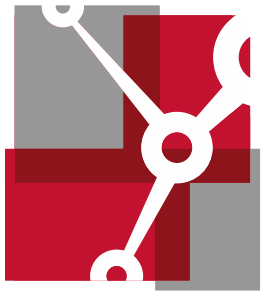

Carnegie Mellon University
Entertainment Technology Center

Helios: An HTML5 Game about Balance

Arseniy Klishin, Neerav Mehta, Yilin Fan, Mu Ni, Sakar Khattar
Sean Brice, Matt Champer, Sam Collier
Mike Christel, Scott Stevens, Bryan Maher

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LEARN
WORK
PLAY

Talk Outline

- Background about ETC and *Helios* Team
- *Helios* Overview Video
- *Helios* Development
  - Goals
  - Value of iterative playtesting
  - One specific formative playtest
- *Helios*: A Lead-in to *Puppybot Rescue*
- Other ETC Educational Game Efforts

IMPACT!

SEAN BRICE MATT CHAMPER SAM COLLIER YILIN FAN

SAKAR KHATTAR ARSENIY KLISHIN NEERAV MEHTA NI MU

SCOTT STEVENS MIKE CHRISTEL BRYAN MAHER

ETC Project IMPACT!

- http://www.etc.cmu.edu/projects/impact/
- Arseniy Klishin
- Neerav Mehta
- Yilin Fan
- Mu Ni
- Sakar Khattar
- Sean Brice, Matt Champer, Sam Collier

ETC Projects: ENGAGE

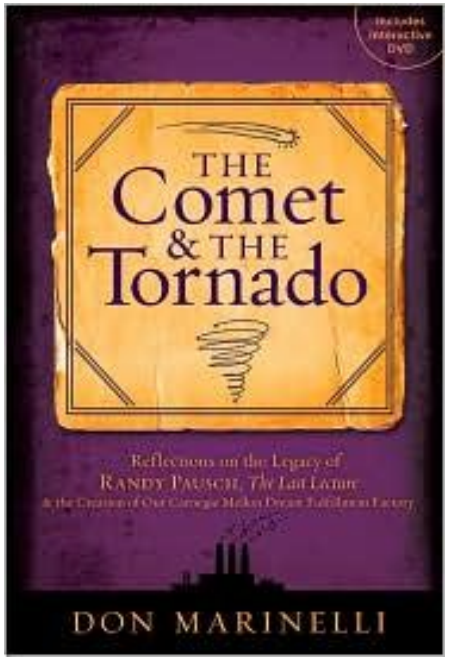
- DARPA ENGAGE program includes promoting scientific literacy, ages 4-12
- Many ETC projects involved, many games produced: http://www.etc.cmu.edu/engage/

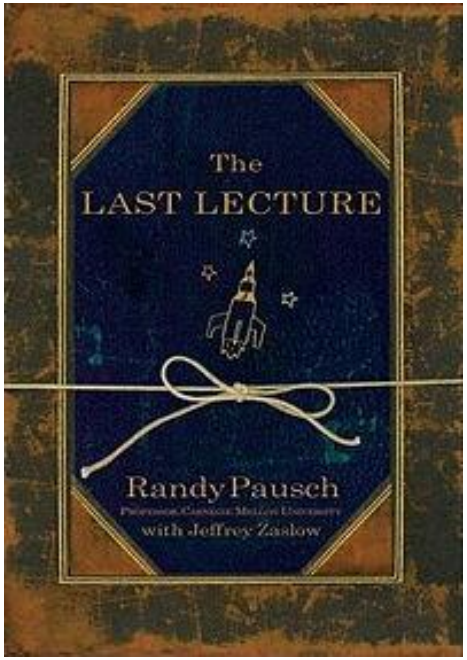
ETC: Technology + Art

2-year graduate degree: MET

ETC: Founded in 1999

- Don Marinelli and Randy Pausch, first co-directors (Drama and Computer Science)
- Drew Davidson, current ETC Director





Power of Stories

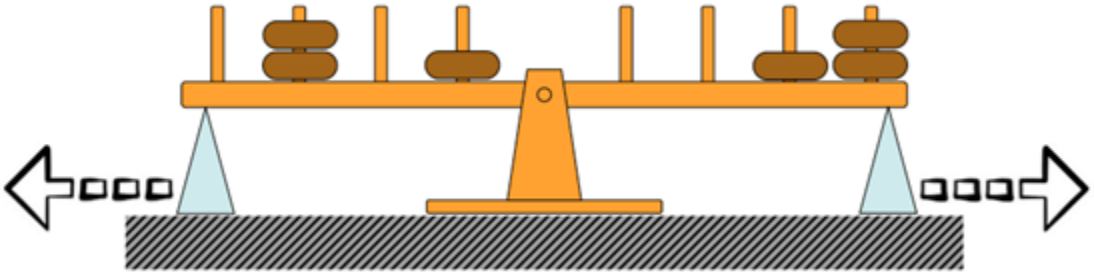
- ETC core courses: *Building Virtual Worlds* (BVW), *Visual Story, Improvisation*
- Games can "hook" users with story
- Proven to be true with children's games developed by ETC for ENGAGE, e.g., *RumbleBlocks*

