

**Carnegie Mellon University**

Entertainment Technology Center

# Helios: An HTML5 Game about Balance

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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/>



The image shows the title screen for the game 'Sci-Fri Impact!'. The title 'SCI-FRI' is prominently displayed in large, white, block letters with a slight shadow effect against a dark purple background with a starry space theme. Below the title, the word 'Impact!' is written in a large, white, sans-serif font. The screen lists several names as advisors and developers. On the left side, names are arranged in two rows: John Balash, Matt Champer, Nora Bastida, Danny Hausmann, Chandana Bhargava, Weiwei Huo, Sean Brice, and Xun Zhang. Below these, the word 'Advisors' is written, followed by Scott Stevens and Mike Christel. On the right side, a list of names is shown: SEAN BRICE, MATT CHAMPER, SAM COLLIER, YILIN FAN, NEERAV MEHTA, ARSENIY KLISHIN, SAKAR KHATTAR, and NI MU. Below this list, it says 'ADVISORS: MIKE CHRISTEL SCOTT STEVENS'. The background features colorful, abstract geometric shapes in shades of green, yellow, and blue, and some faint, stylized text like 'fun', 'weight', 'distance', and 'science'.



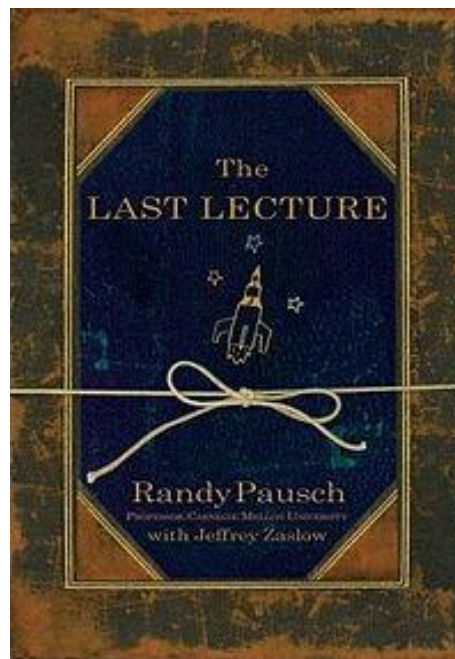
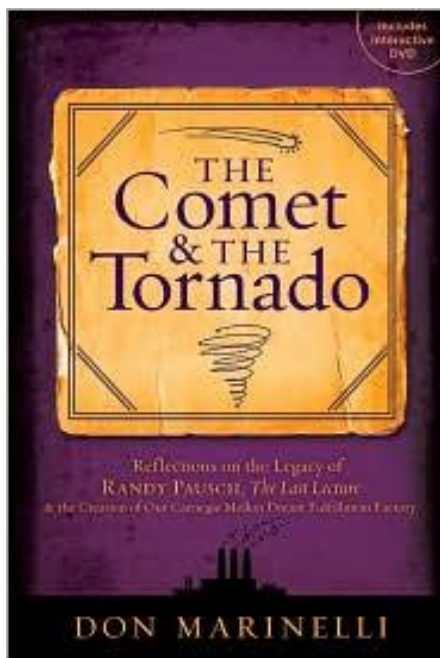
# ETC: Technology + Art

