Visualizing Computational Thinking in STEAM with 3D Modeling.

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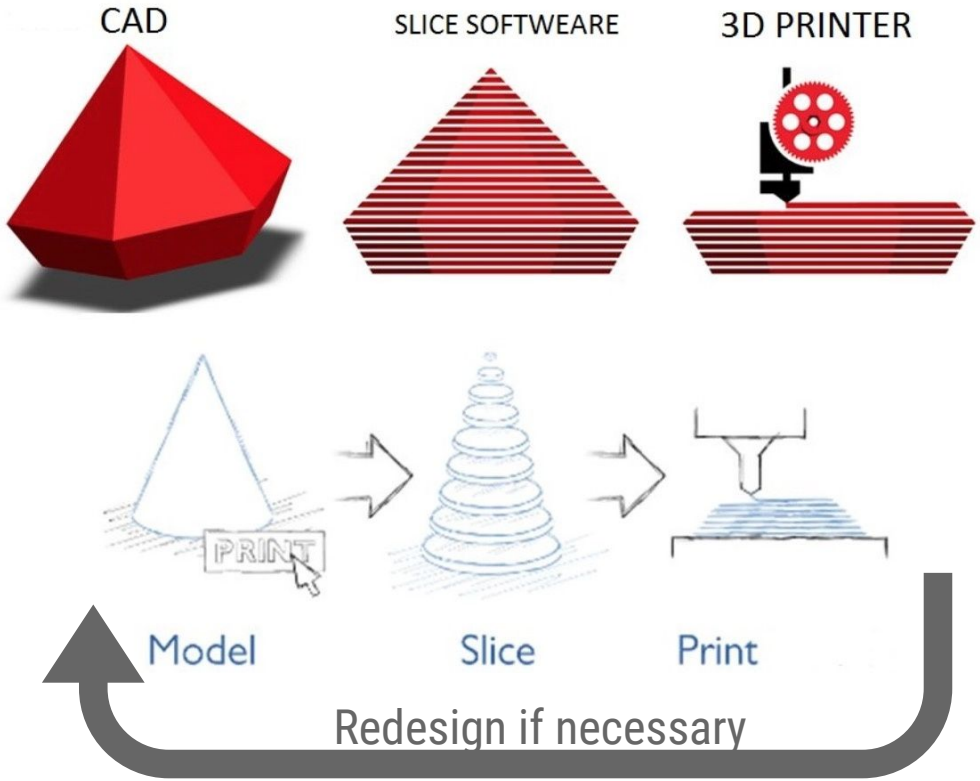
What is 3D Modeling?

3D modeling (or three-dimensional modeling) is the process of developing a mathematical representation of any surface of an object (either inanimate or living) in three dimensions via specialized software. *[from Wikipedia]*

What is 3D Printing?

3D printing, also known as **additive manufacturing (AM)**, refers to processes used to create a three-dimensional object in which layers of material are formed under computer control to create an object. *[from Wikipedia]*

3D Printing Process Flow



Standards Alignment

ISTE

Computational Thinking for Educators (Link)

CSTA

Computer Science Teachers Association (Link)

MA DLCS

Massachusetts Digital Literacy & Computer Science (Link)

STEAM

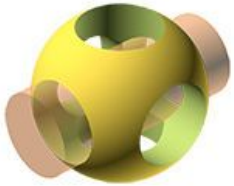
Core Content Standards

Interdisciplinary Integration

Choosing a 3D Printer

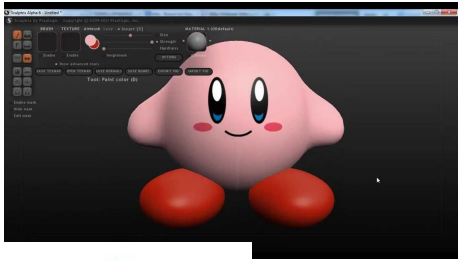
Things to Consider	Dremel Idea Builder	New Matter MOD-t	MakerBot Replicator+
Maximum print size (H x W x D)	5.5 x 9 x 5.9 inches	5 x 6 x 4 inches	6.5 x 11.6 x 7.6 inches
Materials	PLA	PLA	PLA, ABS
Enclosed?	Yes	Yes	Yes
Connectivity	WiFi; USB	WiFi; USB	WiFi, USB
Generic filament?	No*	Yes	No*
Price	~$1500	~$250	~$2400