Helios Development

- Refine a prior game about the balance scale, with input from Sesame Workshop
- Prepare game for in-depth testing by professionals (Pittsburgh Science of Learning Center, CMU HCII)
- Validate that game is playable by children
- Allow for configurability by teachers
- Use iterative development process

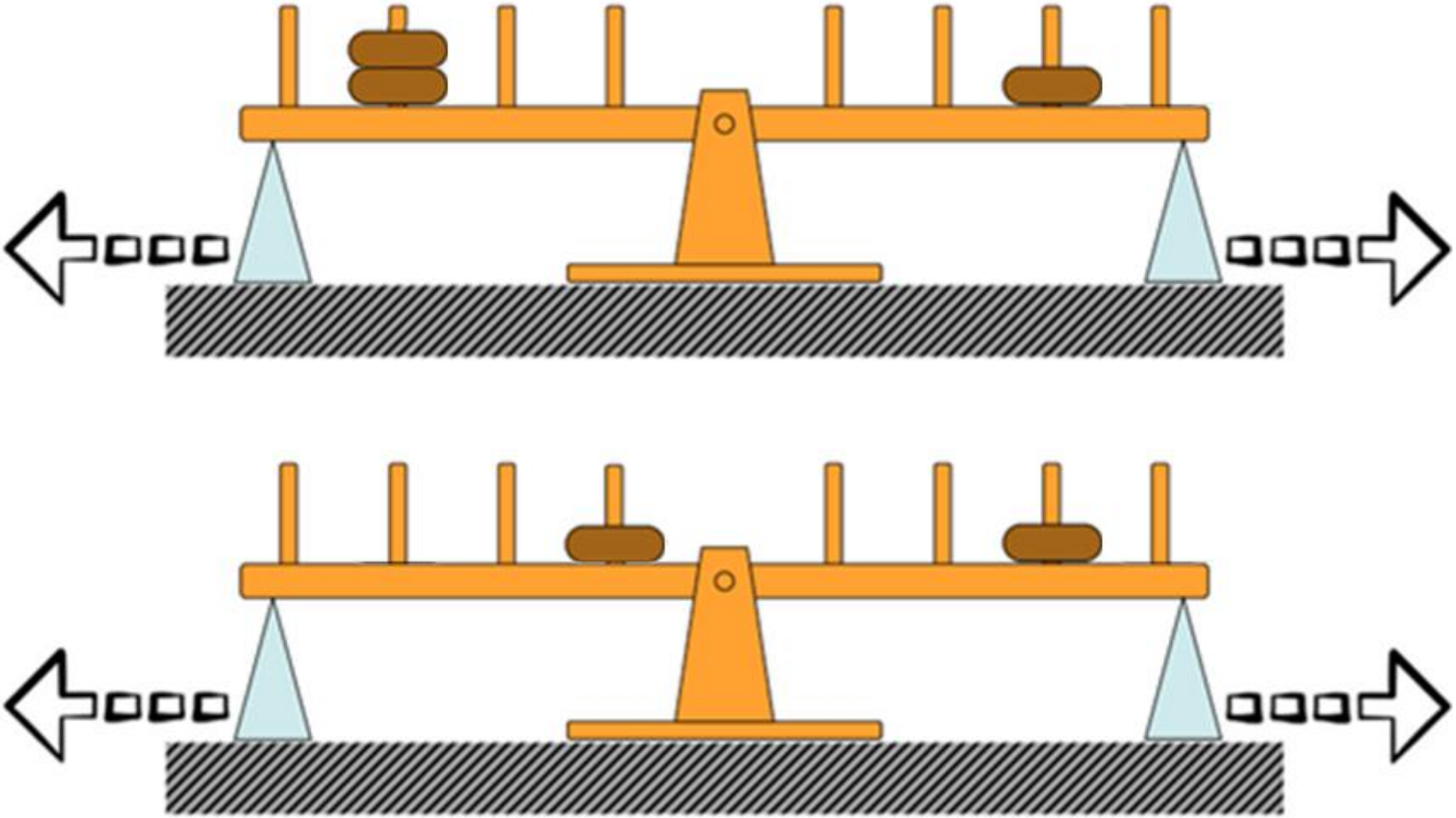
Proportional Reasoning

- Via Siegler* paper: science content is to understand the principles governing the balance scale and the sum of cross products rule that can be used to determine whether a scale will balance, given a particular configuration of weights on each side of the fulcrum



*Siegler, R. S. (1976). Three aspects of cognitive development. *Cognitive Psychology, 8,* 481-520.

Siegler “Rules”



Science Learning Objective

Help children progress through 4 increasingly sophisticated mental models identified by Siegler:

1. Children only pay attention to weight, not distance.
2. Children also consider distance, but only when the weight is equal on both sides.
3. Children consider both weight and distance, but when the cues suggest different outcomes, they guess.
4. Children consider both the amount of weight and distance of weights from the fulcrum; if the cues suggest different outcomes, they use the sum of cross products rule.