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*







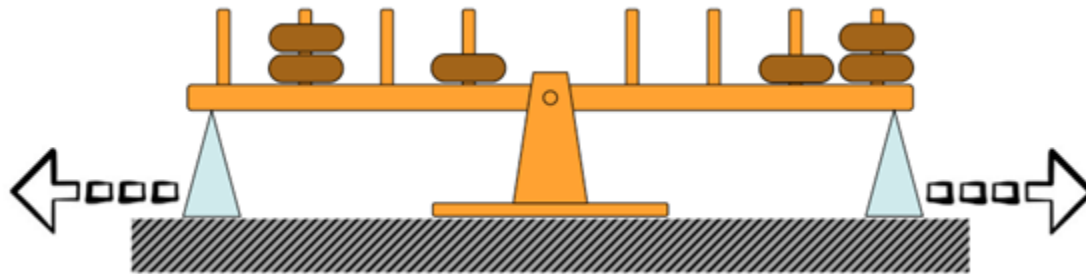
# *Helios* Development

- 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

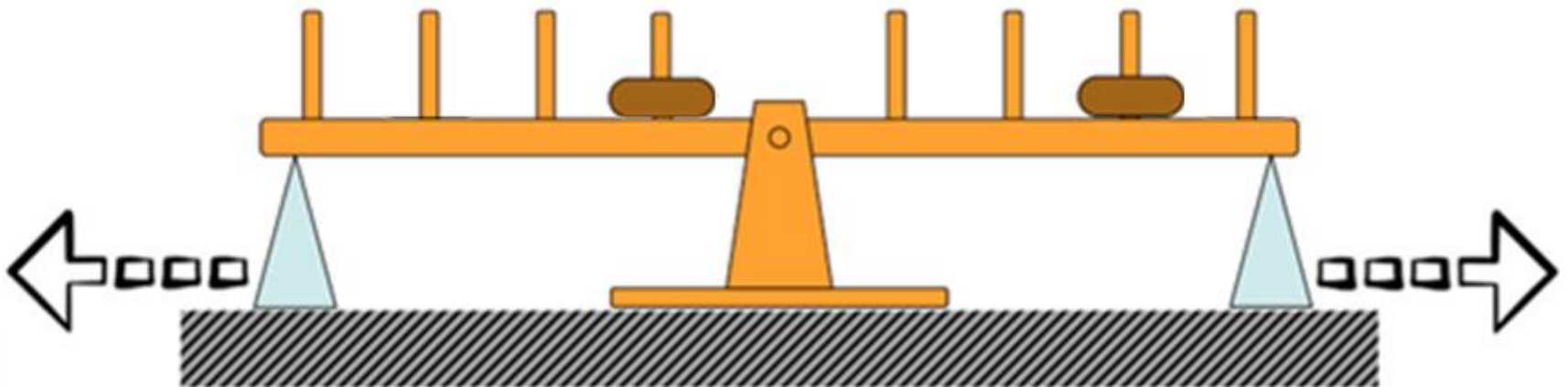
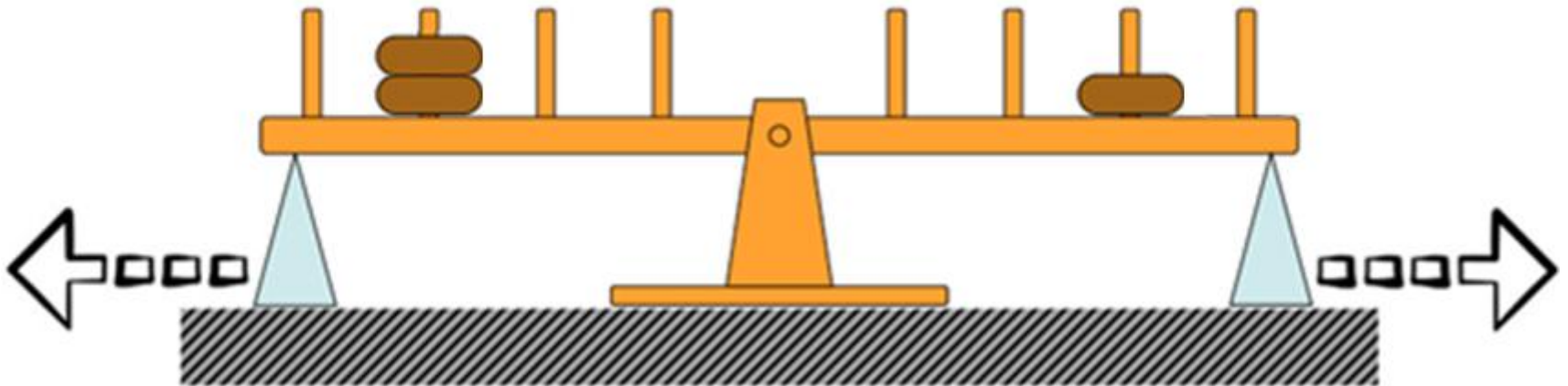
- Via Siegler\* paper: science content is to understand the principles governing the balance scale and the sum of cross products rule that can be used to determine whether a scale will balance, given a particular configuration of weights on each side of the fulcrum



