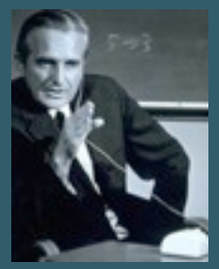
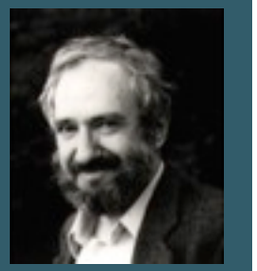
The iPad In Elementary Education
Part 2: Studying Science

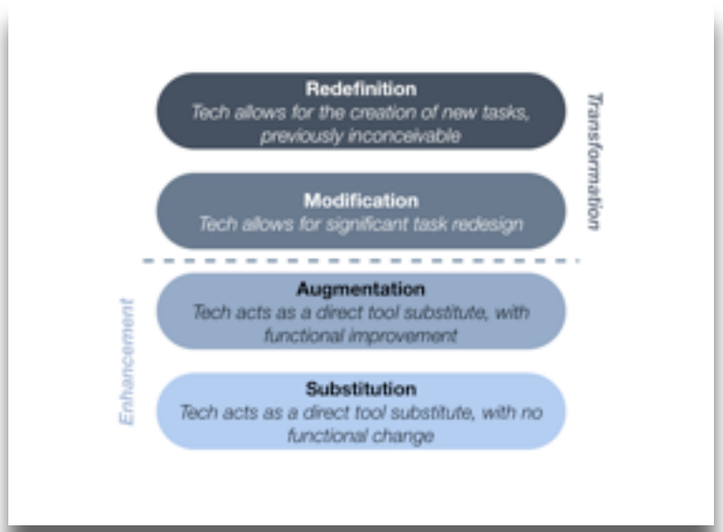
Ruben R. Puentedura, Ph.D.

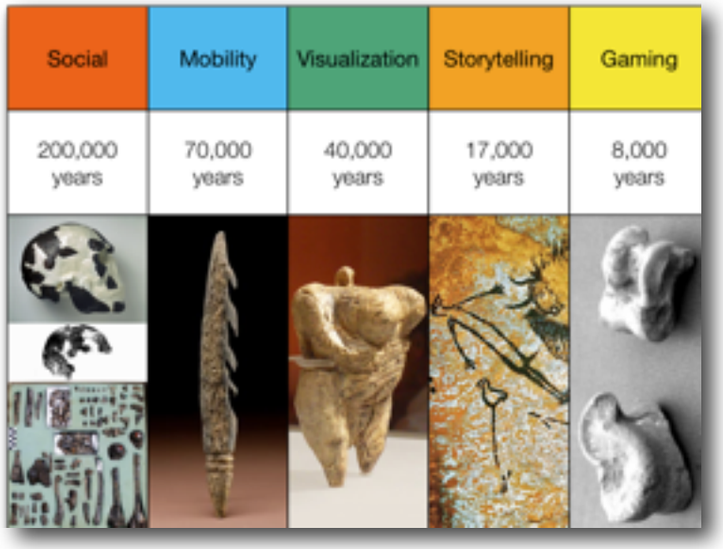



Augmenting Human Intellect & Learning Capacity

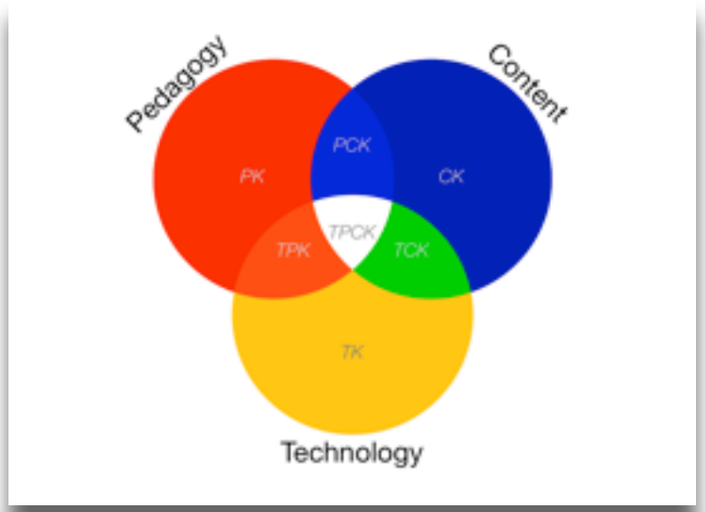



21st Century Learning





Social	Mobility	Visualization	Storytelling	Gaming
200,000 years	70,000 years	40,000 years	17,000 years	8,000 years



One-to-One Technologies

Defining Mobile Devices

- **Three key characteristics:**
  - Ubiquity
  - Intimacy
  - Embeddedness
- **Two metaphors:**
  - The Lively Sketchbook
  - The Curiosity Amplifier