Inquiry Reasoning and SEL

- From National Research Council framework, Scientific and Engineering Practices: construct explanations
- Socio-Emotional Learning (SEL) goals are to measure and support learners to:
  - "Ask for help" – Seek and/or accept assistance from others when encountering a problem
  - "Cooperate" – Cooperate with others to accomplish a joint task
  - "Discuss" – Solve problems through interactions and discussions with peers

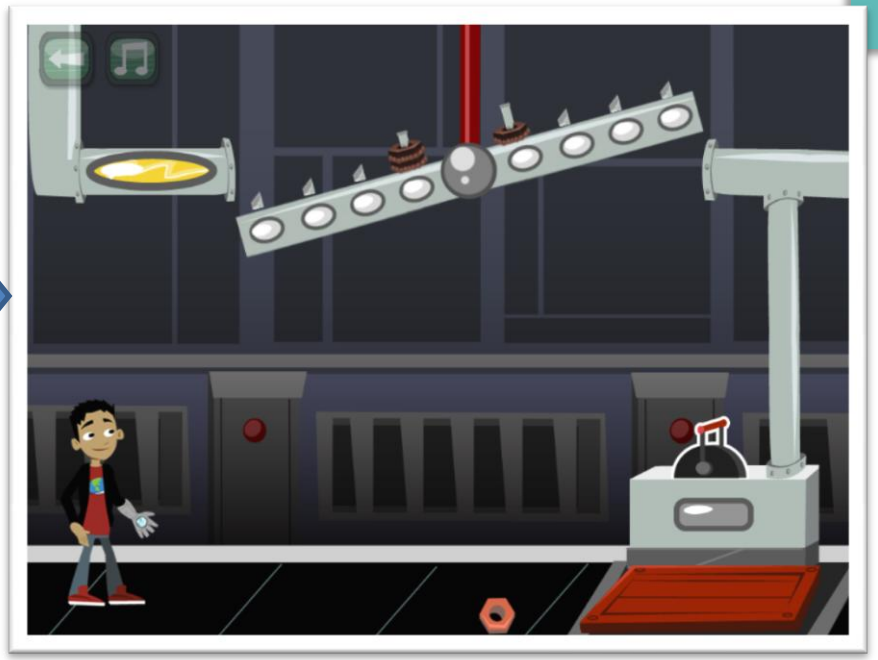
Game Design and Learning

Michelle Dickey* suggests:

- Narrative can set up exploration, collaboration, challenge
- Narrative serves as organizational framework for interactive space
- Intrinsic motivation via: Choice, Control, Collaboration, Challenge, and Achievement

*Dickey, M. “Game design and learning: A conjectural analysis of how massively multiple online role-playing games (MMORPGs) foster intrinsic motivation," Educ. Tech. Research and Development, vol. 55, no. 3, pp. 253-273, June 2006

Teeter Totter Go! → Helios



SEL Features in TTG

- Sharing made an explicit part of the game
- Fellow "player" more a peer than a coach

TTG: Example Playtest Iteration

- 11 children. 7 1st graders. 4 2nd Graders
- User interface was unclear
- Turn making was not clear
- Sharing is difficult (some children resisted, emphatically)
- Fatigued from confusion in UI

TTG Shortfalls Leading to Helios

- Choice was limited (one side of fulcrum, just actions above head of avatar)
- Choice could be deadlocked
- Choice was repetitive and too focused, stifling curiosity

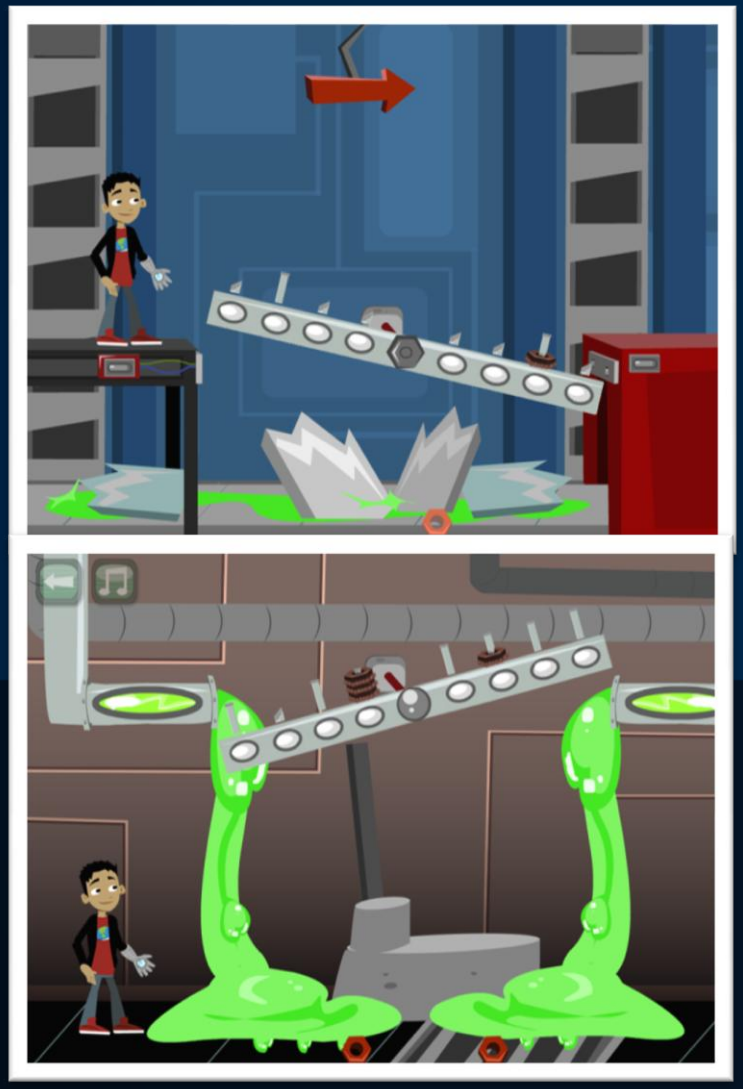
- …Helios grew out from these lessons, informed by Sesame Workshop designers and playtests