\*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

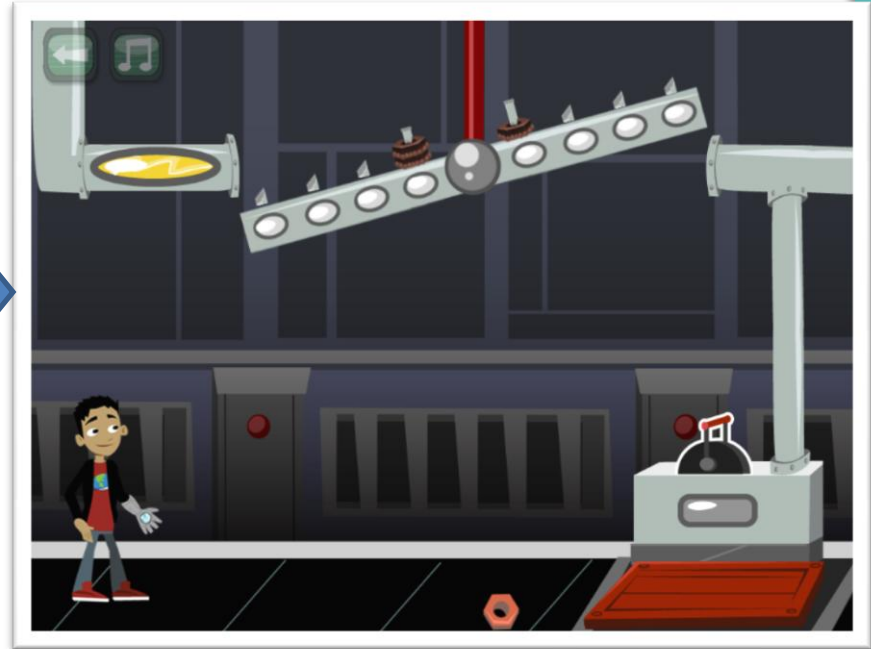
Michelle Dickey\* suggests:

- 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 1<sup>st</sup> graders. 4 2<sup>nd</sup> 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

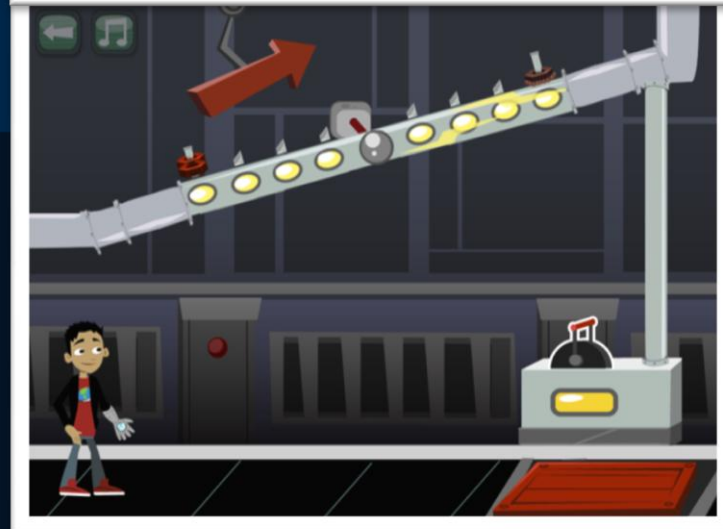
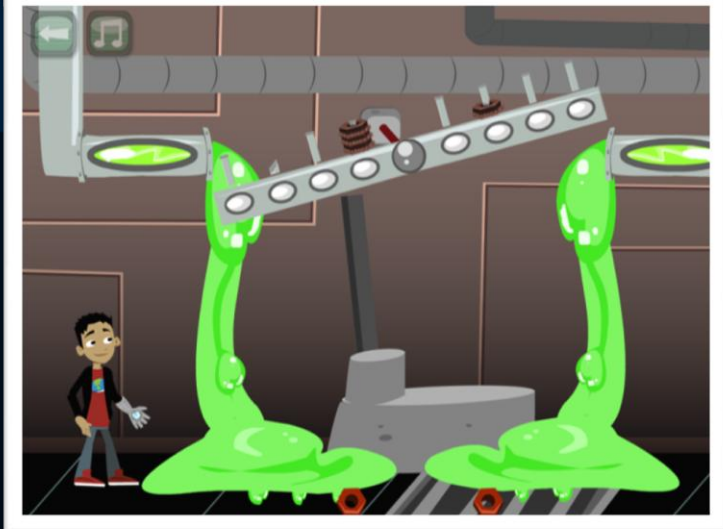
# “Helios”