Redefinition
Tech allows for the creation of new tasks, previously inconceivable

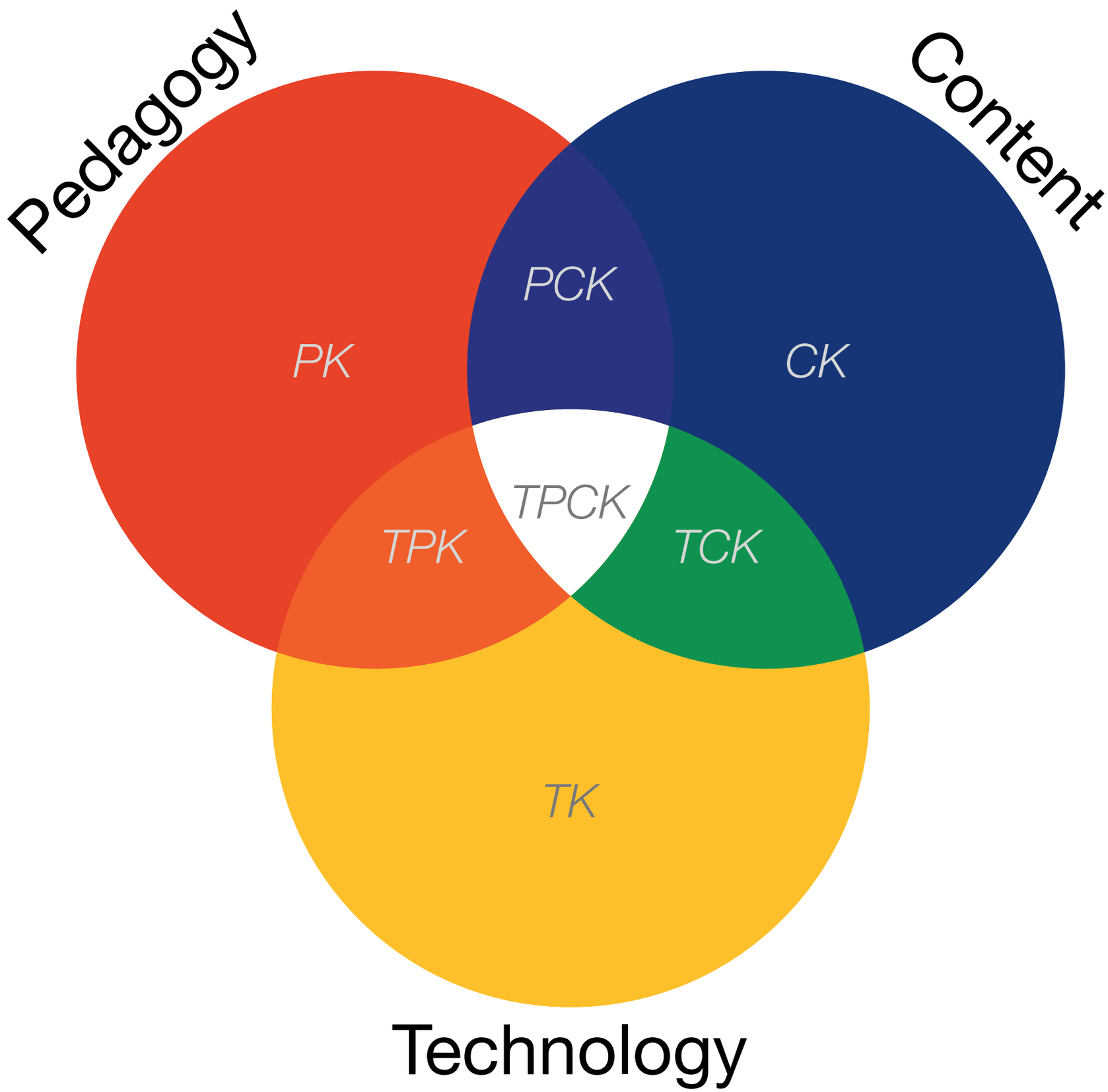
Modification
Tech allows for significant task redesign

Transformation

Augmentation
Tech acts as a direct tool substitute, with functional improvement

Substitution
Tech acts as a direct tool substitute, with no functional change

Enhancement



More Information: http://tpck.org/

Social	Mobility	Visualization	Storytelling	Gaming
200,000 years	70,000 years	40,000 years	17,000 years	8,000 years

21st Century Learning (Mishra & Kereluik)

- **Foundational Knowledge**
  - Core Content Knowledge
  - Information Literacy
  - Cross-Disciplinary Knowledge/Synthesis
- **Meta Knowledge**
  - Problem Solving & Critical Thinking
  - Communication & Collaboration
  - Creativity & Innovation
- **Humanistic Knowledge**
  - Life & Job Skills
  - Cultural Competence
  - Ethical & Emotional Awareness

P. Mishra and K. Kereluik. *What is 21st Century Learning? A review and synthesis*. SITE2011 Conference Presentation. (March, 2011)

Bloom's Taxonomy (Revised) (Anderson and Krathwohl, 2001)

	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge						
Conceptual Knowledge						
Procedural Knowledge						
Meta-Cognitive Knowledge						

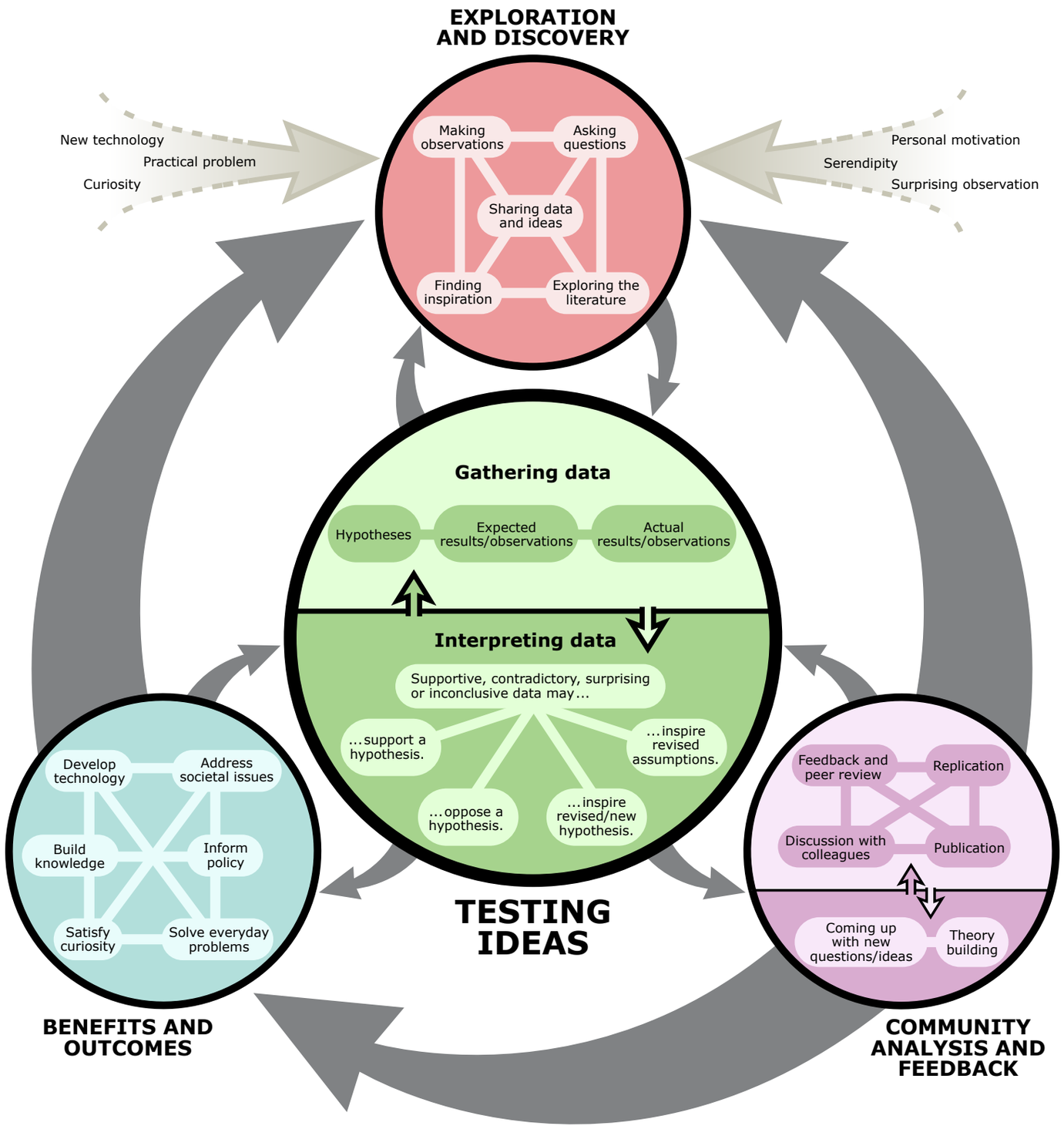
Lorin W. Anderson and David R. Krathwohl (Eds.), *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives, Complete Edition*. Longman. (2000)