“Helios”

- Ages 6-10
- New player interaction and narrative

“Helios”

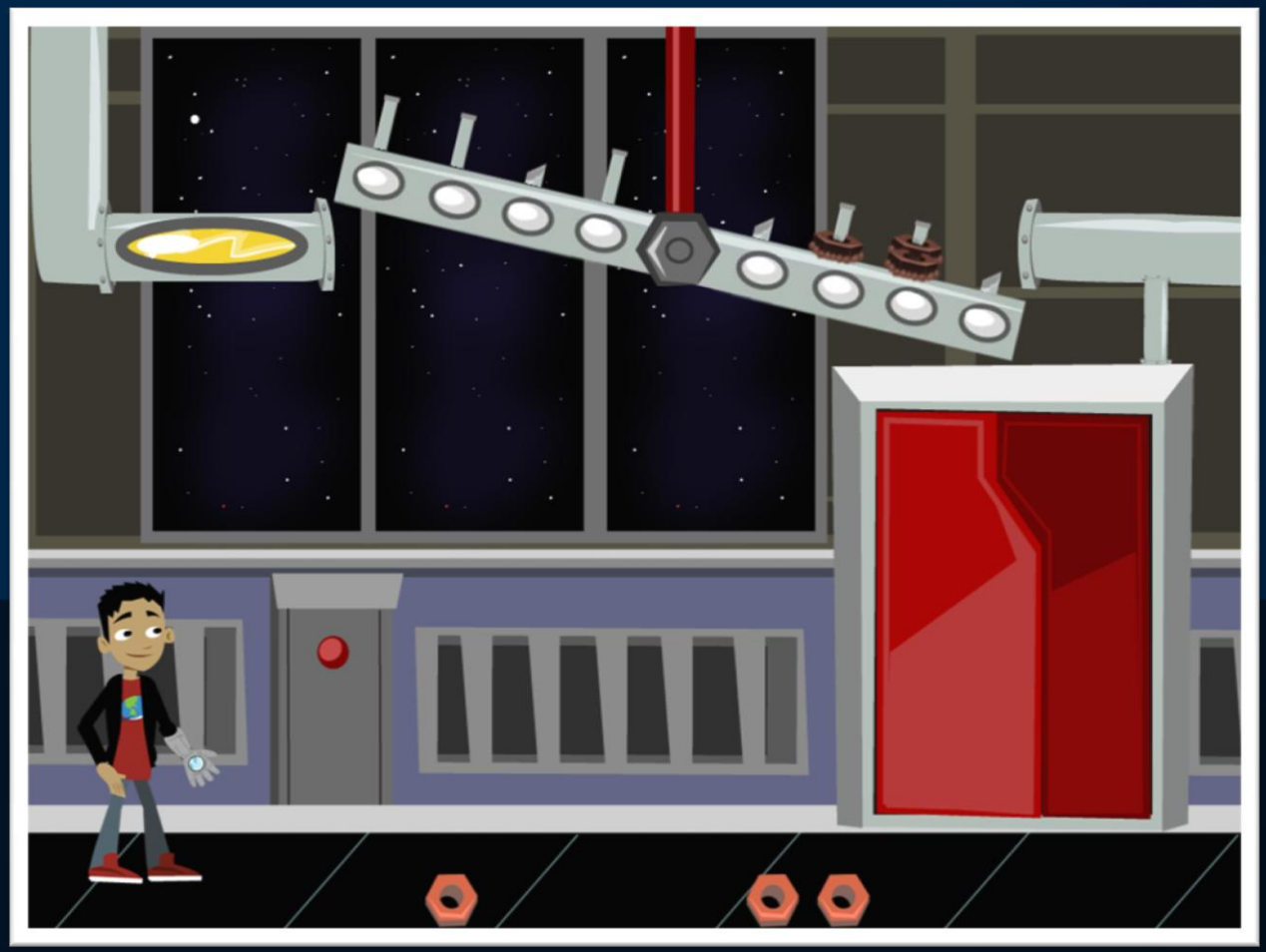
- New level approach



“Helios”

- Uses XML for easy configurability

total_nuts: 3
slot_nuts:
0000_0120
slots_off:
1101_0110
level_type:
circuit



Playtests!