- Ages 6-10
- New player interaction and narrative



# “Helios”

- New level approach

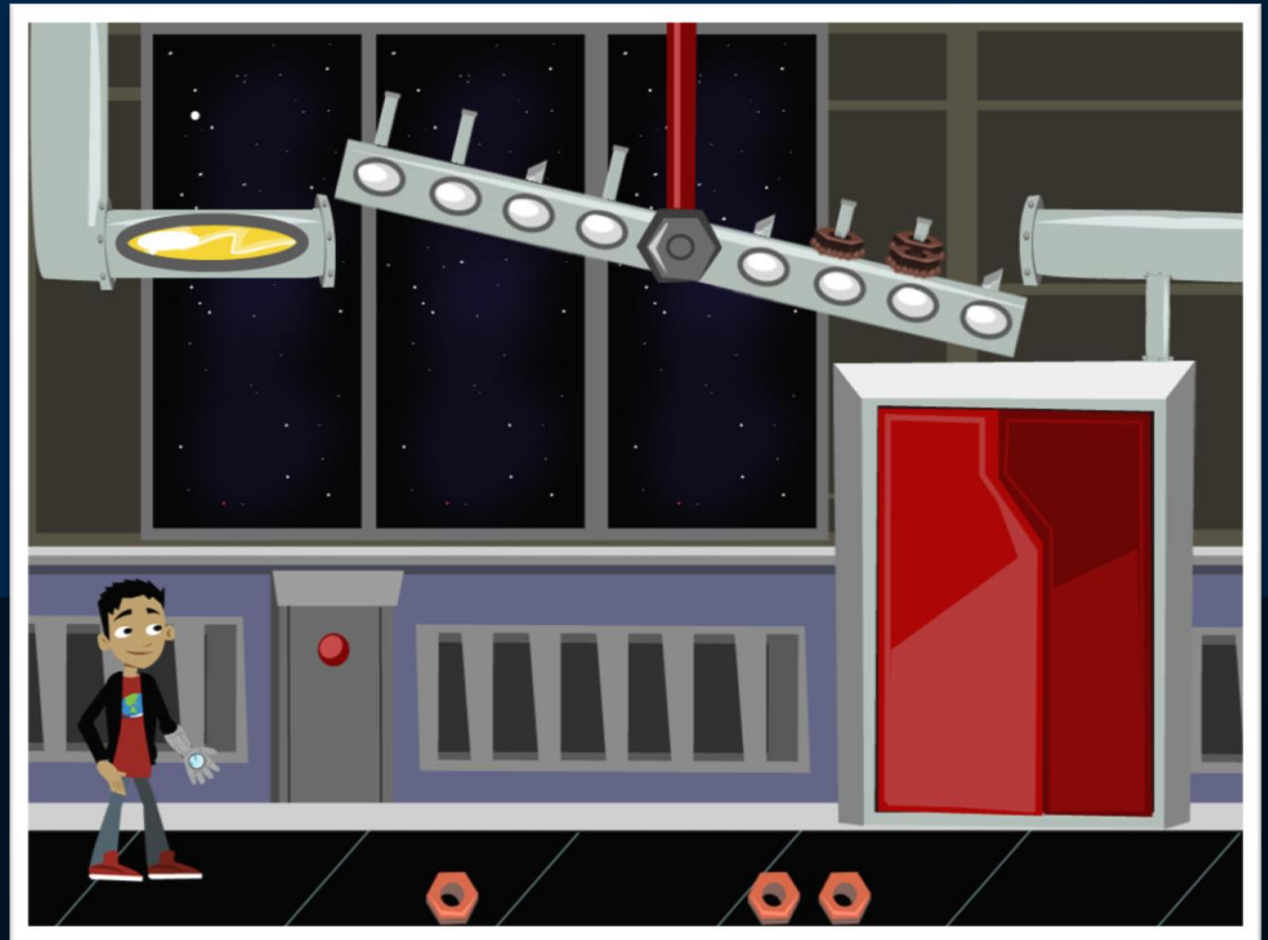




# “Helios”

- Uses XML for easy configurability

**total\_nuts:** 3  
**slot\_nuts:**  
0000\_0120  