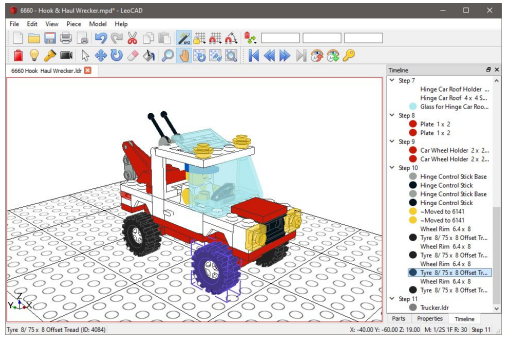
Few Tools & Environments



OpenSCAD

The Programmers Solid 3D CAD Modeller





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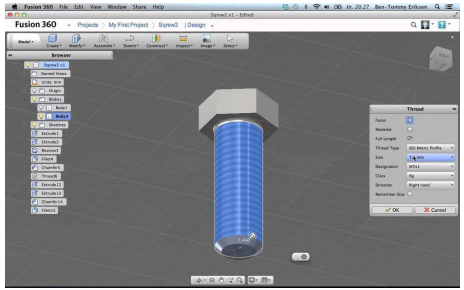


SCULPTRIS

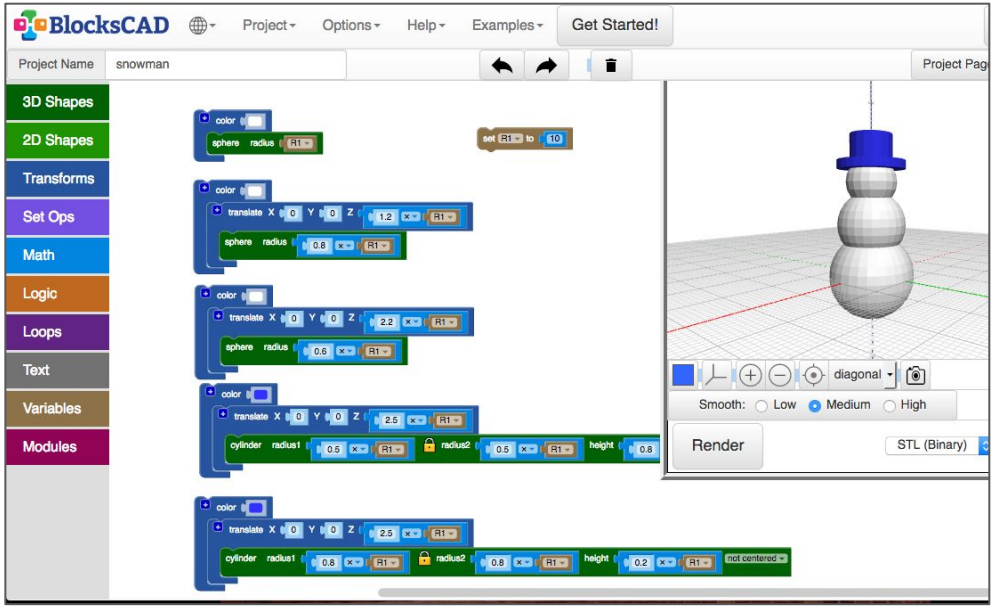
BLOKIFY

LeoCAD

CAD application for creating virtual LEGO models

What is BlocksCAD?