- Feb. 27th
- 8 Pre-K Students
- 4 boys, 4 girls
- Most players asked for more levels to play

Playtests!

- Mar. 13th
- 21 2nd grade students, 7-8 years old

Iterative Feedback

- Nice sound effects and music
- Great art, nice variety
- Good story

May 2013 Formative Playtest

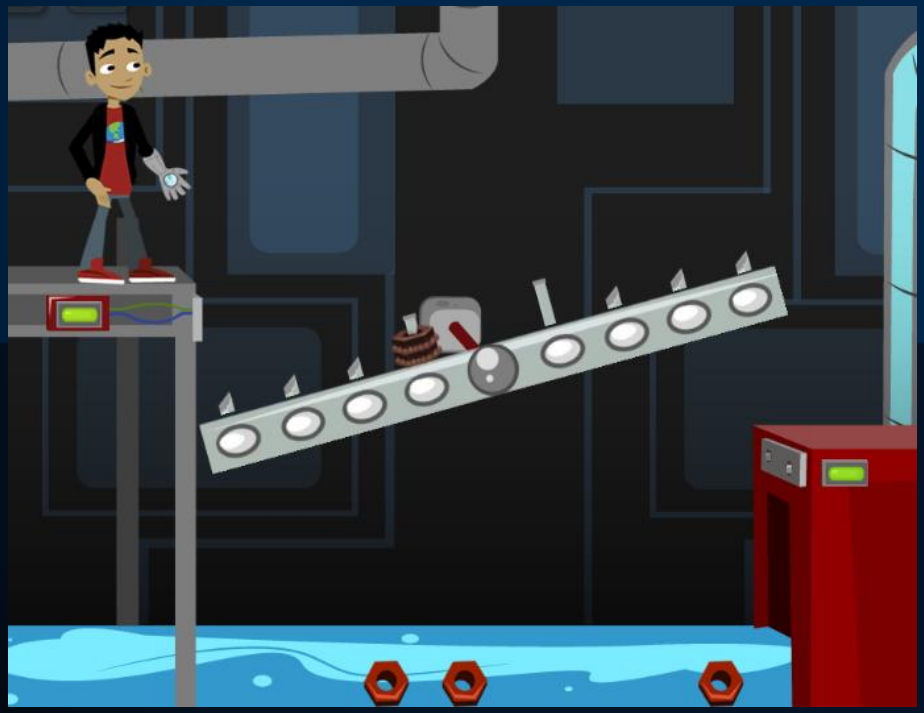
- 17 Playtesters, K-3rd grade
- Player enthusiasm strong through 25 min.
- Level sequences should be tuned to grade (or better, to demonstrated skill)
- SEL integration into science game difficult, too shallow here to measure well

Summary

- Developed "Helios" for science learning, inquiry, and SEL:
  - Predecessor game TTG lacked player motivation
  - Helios **Choice** via male/female avatar, placement on beam, predictions and hypotheses, tone to use in communication with peer (SEL)
  - Helios **Control** in changing the environment
  - **Collaboration** via working with peer to beat "Boss"
  - **Challenge** in beam problems, **Achievement** in progressing through space station

Links

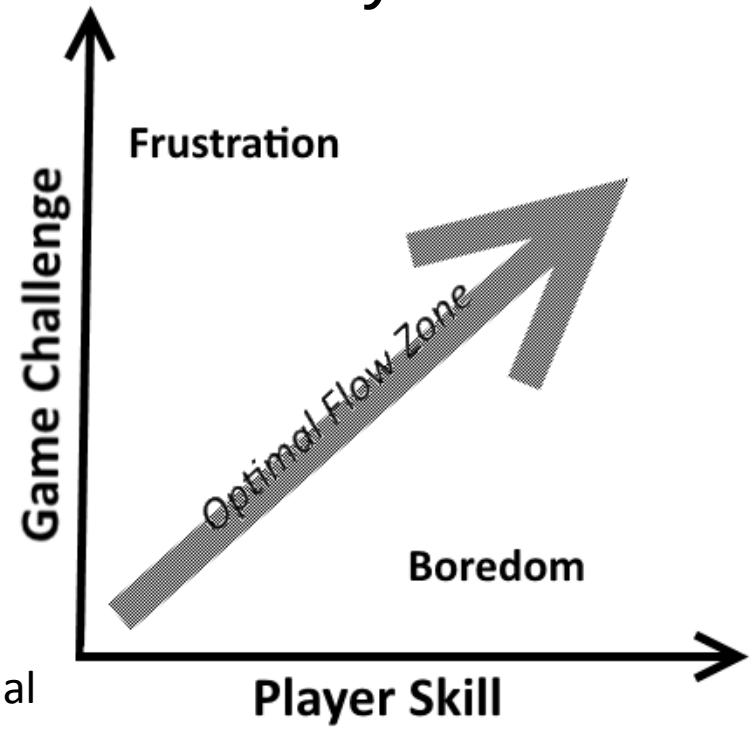
- http://www.etc.cmu.edu/projects/impact/ (within, you'll see Demo: Helios page)
- http://www.etc.cmu.edu/engage/ (old/new games)