Critical Thinking: Cognitive Skills and Subskills

Skill	Subskills
Interpretation	• Categorization • Decoding Significance • Clarifying Meaning
Analysis	• Examining Ideas • Identifying Arguments • Analyzing Arguments
Evaluation	• Assessing Claims • Assessing Arguments
Inference	• Querying Evidence • Conjecturing Alternatives • Drawing Conclusions
Explanation	• Stating Results • Justifying Procedures • Presenting Arguments
Self-Regulation	• Self-examination • Self-correction

Peter Facione, *Critical Thinking: A Statement of Expert Consensus for Purposes of Educational Assessment and Instruction - Executive Summary*. "The Delphi Report". American Philosophical Association, Committee on Pre-College Philosophy. California Academic Press, 1990

Understanding Science: How Science Works



P21 Common Core Toolkit

A Guide to Aligning the Common Core State Standards with the Framework for 21st Century Skills

Partnership for 21st Century Skills

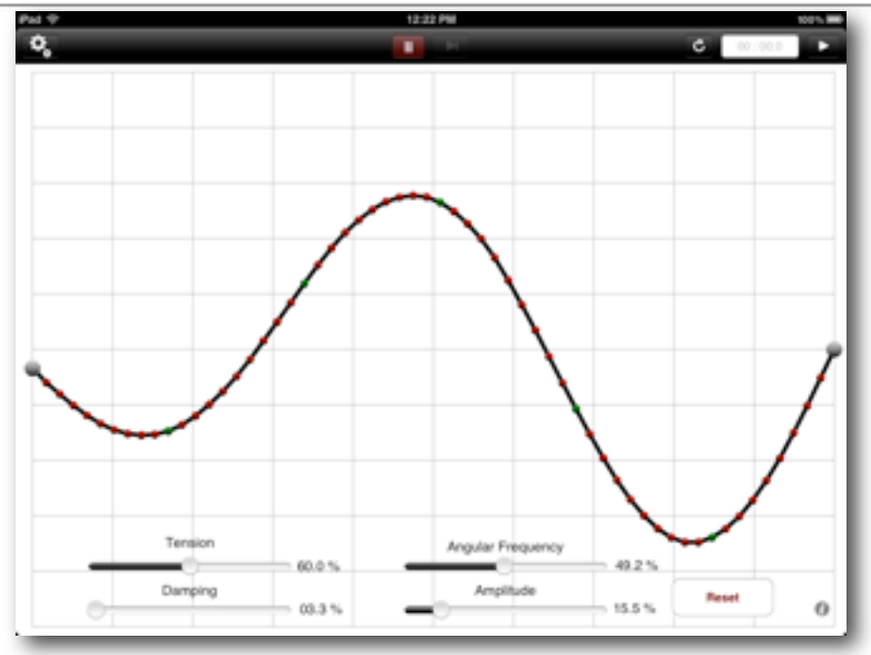
It is imperative that the CCSS be considered the "floor"—not the "ceiling"—when it comes to expectations for student performance in the 21st century.

Using the *Framework for K-12 Science Education*

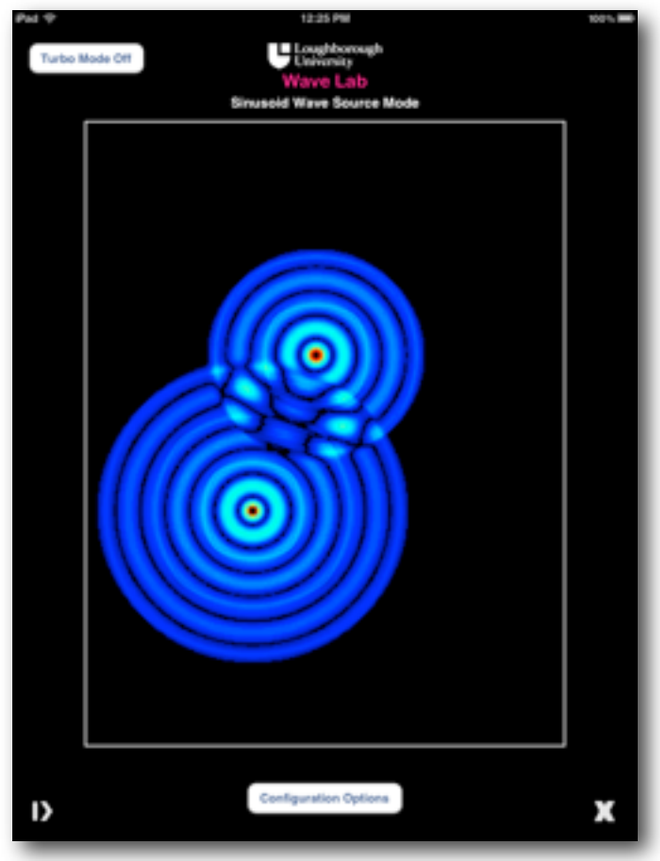
- **Core Idea PS4: Waves and their Applications in Technologies for Information Transfer**
  - PS4.A: Wave Properties
    - *What are the characteristic behaviors and properties of waves?*
  - PS4.B: Electromagnetic Radiation
    - *What is light?*
    - *How can one explain the varied effects that involve light?*
    - *What other forms of electromagnetic radiation are there?*
  - PS4.C: Information Technologies and Instrumentation
    - *How are instruments that transmit and detect waves used to extend human senses?*