**slots\_off:**  
1101\_0110  
**level\_type:**  
circuit



# Playtests!

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



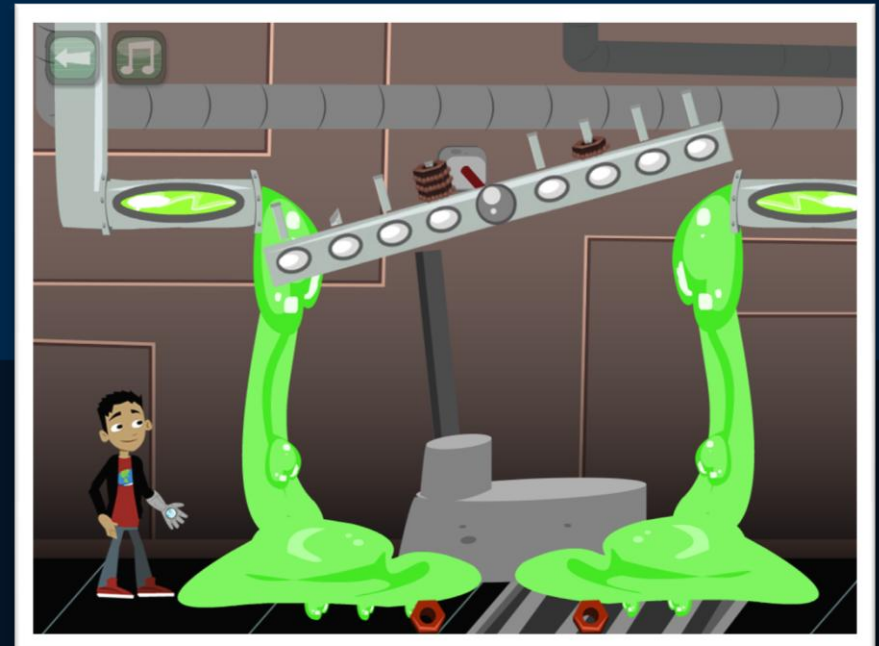
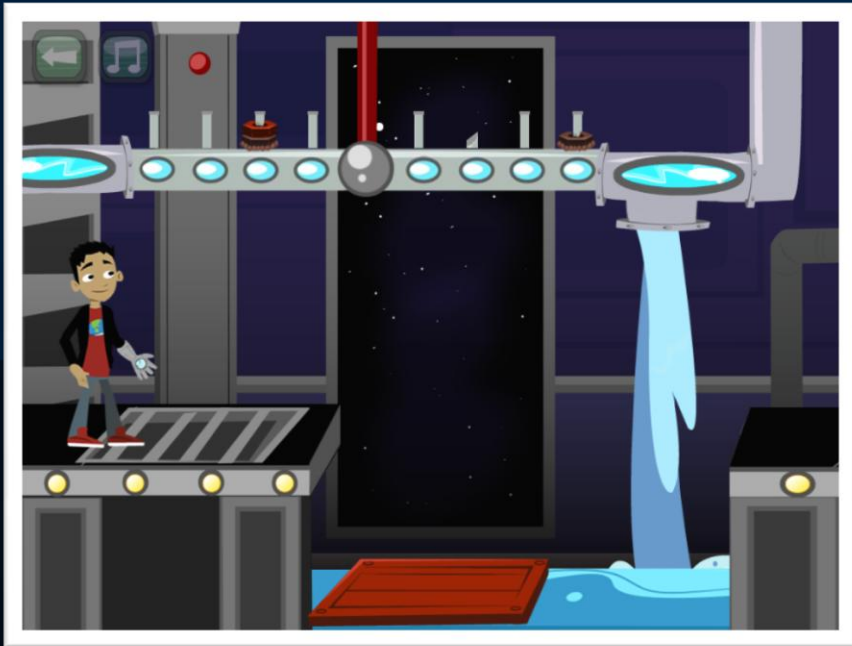
# Playtests!