- Scratch-like coding platform for 3D Modeling
- Compatible with 3D printing
- Learn coding principles while using math to create 3D models



Tinkercad VS BlocksCAD

Tinkercad

- Drag & drop interface; ideal for “tinkering”
- Easier to start
- Rich library of user-generated geometries
- Difficult to make precise designs

BlocksCAD

- Can make precise designs
- Can automate resizing using variables
- Easily make repetitive features using loops
- Uses computational thinking
- Requires more planning
- Limited base geometries

Quick Session Assignment

- Option 1: Design a personalized box or cup for your desk (i.e., business card holder).
- Option 2: Six(or more)-sided die with numbers/letters/symbols of your choice.

Requirements:

- Evidence of planning and design (i.e., photo of a sketch)
- Use of at least two types of 3D Shapes
- Design must be resizable using ***variables***

Basic Steps

Basic Shapes:

- Box
- Cylinder
- Sphere
- Torus (polygon)

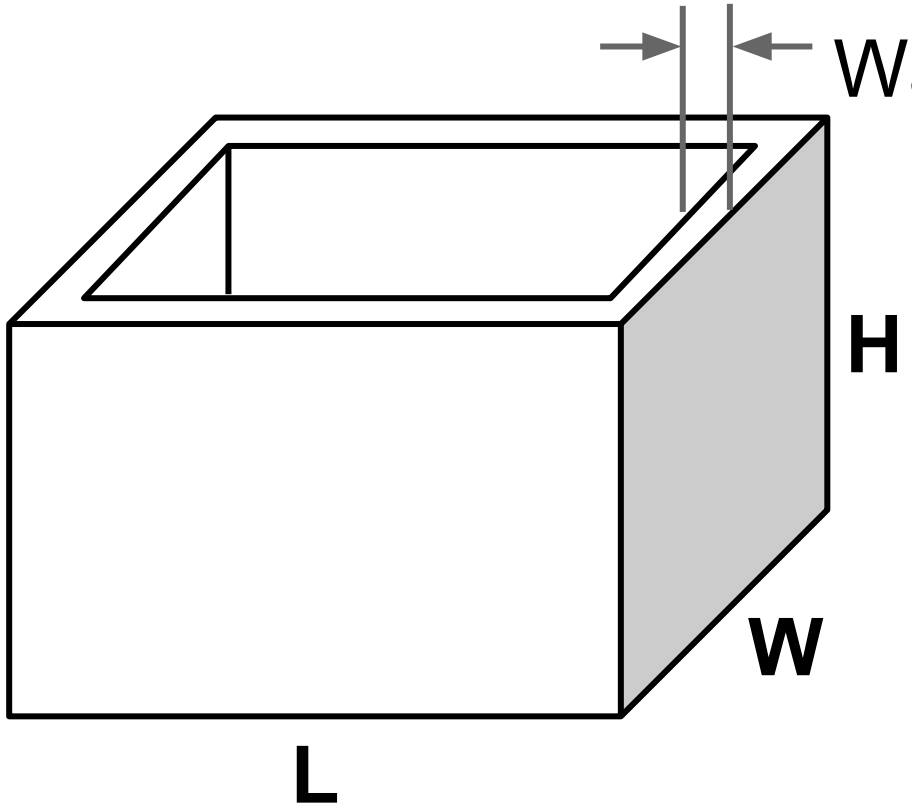
Apply Transformations:

- Translate
- Rotate
- Scale
- Mirror

Combine Shapes:

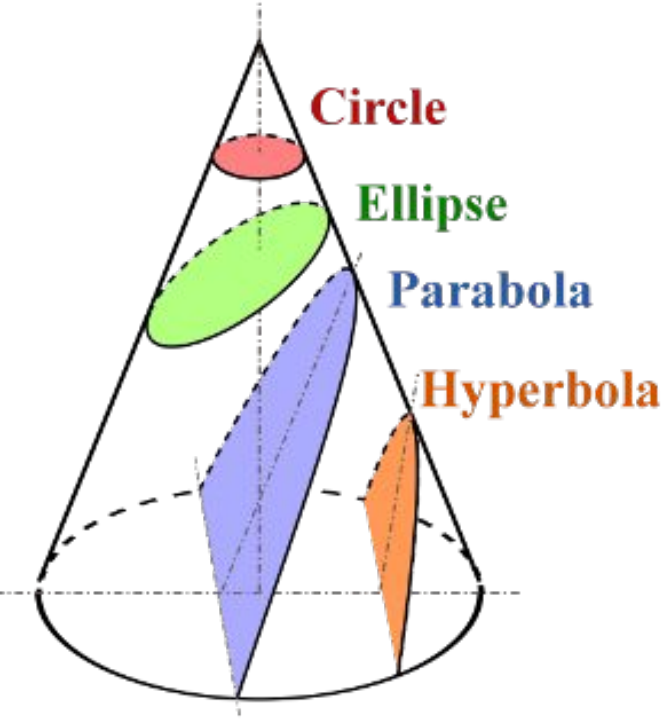
- Union
- Difference
- Intersect
- Hull

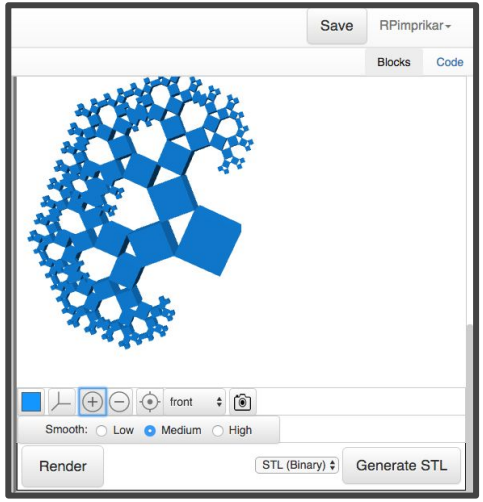
Variable Box or Dice

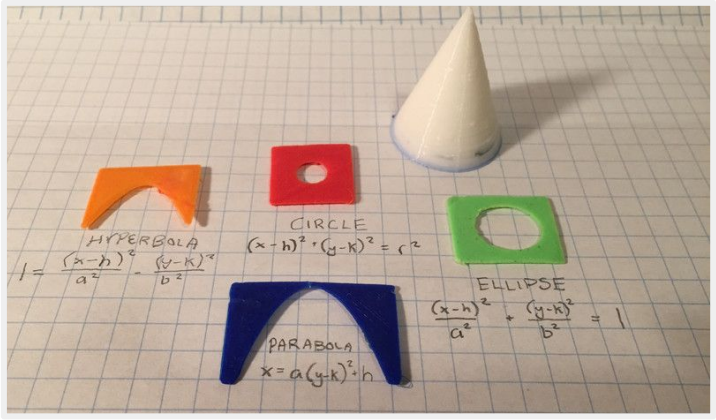


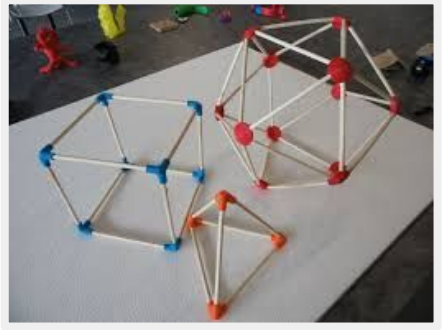
Interdisciplinary Student Projects

3D Modeling in Mathematics

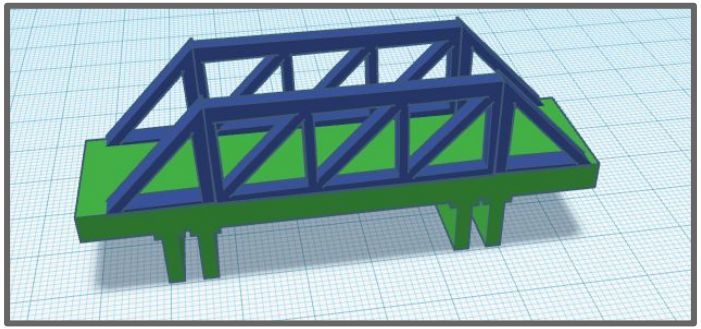


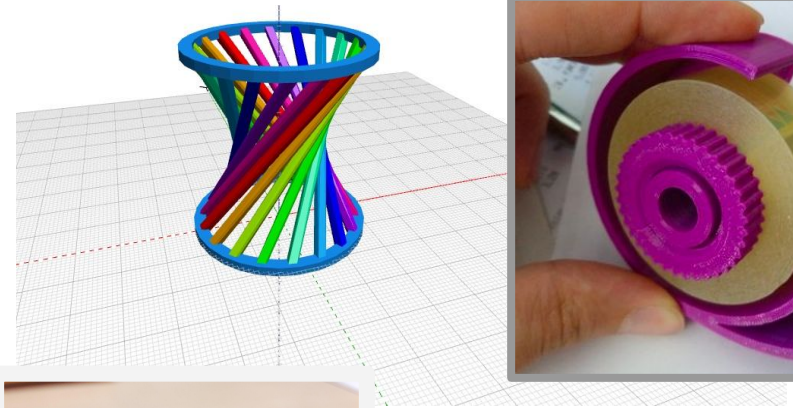


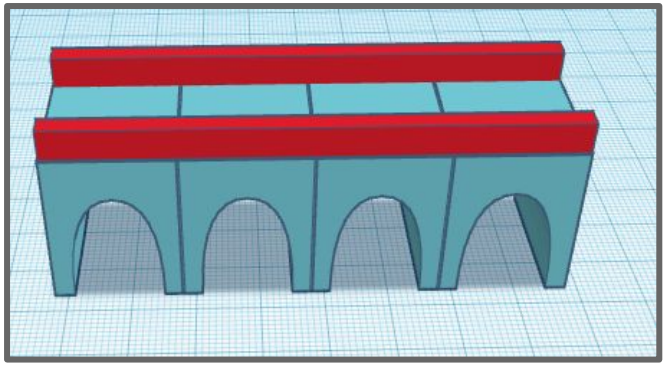




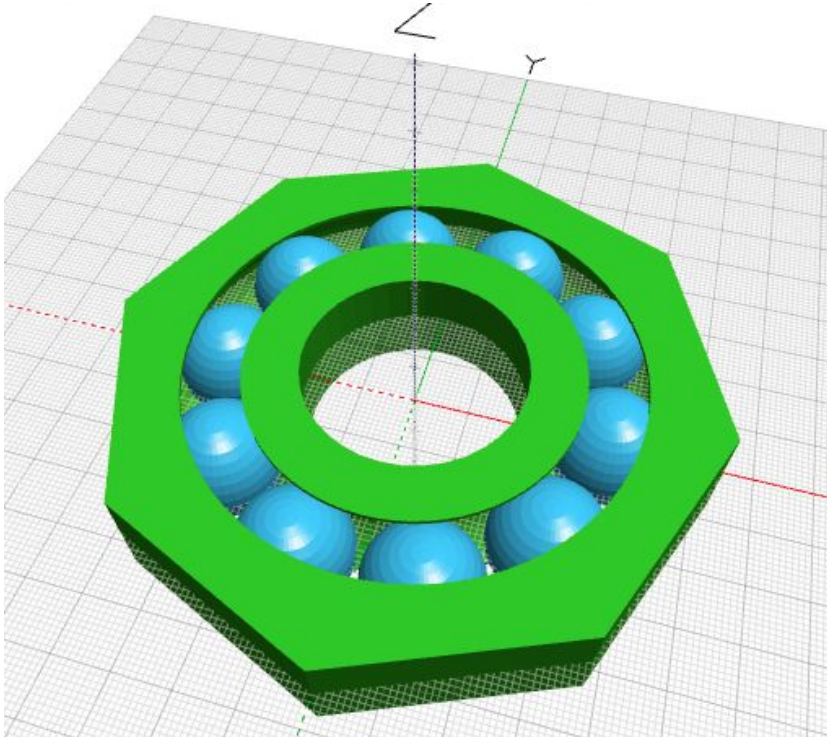
Prototypes

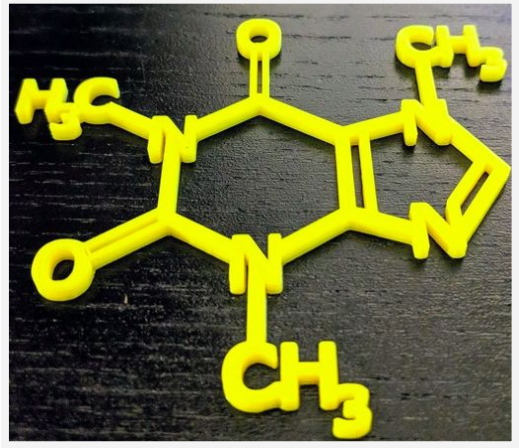


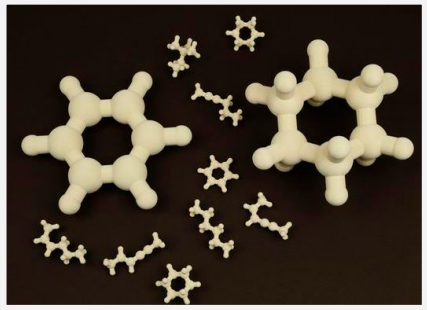


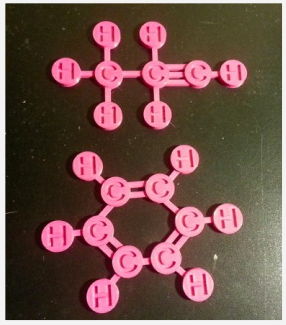


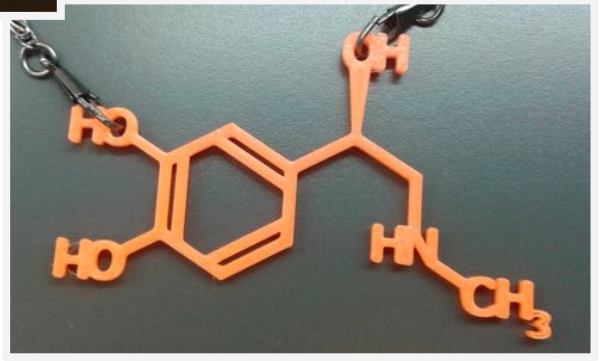
3D Modeling in SCIENCE



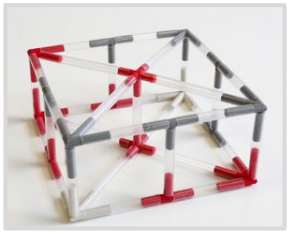