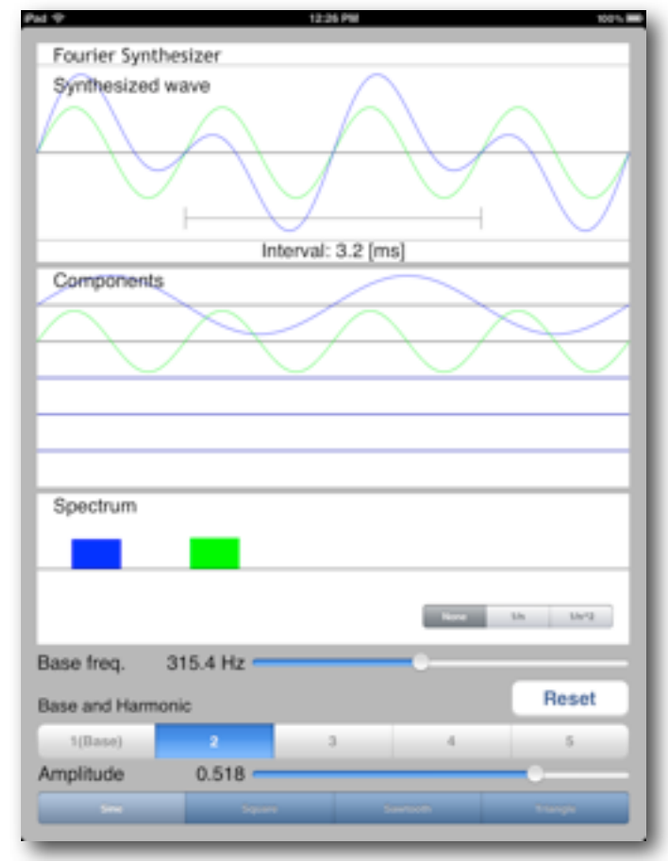
Observe Waves

Basic Waves

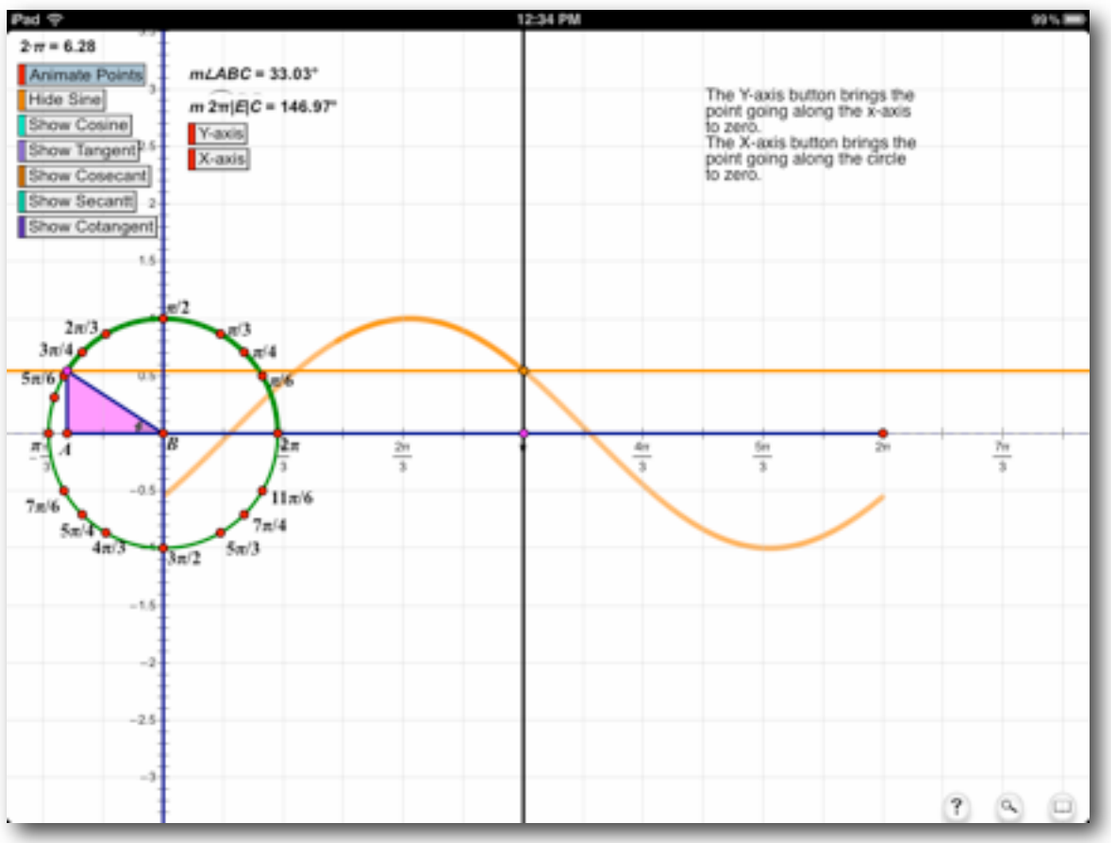

Tension
60.0 %
Angular Frequency
49.2 %
Damping
03.3 %
Amplitude
15.5 %
Reset

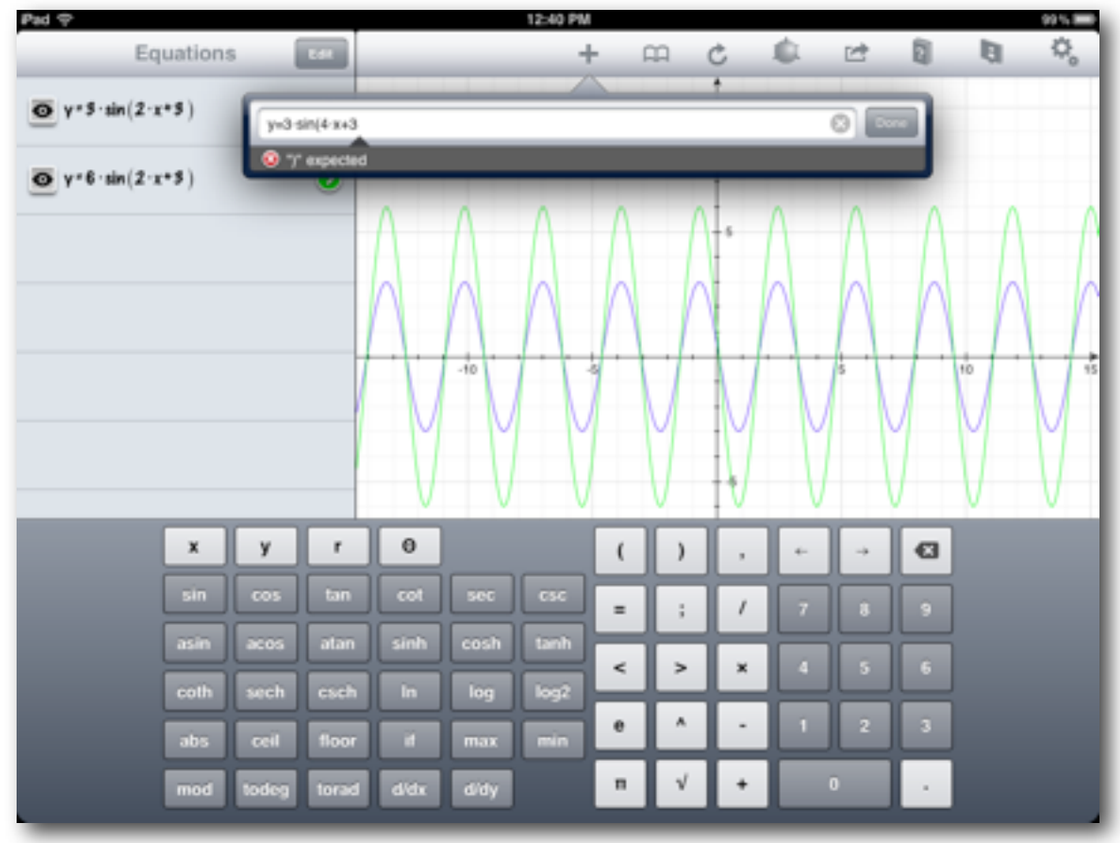

TONES
NOISE
SWEEP
SQUARE WAVE
ON
OFF
2500
Hz
OCTAVE
TONE GENERATOR PRO
25
100
250
400
1 K
