

**Science and Math in Motion! Using Scratch to
Create Interactive Programs That Integrate
Computer Science, Math, and Science Standards**

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BYOL Session 16

Christopher Michaud, Nebo Elementary

Paulding County Schools

Dallas, Georgia

www.nebomusic.net



Three Activities of Children

- Games
- Storytelling
- Simulations



Why Programming?

- Programming allows students to encode and reflect on sequential and logical thought in a dynamic system.
- Real applications of math concepts
 - Coordinate plane
 - Directions
 - Grids/Arrays
- Game making is a form of storytelling
- Develops Technological Fluency



What is Scratch?

- Scratch was developed by MIT to teach young students programming concepts and develop skill in multimedia communication. Using a visual system of "Tiles" that contain commands users can connect together to create scripts. These scripts direct the characters and objects in the program.
- Website: www.scratch.mit.edu



Why Scratch?

- Easy and Fun!
- Visual - way we think
- Object orientated
- Flexible - low floor, high ceiling
- Runs on Mac, Windows, and Linux
- Encourages Open source model
- FREE!!!



Hierarchy of Technology Skills

1. **Passive Reception:** From creator to receiver with no action on receiver to alter flow of content. (watching a video)
2. **Active Research:** From creator to receiver with receiver selecting path and specific points of content. (Surfing the web)
3. **Interactive 1 way:** From creator to receiver through game model. Receiver must master a skill to progress through activity. (Skill and Drill)
4. **Communication / Expression:** User creates content and art with technology.
Verbal / Text Images Plot Web
5. **Interactive 2 way:** creator and users interact. (Email, Blogs, Multi-User Virtual Environments)
6. **Data manipulation and Analysis:** User uses computer to interact and manipulate the content and data.
7. **Software creation / programming:** Users encodes logical thought and algorithms into computer. User tells computer what to do. Provides platforms and engines for above skill sets.
8. **Hardware creation:** User designs and assembles hardware to run, input, display software.



7 Essentials Elementary

Programming:

Objects

Loops

Methods

Conditionals \implies Events

Properties

Variables

7 Essentials Elementary

Programming:

Who

What

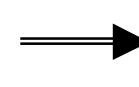
When

Objects

Loops

Methods

Conditionals



Events

Properties

Variables



Computer Science Concepts Covered in Elementary Scratch

- Sequence
 - Iteration
 - Threading
 - Variables
 - Conditionals
 - Boolean Logic
 - Algorithms
 - Random numbers
- New in Scratch 1.4:
- Strings
 - Lists
 - Question and Answer (User text input)
 - We-Do Robotics Support (Blocks for motors and sensors)

Installing Scratch

Windows:

- Copy Scratch Directory to C:\ Drive
- Double Click Scratch icon to open

OS X:

- Open Disk Image
- Scratch folder to your home directory
- Double click Scratch icon to open

Linux

Copy files

Install Squeak

Run Squeak in terminal with
Scratch.image

“squeak Scratch.image”

Download:

www.scratch.mit.edu/pages/download



Today's Goals

- Overview of Connecting Math and Science Standards to Scratch Activities
- Coordinate Plane and Scratch
- Balloon Game
- Cell Program
- Question and Answer



GPS Standards and Scratch

- **M5A1:** Students will represent and interpret the relationships between quantities algebraically.
- **M4G3:** Students will use the coordinate system.



GPS Standards and Scratch

- **M5P3:** Students will communicate mathematically.
- **M5P1:** Students will solve problems (using appropriate technology).

Script Selection Buttons Pane:

Getting Started

The image shows the Scratch 1.0.1 interface with several callout boxes explaining key components:

- Script Selection Buttons Pane:** Located on the left side, it contains buttons for Motion, Looks, Sound, Pen, Control, Sensing, Numbers, and Variables.
- Scripts Pane:** The central workspace where instructions for the sprite are entered. An example script is shown: "when right arrow key pressed" followed by "move 10 steps".
- World:** The main stage where the game takes place.
- Go and Stop:** Buttons in the top right corner for starting and stopping scripts.
- Sprite:** Any character or object, represented by the Scratch cat.
- Tiles:** Commands for the sprite, such as "x position", "y position", and "direction", located at the bottom left of the Scripts Pane.
- Sprites Pane:** Located at the bottom right, it lists the sprites in the program, showing "Sprite1" with 2 costumes and 1 script.



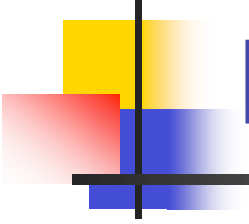
Online Scratch Exercise: Balloon Game

- <http://www.nebomusic.net/BalloonPopScripts.html>



Online Scratch Exercise: Eater

- <http://nebomusic.net/scratchlesson1/scratchexercise1.html>
- Lesson 1: Choosing a Sprite and Making it move in 4 directions.
- Lesson 2: Sense the World - Using Conditional Statements.
- Lesson 3: Something to Eat - Conditionals, Variables, Hiding, and Sound



Online Scratch Exercise: Polygon Robot

- www.nebomusic.net

- <http://nebomusic.net/PolyRobotProject.html>

- <http://nebomusic.net/Polygon Step By Step.html>



Online Scratch Exercise: Molecule Simulator

- www.nebomusic.net

- [Directions for Teachers](#)

- [Directions for Students](#)

- http://nebomusic.net/Molecule_Simulator_Step_By_Step.html



Online Scratch Exercise: Cell Simulator

- www.nebomusic.net

- [Directions for Teachers](#)



Uploading and Accounts

- Scratch provides free user accounts to upload your projects to the internet.
- Allows other users to run your programs through their web browser. (Uses Java)
- “You Tube” for Scratch Programmers
- Access scripts - open source model
- Can embed Scratch applications in your websites. [\(Example 1\)](#) / [\(Example 2\)](#)

Types of Games / Sequence for teaching beginners

Types of Games:

- “Chasing”
- “Red Light / Green Light”
- Pong
- Target Games
- Animations
- Simulations

Sequence for Beginners:

1. Creating/Drawing Sprites
2. User Directed Movement
3. Random Movement
4. Costumes
5. Interacting/Hide/Show
6. If - Then Scripts
7. “Bouncing”
8. Scoring/Variables
9. Sound and Stage
10. Pen and Stamp
11. Broadcast Commands
12. Storytelling/Animation
13. Simulations/Functions



Sample Scratch Projects

- www.nebomusic.net
 - [Student Projects by Students](#)
 - [Sample Projects for Students](#)
 - [Sample Teacher created Projects for Music Class](#)
- Also more advanced project examples included with Scratch Download.

Have a Great Nebo Day!



Scratch On!

Questions: Please contact Mr. Michaud
at:

nebomusic@gmail.com

-Or-

www.nebomusic.net