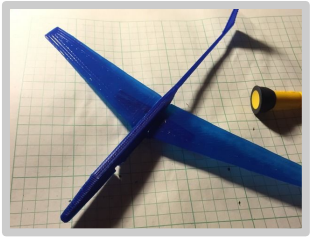


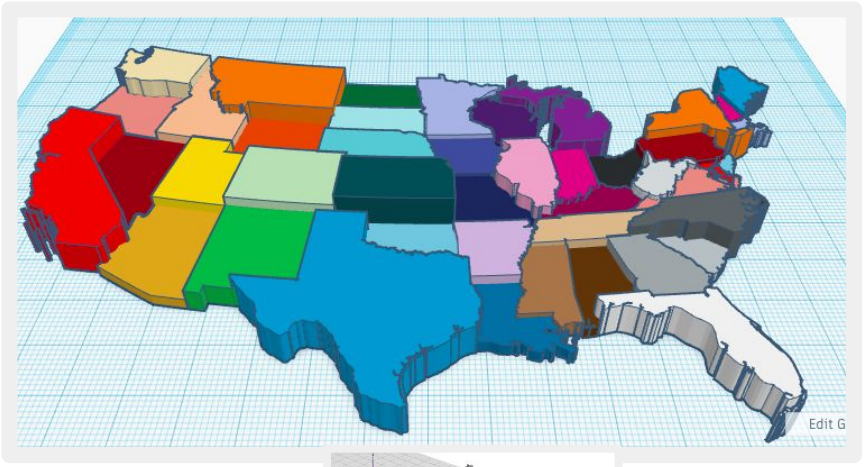


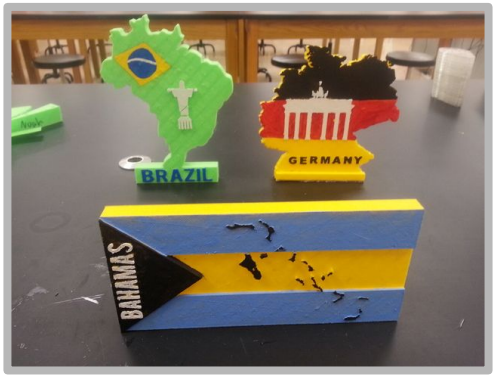


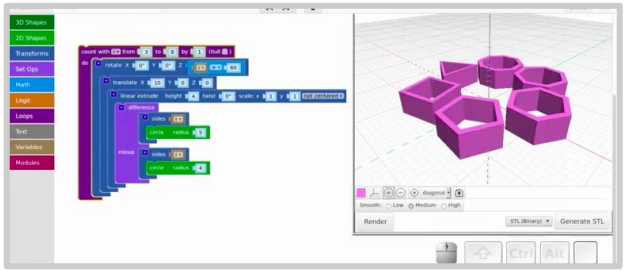
A few Prototypes

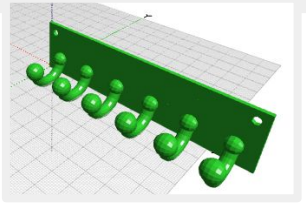












DLCS @ Lesley University

Digital Literacy and Computer Science (DLCS) Overview

The standards for Kindergarten to grade12 are organized by **grade span**: Kindergarten to grade 2, grade 3 to grade 5, grade 6 to grade 8, and grade 9 to grade 12. Within each grade span, standards are grouped in four **strands**: Computing and Society, Digital Tools and Collaboration, Computing Systems, and Computational Thinking. Each strand is further subdivided into **topics** comprised of related **standards**. Standards