1.6 K
2.5 K
10 K
16 K
Tools
Info


Turbo Mode Off
Loughborough University
Wave Lab
Sinusoid Wave Source Mode
Configuration Options

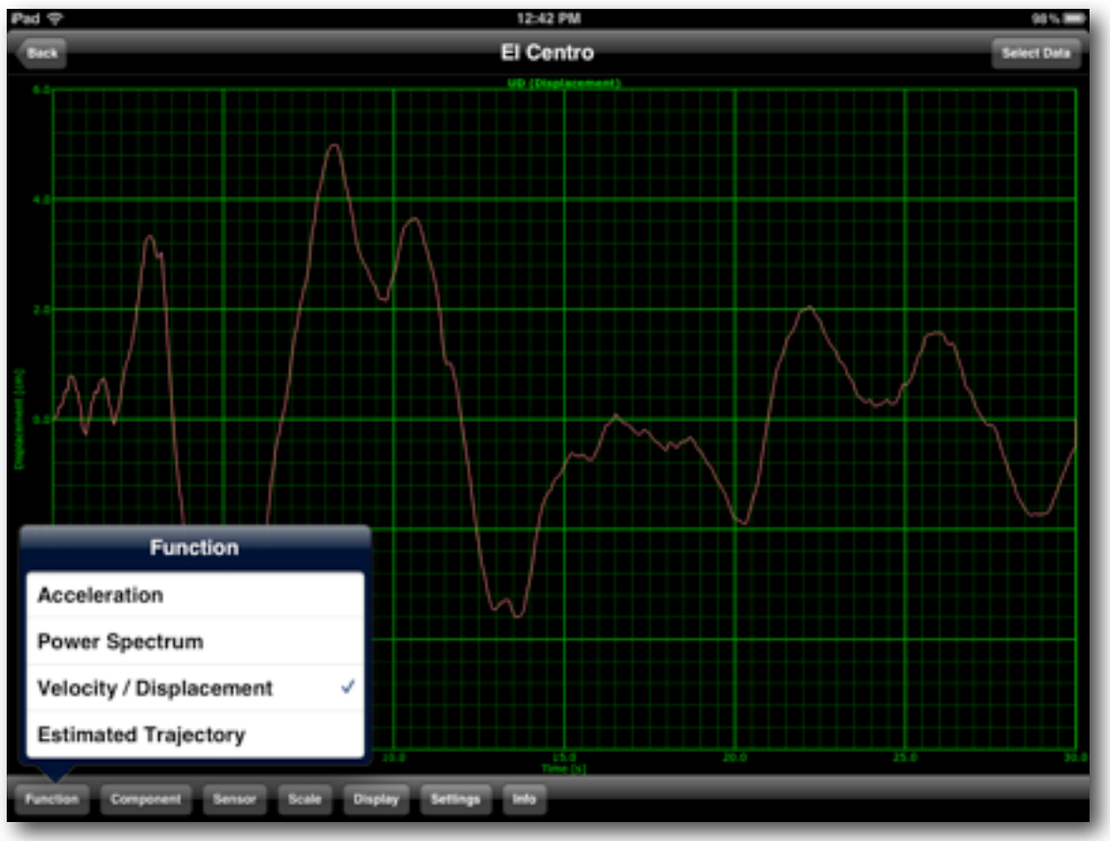

Fourier Synthesizer
Synthesized wave
Interval: 3.2 [ms]
Components
Spectrum
Base freq.
315.4 Hz
Base and Harmonic
Reset
1(Base)
2
3
4
5
Amplitude
0.518