Flow

Mihaly Csikszentmihalyi* and “Flow Theory”:

- Being completely absorbed in an activity
- For *Helios*, level complexity increasing ideally to let the child player enjoy rewarding experience to remain engaged and feel a sense of achievement without undue frustration

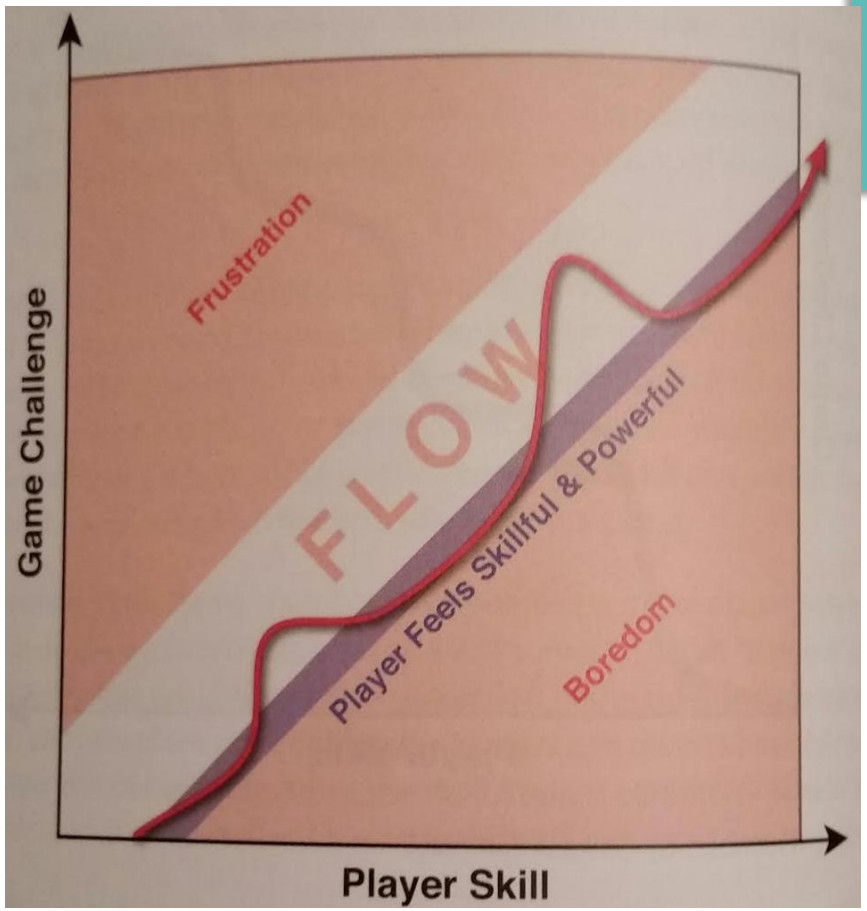


*M. Csikszentmihalyi, Flow: The Psychology of Optimal Experience. New York, NY: Harper and Row, 1990.

Flow, in More Detail

Jeremy Gibson*:

- Player must be “out of flow” a bit at times to feel skillful
- Playtesting can help test for player boredom/frustration



*Jeremy Gibson, Introduction to Game Design, Prototyping, and Development. Upper Saddle River, NJ: Addison-Wesley, 2014.

Importance of Iteration

- *Helios* one example of learning from your players
- See also Schell's *Art of Game Design*, Gibson's *Introduction to Game Design, Prototyping, and Development* (1st Ed. 2008)
- Paper: de Valk, L., Bekker, T., and Eggen, B. Leaving Room for Improvisation: Towards a Design Approach for Open-ended Play. In *Proc. Conf. on Interaction Design and Children 2013*, 92-101

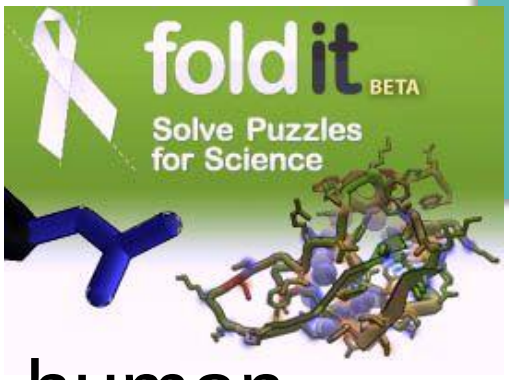
Building from Helios

- Better flow through adaptive learning strategies
- Improved “stickiness” through touch interfaces, fast play-through
- Emphasize one thing: Siegler Rules
- New game is PuppyBot Rescue (HTML 5 game as well, but built with CreateJS library): http://www.etc.cmu.edu/engage/

