Reading for Technical Subjects**
Data types	**Create a method with three parameters, each one of a different data type.**	**Data**	**Data representation**	**Understand how data of various types (including text, sounds, and pictures) can be represented.**	**Math, College & Career Readiness**

Interactivity	**Obtain user input using "ask user" and create output based on the input information. Use events.**	**Data**		**Work with variables and various forms of input and output**	
Events	**Create a set of lights and controls where the user can mouse-click on a control to turn on/off the lights. Display a random value between 1 and 8. Then, allow the user to turn on/off the lights to create a binary representation of the number.**	**Creativity, Data types and representations**	**Data representation and analysis**	**Work with variables and various forms of input and output. Be able to carry out simple operations on binary numbers (for example, binary addition and conversion between binary and decimal).**	**Math**
List Structure & Transversal	**Create a list of penguins all standing at the edge of the water. Use a random number generator to determine which penguin is the next to jump into the water. If the penguin is already in the water, have them jump back up onto the ice. Calculate the percentage of times the random number generator selects a penguin that has already jumped into the water.**	**Data**	**Data representation and analysis**	**Make appropriate uses of data structures (for example, lists, tables, or arrays)**	**Math**
Model Validation	**Create an animation of a random event and repeatedly run the animation to show that you can't predict which event occurs next. (For example, which mole will pop up next in a whack-a-mole game.)**	**Data**	**Model validation**	**Design, use, and evaluate computational abstractions that model the state and behavior of real-world problems and physical systems.**	**Math**
Nested controls	**Simulate the action of a double Ferris wheel, where the wheels go around within a larger wheel.**	**Computing Practice & Programming**	**Control Structures**	**Use sequence, selection, and repetition in programs**	**College and Career Readiness, Writing**

Persistence	**Use incremental development as part of the development process. As bugs are discovered, fix the bug and continue until the project is completed.**	**Persistence**		**Use logical reasoning to detect and correct errors in algorithms and programs**	
Problem Solving with Decomposition	**Identify essential facts in a scenario for a story or a game. Break a complex action into simpler and simpler steps until you have a short sequence of basic instructions that, when performed, carry out that action.**	**Computing Practice & Programming**	**Problem Decomposition**	**Solve problems by decomposing them into smaller parts**	**Math**
Problem Solving with Expressions	**Create a Boolean expression that evaluates whether an object's color is blue.**	**Computing Practice & Programming**	**Problem Decomposition**	**Use sequence, selection, and repetition in programs**	**Math**
Problem Solving with Functions	**Create a function that returns the tallest of three objects in the scene.**	**Computing Practice & Programming**	**Problem Decomposition**	**Design and develop modular programs that use procedures or functions**	**Math**
Problem Solving with Open-ended Projects	**Work with a team to create a game, where each person on the team is responsible for a different part of the game.**	**Creativity, Collaboration**	**Problem Decomposition**	**Design, use, and evaluate computational abstractions that model the state and behavior of real-world problems and physical systems.**	**College and Career Readiness**
Problem Solving with Procedures	**Create a named set of instructions that defines an action for an object in a virtual world. (For example, a set of instructions that tell a dragon object how to flap its wings and fly.)**	**Abstraction, Decomposition, Procedures**	**Procedures**	**Design and develop modular programs that use procedures or functions**	**College and Career Readiness, Writing**

Recursive control	**Create an animation that shows the explosion of a rabbit population over 3 generations, using a Fibonacci sequence.**	**Computing Practice & Programming**	**Control Structures**	**Use sequence, selection, and repetition in programs**	**College and Career Readiness, Writing**
Repetitive Control with Counted Loop	**Simulate the action of a carousel, where the carousel goes around 10 times.**	**Computing Practice & Programming**	**Control Structures**	**Use sequence, selection, and repetition in programs**	**College and Career Readiness, Writing**
Repetitive Control with While Loop	**Create a whack-a-mole game that continues while the score is less than 10.**	**Computing Practice & Programming**	**Control Structures**	**Use sequence, selection, and repetition in programs**	**College and Career Readiness, Writing**
Sequential Control	**Create an animation consisting of a sequence of steps, e.g. have a frog jump through a hoop and then say "G-day"**	**Computing Practice & Programming**	**Control Structures**	**Understand that a program executes by following precise and unambiguous instructions**	**College and Career Readiness, Writing**
Sharing your world	**Save world as a video. Posting a video online.**	**Community, Global, and Ethical Impacts**		**Understand a range of ways to use technology safely, respectfully, responsibly, and securely, including protecting their online identity and privacy**	**College and Career Readiness**
Simulation	**Create an animation that simulates dropping a ball from the roof a building. The effect of gravity should determine the time it takes for the ball to hit the ground, given the height of the building.**	**Computing Practice & Programming**	**Simulation**	**Design, create, and debug a program that accomplishes a specific goal, including controlling or simulating a physical system**	**Math**