- Mar. 13<sup>th</sup>
- 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-3<sup>rd</sup> 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



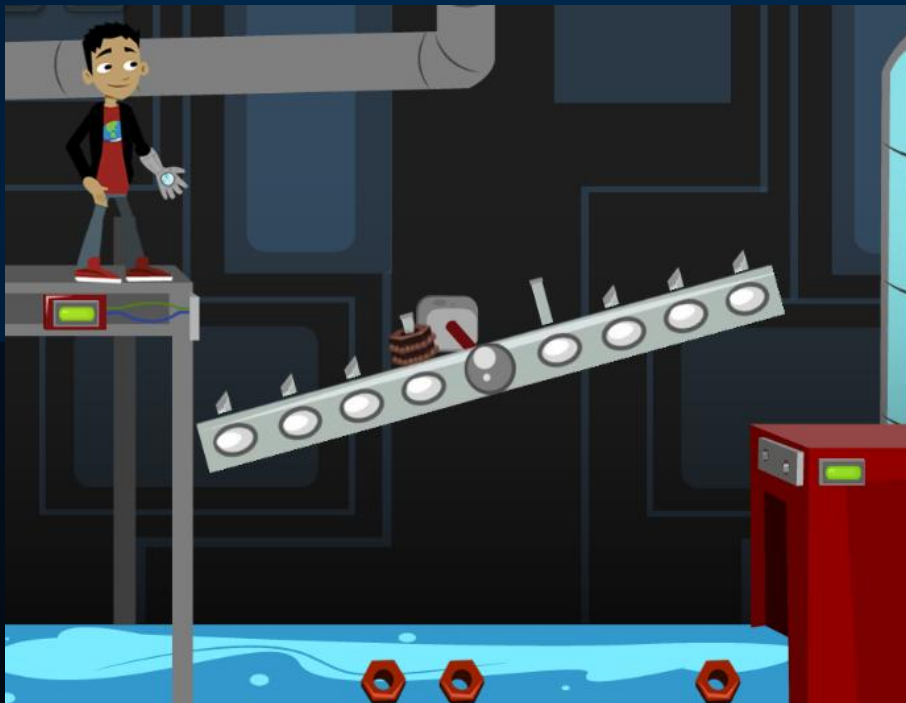
# Summary



- 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

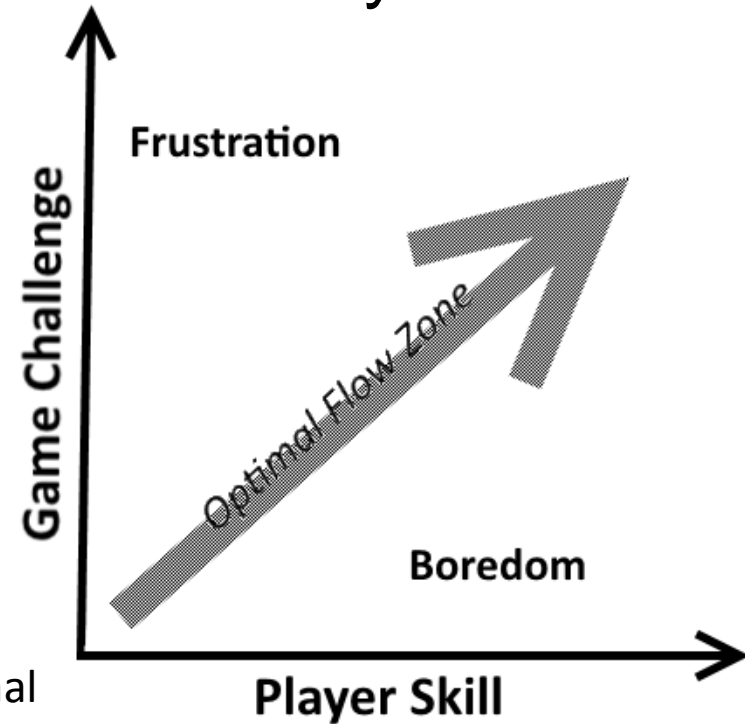
- <http://www.etc.cmu.edu/projects/impact/> (within, you'll see Demo: Helios page)
- <http://www.etc.cmu.edu/engage/> (old/new games)