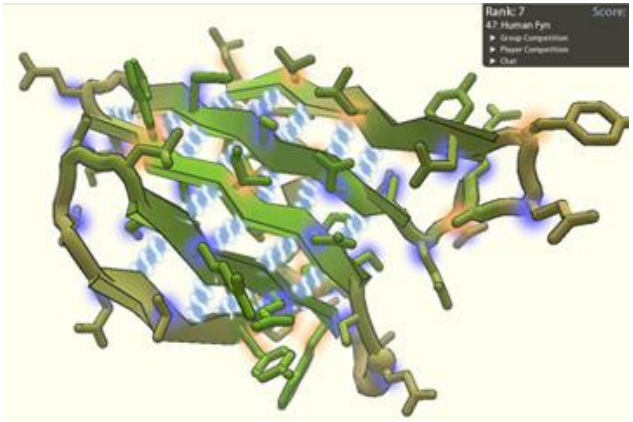
Games with a Purpose

- "GWAP" – popularized by Louis von Ahn at Carnegie Mellon
- *ESP Game*
- Licensed by Google, *Image Labeler*
- Metadata generation as by-product of play
- von Ahn & Dabbish CACM 2008 paper, DOI 10.1145/1378704.1378719

GWAP: Benefitting Science



- *Foldit*, Univ. Washington Center for Game Science, 2008
- Protein-folding game leveraging human spatial reasoning
- Scientific publications with Foldit players as co-authors, e.g., 2011 article with DOI 10.1038/nsmb.2119



Transformational Games

- Jesse Schell, fellow ETC faculty member
- *The Art of Game Design*
- "Games that change the player…."
  - Educational
  - Behavior
- Some examples from ETC follow…

Chicago USA: Invasive Species

ETC project: *Invasion!!* (at *BrainPop* games pages – http://www.brainpop.com/games/invasion!!/)

ETC Imagica: Biomes for Children

Imagica: 1 Semester, 6 Students

Producer, UX designer, 2D/3D artist, animator, interaction & tech programmer

Iterative Playtesting with Imagica

- Tablet-driven experience for 8-11 year olds
- Marine biologist validates content
- Child-testing confirms appeal of experience

ETC Project Ursa: World Hunger

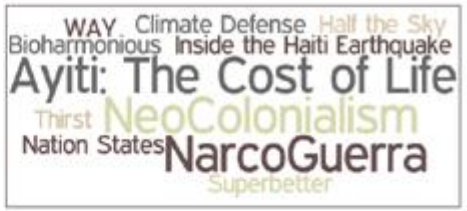
- Created *Feed*, played at Games for Change
- Outdoor, many-player game

GAMES FOR CHANGE

Carnegie Mellon University
Entertainment Technology Center

Research Behind *Feed*

Web-based Games



Games for Change

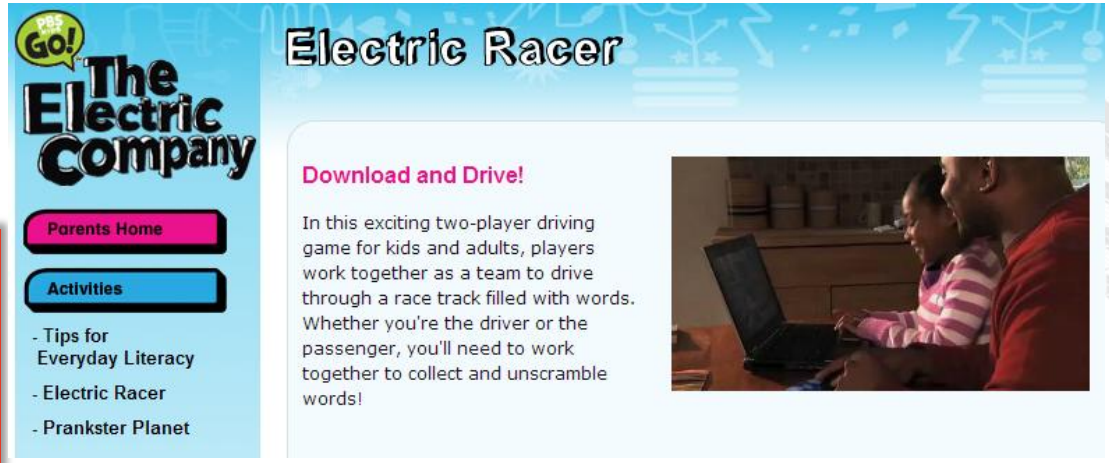
Distribution

Large / Outdoor Games

ETC Project: Electric 4 Education

- Produce intergenerational literacy game for 6-9 year olds and their parents
- Fielded at Public Broadcasting System activities website:

www.pbs.org/parents/electriccompany/electric-racer.html



Promoting Systems Thinking

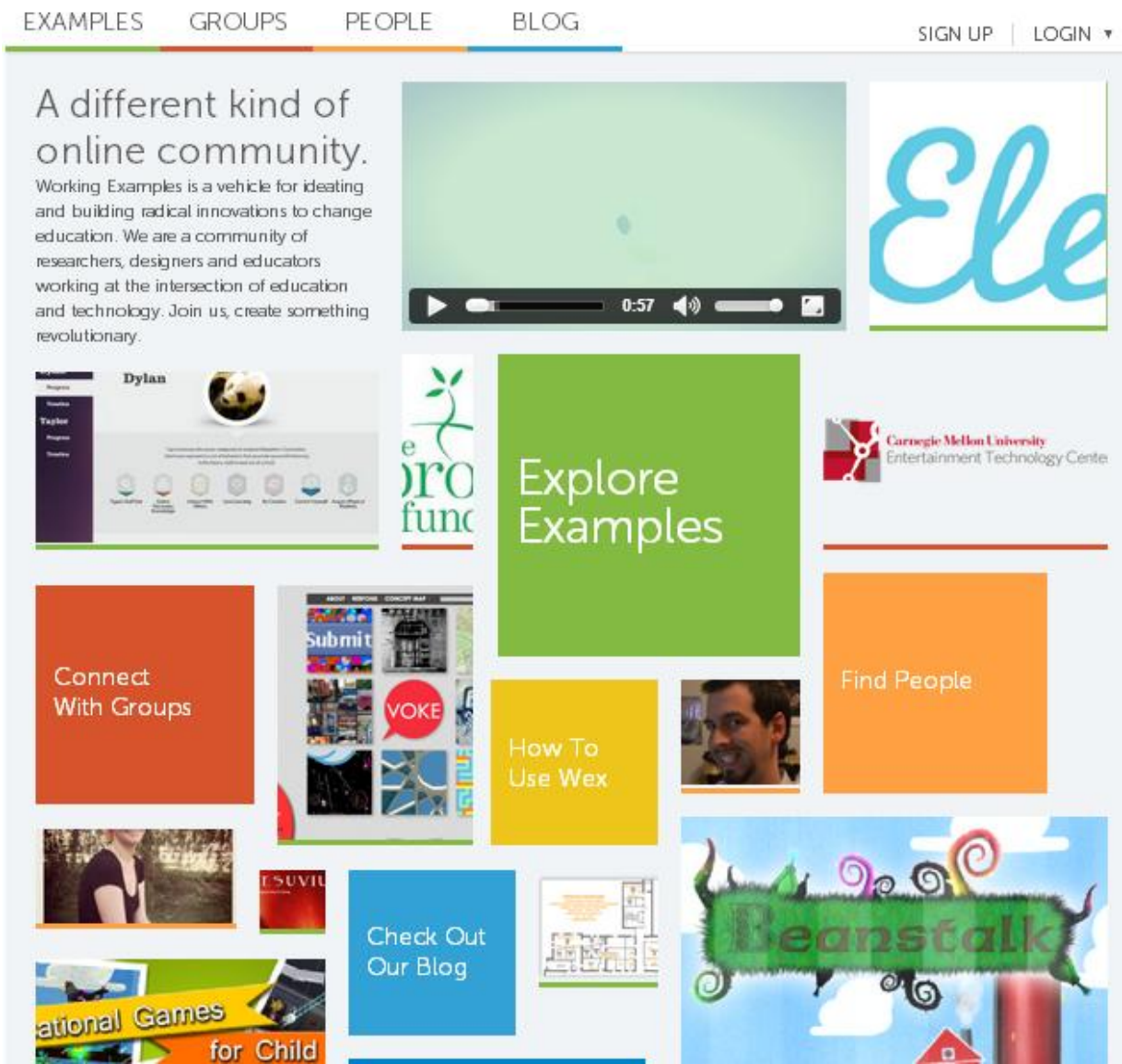
- GameGrid ETC team, Fall 2013
- Work with Creativity Labs, Indiana Univ.
- Produced a game to give children practice with and stimulate interest in systems thinking: *Water+*
- Game uses Unity Web Player: *http://www.etc.cmu.edu/projects/gamegrid/*

Educational Games: Community

workingexamples.org

Many ETC projects detailed there as "Seed-Sprout-Bloom":

- GameGrid (*Water+*)
- *RumbleBlocks*
- *Beanstalk*
- *PuppyBot Rescue*



ETC: Many Projects, Many Experiences

"Extended" Summary

- Games can be transformational, including literacy, science literacy, world hunger, etc.
- Games can drive people to learn more:
  - *Invasion!!* (for Field Museum; invasive species)
  - Imagica www.etc.cmu.edu/projects/imagica/
  - Ursa (*Feed*) …projects/ursa/
- Further information
  - www.workingexamples.org
  - www.etc.cmu.edu for ETC and its projects