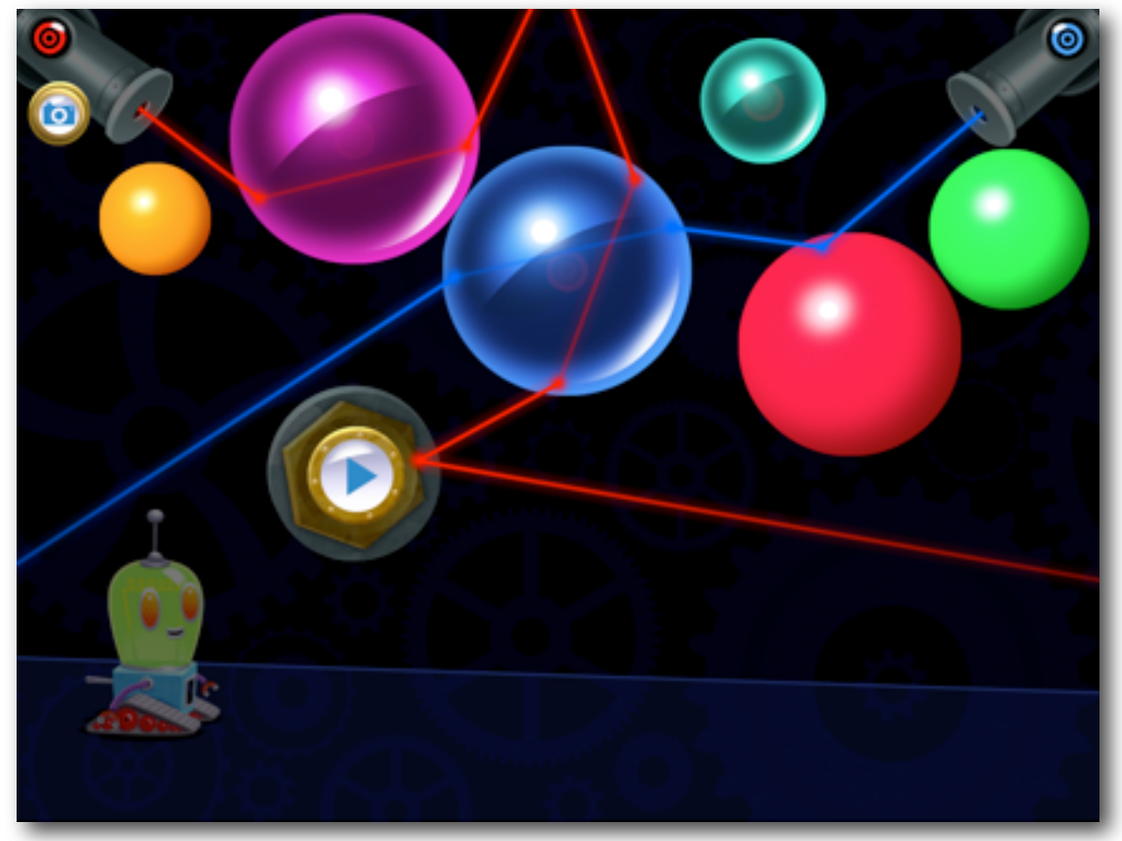
Math Waves


2·π = 6.28
Animate Points
Hide Sine
Show Cosine
Show Tangent
Show Cosecant
Show Secant
Show Cotangent
mLABC = 33.03°
m 2π|E|C = 146.97°
Y-axis
X-axis
The Y-axis button brings the point going along the x-axis to zero.
The X-axis button brings the point going along the circle to zero.

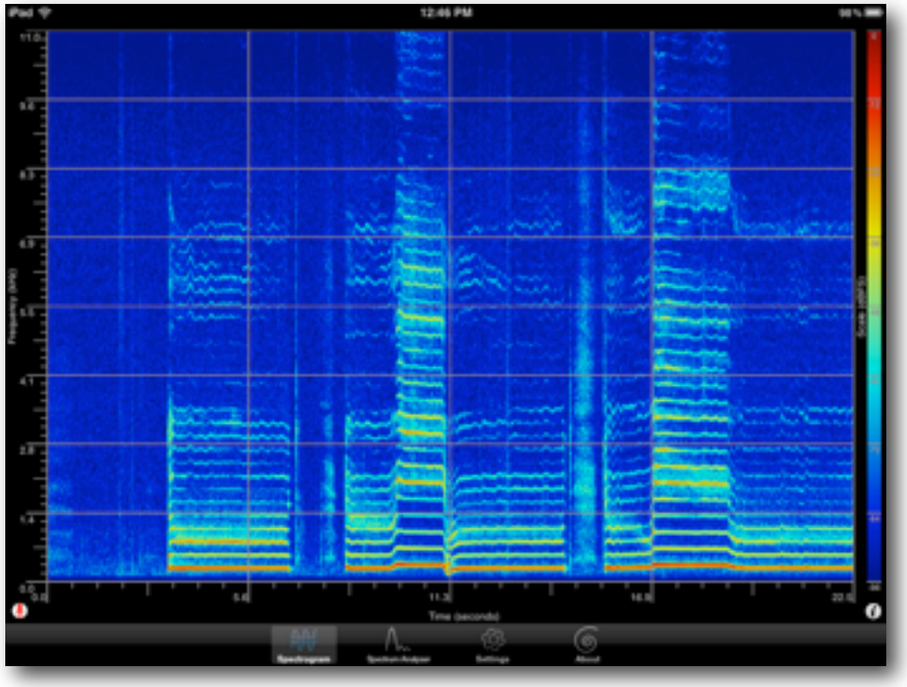

Equations
Edit
y=3·sin(4·x+3
"(" expected
Done

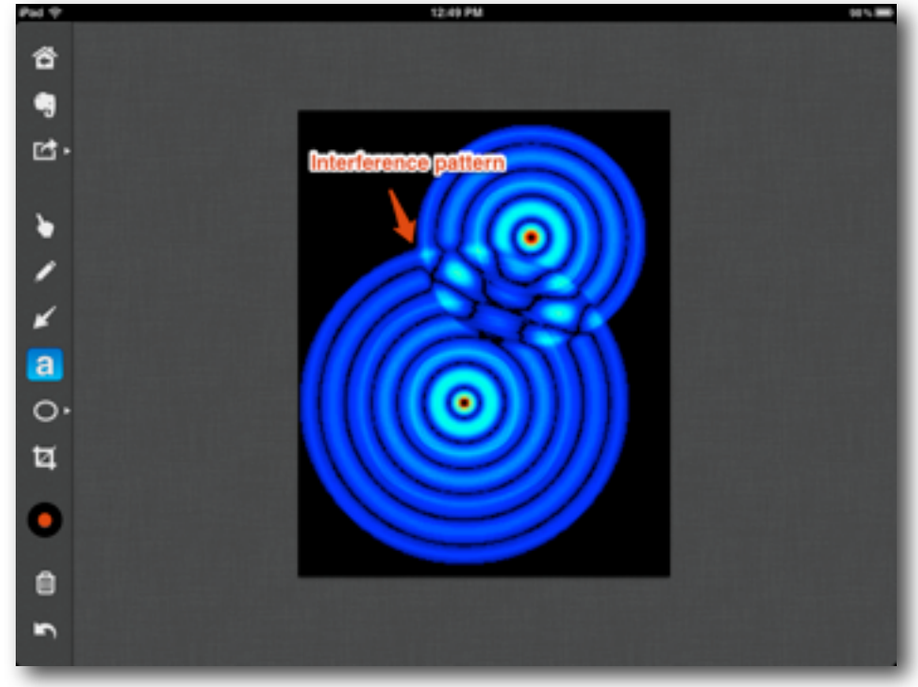
Other Waves


iPad
12:42 PM
Back
El Centro
Select Data
Function
Acceleration
Power Spectrum
Velocity / Displacement
Estimated Trajectory
Function
Component
Sensor
Scale
Display
Settings
Info