define performance expectations, as well as what students should know and be able to do. Standards from different strands or topics may sometimes be closely related. Standards in every grade span and strand demonstrate a range of cognitive complexity such as reflected in Bloom's Revised Taxonomy: remembering, understanding, applying, analyzing, evaluating, and creating.[1]

Vision
Digital Literacy and Computer Science (DLCS) knowledge, reasoning, and skills are essential both to prepare students for personal and civic efficacy in the twenty-first century and to prepare and inspire a much larger and more diverse number of students to pursue the innovative and creative careers of the future. The abilities to effectively use and create technology to solve complex problems are the new and essential literacy skills of the twenty-first century.

Learning Progression

Grade Spans	Strands			
	CAS: Computing and Society	**DTC: Digital Tools and Collaboration**	**CS: Computing Systems**	**CT: Computational Thinking**
K-2	a. Safety and Security b. Ethics and Laws c. Interpersonal and Societal Impact	a. Digital Tools b. Collaboration and Communication c. Research	a. Computing Devices b. Human and Computer Partnerships c. Networks d. Services	a. Abstraction b. Algorithms c. Data d. Programming and Development e. Modeling and Simulation
3-5				
6-8				
9-12				

Practices: Connecting, Creating, Abstracting, Analyzing, Communicating, Collaborating, Research

Q/A