State and Behavior	**Create an animation with two objects of the same type. Each object performs move, turn, and roll actions. Track the changes in position and orientation as the behavior changes the state of the object.**	**Computing Practice & Programming**	**Simulation**	**Design, create, and debug a program that accomplishes a specific goal, including controlling or simulating a physical system**	**Math**
Storyboard Design	**Create a storyboard for a story. Convert the story to an algorithm.. Present the design to other members of a group to obtain feedback.**	**Algorithms, Collaboration**	**Algorithms**	**Understand what an algorithm is and how it is implemented in a program. Use logical reasoning to explain how some simple algorithms work.**	**College and Career Readiness, Speaking and Listening**
Testing & Debugging	**Use incremental development, where a program is composed in small units, one unit at a time. Each unit is tested by running it. If a problem is observed, fix the problem before going on. Test with different input to verify. (For example, mouse click on different objects in the world while the animation is running, to verify appropriate responses.)**	**Computing Practice & Programming**	**Testing and Verification (debugging)**	**Understand that a program executes by following precise and unambiguous instructions. Use logical reasoning to detect and correct errors in algorithms and programs.**	**Math**
Writing Code	**Create program code in the code editor.**	**Computing Practice & Programming**	**Implementation**	**Design and develop modular programs that use procedures or functions**	**College and Career Readiness, Writing**

Alice 2 Programming Topic Outline

Note: Topics are in blue, subtopics in green, and mapped concepts in red.

An Alice Virtual World Creativity

- Models and Objects Data
- Center Data
- Position Data
- Properties Data

Animation State & Behavior, Data

- Three dimensions Data
    - *Positive number line*
    - *Negative number line*
- Six directions of motion State & Behavior
    - *Self-centric*
- Distance traveled Data
- *Real numbers Data*

Scenario (Read and Understand the Problem) Problem Solving

- Reading the scenario Read for understanding
- Identify the objects Data
- Identify the actions State & Behavior

Design Algorithm, Abstraction, Communication

- Create a storyboard Storyboard Design, Problem Solving - Decomposition
  - Frames Decomposition, State & Behavior
  - Text version – Algorithm
- Set up a scene Creativity, Virtual World
  - Add objects Classes & Objects
  - Markers Data
  - Camera motions State & Behavior
  - One-shot actions State & Behavior

A First Program Computing Practice and Programming

- What is a program? Writing code
- Create program statements Writing code
  - Required information Data
- Sequence Control
  - Do in order Sequential Control
  - Do together Concurrency
- Play (view & test) Persistence, Testing & Debugging
- How to modify statements Debugging
  - Optional information Data
  - Duration Data

- Comments Communication
- Saving your program Computers and Communication Devices
    - Hard drive, thumb drive
    - Dropbox (network)

Functions Problem Solving - Functions, Animation of Automation

- Conditions in a virtual world Data
- What does a function do? Abstraction
- Different kinds of functions Data
    - Types of data (numeric (whole, real, binary), string, object, color Data
    - Whole world or object-based Abstraction

Expressions Problem Solving –Expressions, Data

- Math
    - Operators
    - Functions
- Relational
    - Operators
    - Functions
- Boolean logic

Control blocks Computing Practice and Programming

- If-else (conditional) Control, Conditional (Selection)
  - Logic diagram
  - Two segments
  - Do nothing
- Loop (repetition) Control, Repetition
  - Counted
  - Whole number index
  - While
  - Nested Nested controls
  - Recursion Recursive control

Writing a method Abstraction, Problem Solving - Procedures

- Create a new method Writing code
  - World-level Virtual world
  - Class/object-level Classes & Objects

- **Calling a new method Writing code**

Interactivity and Events Interactivity, Computing Practice and Programming

- **How to create an event Writing code**
    - **Key press Events**
    - **Mouse click Events**
- **Calling a method when an event occurs Writing code**
- **When versus while Control**
- **Game Project Collaboration, Problem Solving – Open-ended Projects**

Variables Data Representation

- **Data types**
- **Parameters**

Using a list List structure & traversal, Simulation

- Creating a list **Creativity, Virtual World**
- Traversal **Algorithm**
    - All in order **Sequence**
    - All together **Concurrency**
- Tracking data **Model validation**
    - Representation with bar chart **Data collection, analysis**

Sharing your world Community, Global, and Ethical Impacts

- Creating a video
- Posting a video
- Online safety