# 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



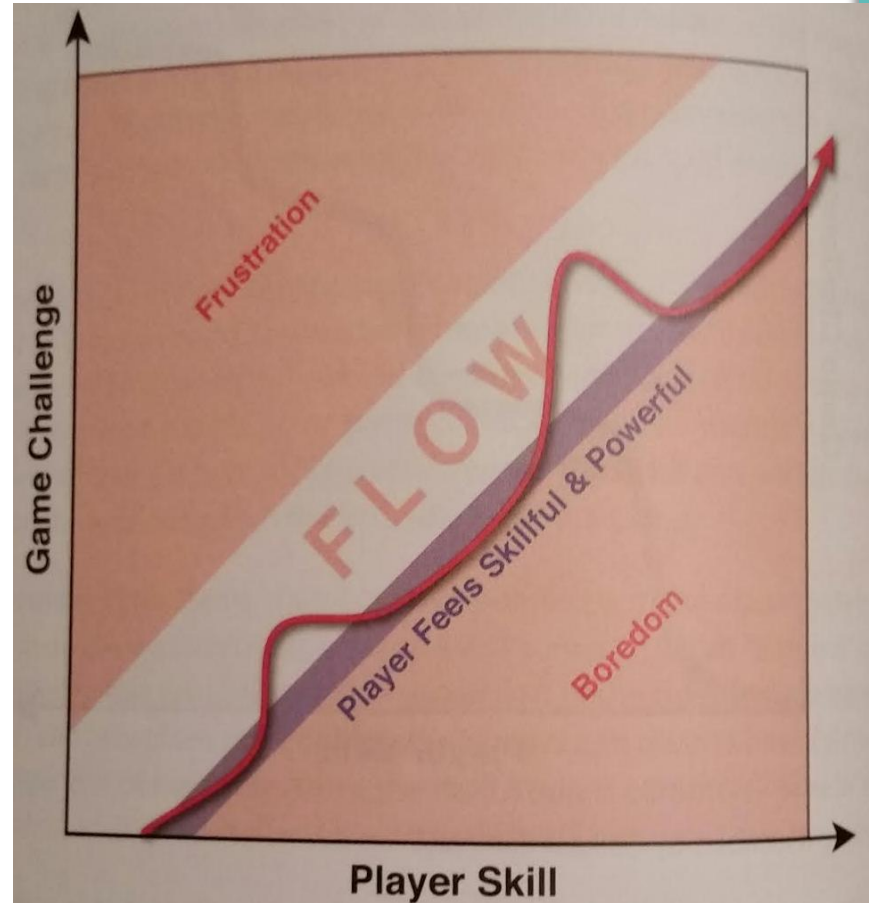
\*M. Csikszentmihalyi, *Flow: The Psychology of Optimal Experience*. New York, NY: Harper and Row, 1990.



# 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* (1<sup>st</sup> 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/>



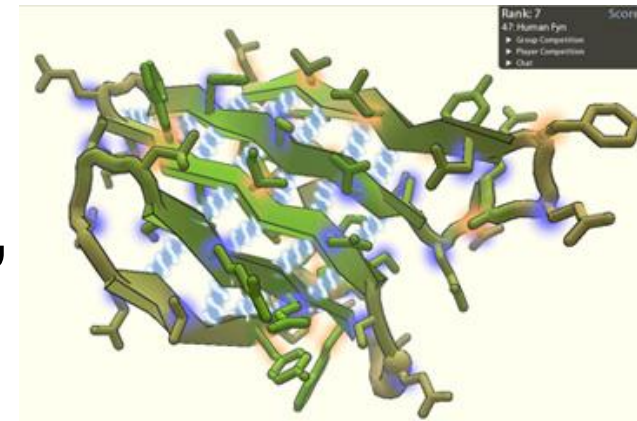
# Games with a Purpose

- “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](https://doi.org/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!!/> )

The Field Museum

## The Field Times

### NEW CARP CZAR APPOINTED!

**MIKE**

PLEASE ENTER YOUR NAME

**CLICK HERE TO CONTINUE**



CHICAGO

CARP DIRECTION

CHICAGO

LAKE MICHIGAN

Your job is to stop the Asian carp from reaching Lake Michigan. To WIN, collect 10 GOLD STARS. You get 1 GOLD STAR each turn if the Asian carp do not advance. You lose 1 gold star if the Asian carp advance during your turn.