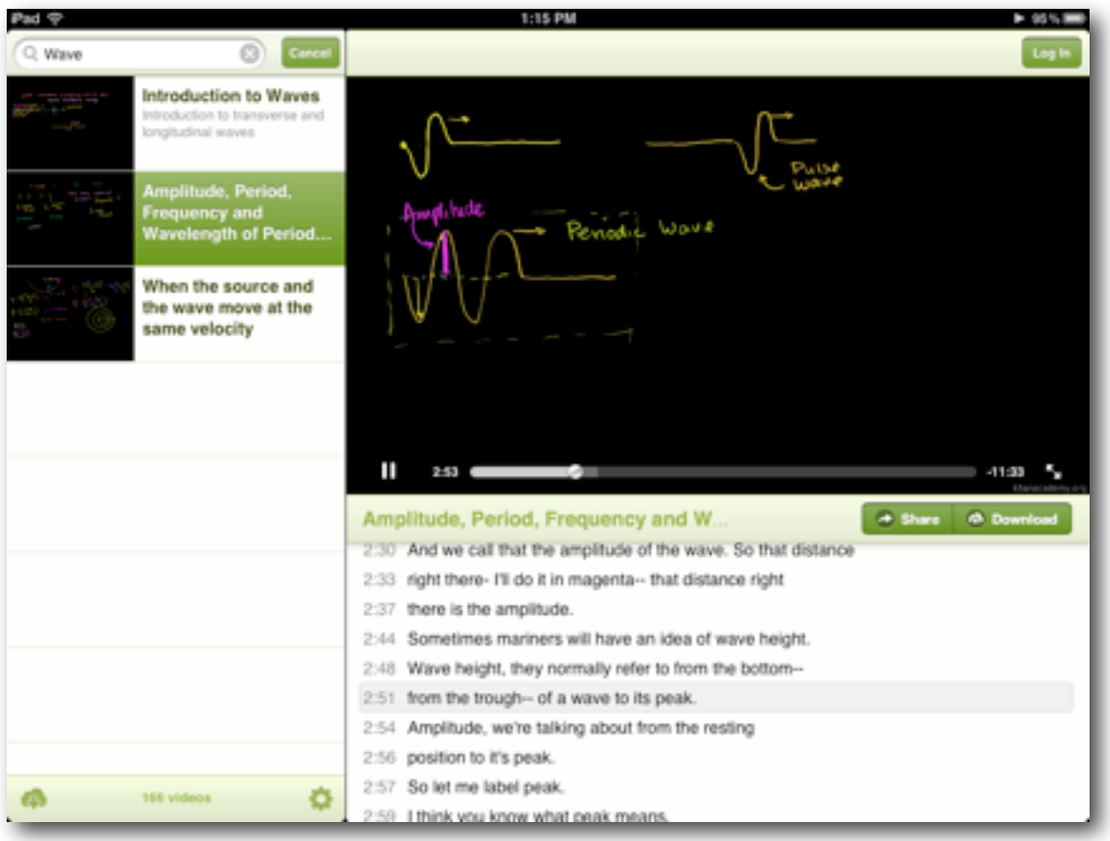


Measuring Waves

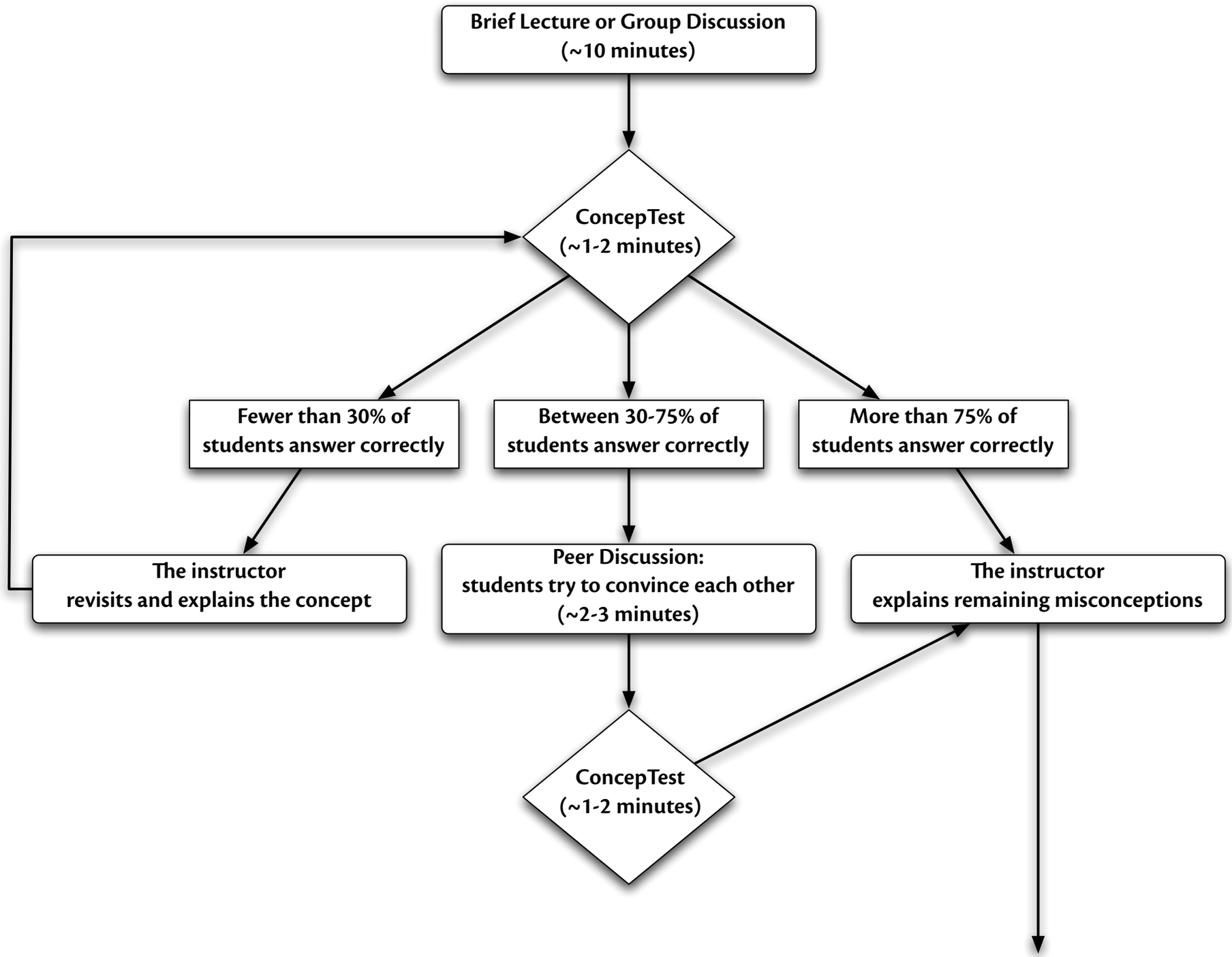




Flipping the Classroom:
Finding & Creating Resources



Flipping the Classroom: ConcepTests



Mazur, E. *Peer Instruction - A User's Manual*. Prentice Hall (1997)

Which of these scenarios does not describe an acceleration?