MIKE

PUBLIC APPROVAL

YOU HAVE 3 ACTIONS LEFT THIS TURN  
CHOOSE AN ACTION

BUILD

DRAW/PLAY CARD

STATUS:

INDUSTRIES

TOURISM - RECREATION

SURROUNDING STATES

ADVOCACY

CHICAGO

LAKE MICHIGAN

# 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

Jack Koo  
Art

Yan Jin  
Game Designer

Tim Rosko  
Sound Designer / Writer



Xuyan Ke  
Programmer

Alex Hu  
Programmer

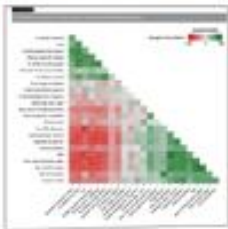
Lisa Elkin  
Producer

Janet Lin  
Producer



# Research Behind *Feed*

GIVING  
what we can



Corruption

RIISING FOOD PRICES, SOCIAL MOBILIZATIONS,  
AND VIOLENCE: CONCEPTUAL ISSUES IN  
UNDERSTANDING AND RESPONDING TO THE  
CONNECTIONS LINKING HUNGER AND CONFLICT

SILVIA MALALA  
Professor, School of Nutrition, Food and Policy, Tufts University, Boston, MA

CONFLICT: A CAUSE AND EFFECT OF HUNGER  
By Ellen Messer, Marc J. Cohen, and Thomas Robinson



Conflict

World Wide Maze  
Spaceship Pilot  
Multiplayer OSMOS  
Cookie Clicker  
Node.js

Web-based Games

WAY, Climate Defense, Half the Sky  
Bioharmonious, Inside the Haiti Earthquake  
Ayiti: The Cost of Life  
Thirst, NeoColonialism  
Nation States, NarcoGuerra  
Superbetter

Games for Change



Distribution

Isle of Tuna Mobile  
Neopets, Bear Hunter, Fennia, Ghost  
Turn Yourself into Pixels  
Smugglers and Spies, Blind Bell  
Cytus, Capture the Flag, Pokemon  
Wow Name Tags, Enemy Defender, Arathi Basin  
Red Light Green Light, Sunny Day, Shadow Tag  
Go Tutorial, Games Three, Sudio Fish, Project Assassin  
Flight Simulator, Barthol Games  
Quarter Football, Parallelweb

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](http://www.pbs.org/parents/electriccompany/electric-racer.html)



A screenshot of the 'Electric Racer' game page. The page has a blue background with a grid pattern. On the left, there is a sidebar with 'The Electric Company' logo and buttons for 'Parents Home' and 'Activities'. The main content area has the title 'Electric Racer' and a 'Download and Drive!' section with a description of the game and a photo of a family playing on a laptop.

# 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](http://workingexamples.org)

Many ETC projects detailed there as “Seed-Sprout-Bloom”:

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

The screenshot shows the homepage of workingexamples.org. At the top, there are navigation tabs for EXAMPLES, GROUPS, PEOPLE, and BLOG, along with SIGN UP and LOGIN links. The main content area features a video player with the text "A different kind of online community. Working Examples is a vehicle for ideating and building radical innovations to change education. We are a community of researchers, designers and educators working at the intersection of education and technology. Join us, create something revolutionary." Below the video is a user profile for "Dylan" and a "eRO func" logo. A large green box says "Explore Examples". Other tiles include "Connect With Groups", "How To Use Wex", "Check Out Our Blog", and a large "Beanstalk" graphic. The Carnegie Mellon University Entertainment Technology Center logo is visible in the top right.



# 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/](http://www.etc.cmu.edu/projects/imagica/)
  - Ursa (*Feed*) [...projects/ursa/](http://...projects/ursa/)
- Further information
  - [www.workingexamples.org](http://www.workingexamples.org)
  - [www.etc.cmu.edu](http://www.etc.cmu.edu) for ETC and its projects