A. A car going round a circular racetrack at constant speed.

B. A car traveling on a straight racetrack at constant speed.

C. A stone falling from the top of a building.

D. A simple pendulum.

Additional Resources – Part I

Augmenting Human Intellect & Learning Capacity:

- Vannevar Bush, “As We May Think”. *The Atlantic Monthly*. (July 1945) Online at: http://www.theatlantic.com/magazine/archive/1969/12/as-we-may-think/3881/
- Douglas C. Engelbart, *A Research Center for Augmenting Human Intellect*. (December 1968 live demo) Archived online at: http://sloan.stanford.edu/mousesite/1968Demo.html
- Alan Kay, “A Personal Computer for Children of All Ages”. *Proceedings of the ACM National Conference*. Boston (August 1972) Online at: http://www.mprove.de/diplom/gui/Kay72a.pdf
- Seymour Papert, “On Making a Theorem for a Child”. *Proceedings of the ACM National Conference*. Boston (August 1972) Online at: http://portal.acm.org/citation.cfm?id=569942

SAMR and TPCK:

- Ruben R. Puentedura, *Transformation, Technology, and Education*. (2006) Online at: http://hippasus.com/resources/tte/
- Ruben R. Puentedura, *As We May Teach: Educational Technology, From Theory Into Practice*. (2009) Online at: http://tinyurl.com/aswemayteach
- *TPCK - Technological Pedagogical Content Knowledge*. (2008-2010) Online at: http://www.tpck.org/tpck/index.php?title=Main_Page
- AACTE (Eds.) *The Handbook of Technological Pedagogical Content Knowledge for Educators*. New York:Routledge, 2008.

Additional Resources – Part II

Defining Mobile Devices/The Lively Sketchbook:

- Ruben R. Puentedura, “Drawing On The Lively Sketchbook”. *Connect@NMC Talks*. (2010) Online at: http://archive.nmc.org/connect/2010/april/16
- Ruben R. Puentedura, “The Lively Sketchbook”. (2010) Online at: http://www.hippasus.com/rrpweblog/archives/2010_01.html

The Curiosity Amplifier:

- John Seely Brown. “A New Culture of Learning”. NMC Summer Conference, Closing Keynote. (2010) Online at: http://archive.nmc.org/2010-summer-conference/jsb-keynote-video

Technology In Education: The First 200,000 Years:

- Ruben R. Puentedura. “Technology In Education: The First 200,000 Years”. NMC Summer Conference, *Ideas that Matter* Presentation. (2012) Online at: http://www.hippasus.com/rrpweblog/archives/000069.html

Additional Resources – Part III

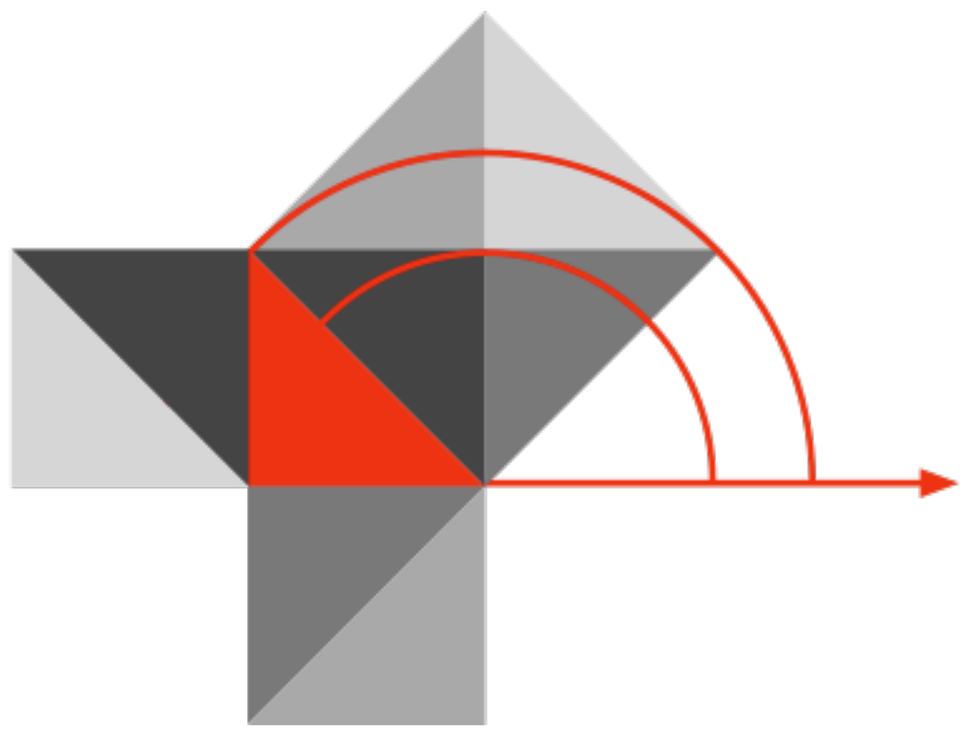
21st Century Learning, Bloom's Taxonomy and Critical Thinking:

- P. Mishra and K. Kereluik. “What is 21st Century Learning? A review and synthesis.” SITE2011 Conference Presentation. (2011) Online at: http://punya.educ.msu.edu/presentations/site2011/SITE_2011_21st_Century.pdf
- Lorin W. Anderson and David R. Krathwohl (Eds.) *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom’s Taxonomy of Educational Objectives, Complete Edition*. Longman. (2000)
- Peter Facione, *Critical Thinking: A Statement of Expert Consensus for Purposes of Educational Assessment and Instruction - Executive Summary. "The Delphi Report"*. American Philosophical Association, Committee on Pre-College Philosophy. California Academic Press. (1990) Online at: http://www.insightassessment.com/content/download/623/4009/file/DEXadobe.PDF

Science for Students:

- University of California Museum of Paleontology. *Understanding Science: how science really works*. (2008) Online at: http://undsci.berkeley.edu/index.php
- Partnership for 21st Century Skills. *P21 Common Core Toolkit: A Guide to Aligning the Common Core State Standards with the Framework for 21st Century Skills*. (2012) Online at: http://www.p21.org/tools-and-resources/publications/p21-common-core-toolkit
- Committee on Conceptual Framework for the New K-12 Science Education Standards; National Research Council. *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. (2012) Online at: http://www.nap.edu/catalog.php?record_id=13165
- E. Mazur. *Peer Instruction - A User's Manual*. Prentice Hall (1997)

Hippasus



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