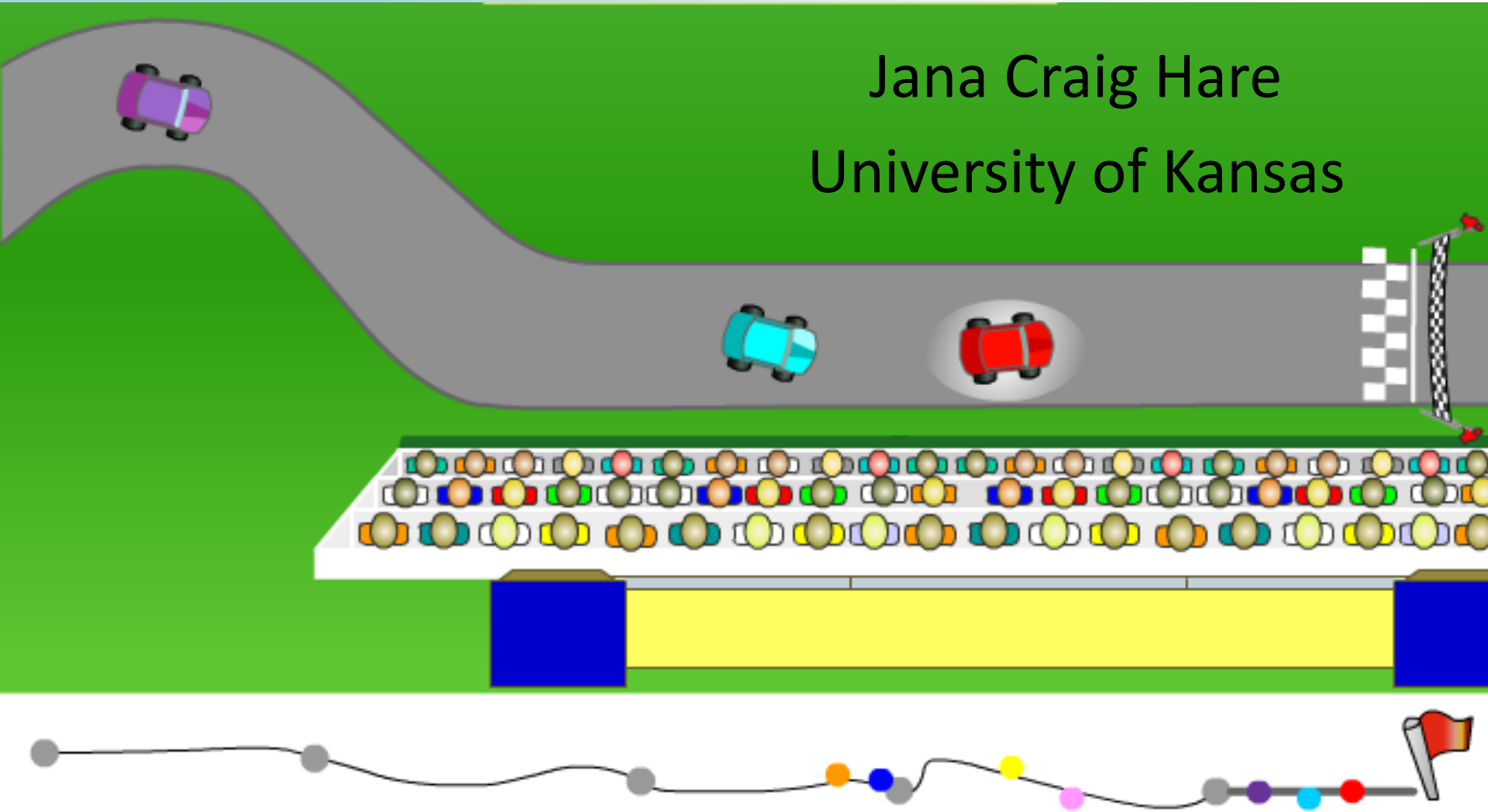
The Teacher's Role in Game- and Simulation-Based Learning

Jason Chen, Jana Craig Hare, Rick Gaston,
Emily Moore, and Karen Trujillo.

The Evidence Game

Jana Craig Hare

University of Kansas



Goals:

The purpose of the Evidence Game Project is to develop and evaluate the effect of a game designed to promote middle school science students' basic level of fluency with knowledge of and thinking related to scientific argumentation.

ALTEC

KU CENTER FOR RESEARCH ON LEARNING
The University of Kansas

Argumentation & Evaluation Guide

Topic_____ Name: _____
Title_____ Class: _____
Source_____ Date: _____

1 What is the **Claim**, including any **Qualifiers**? Are there qualifiers? **Yes/No**. (If yes, underline them.)

2 What **Evidence** is presented? In column 3, identify the type of evidence with the letter: **D**ata (D), **F**act (F), **O**pinion (O), **T**heory (T).

3

5 What chain of **reasoning (warrant)** connects the evidence to the claim? In column 6, identify type of reasoning with the letter(s): for **A**UTHORITY (A), **T**HEORY (T), or type of LOGIC: **An**alogy (AN), **C**orrelation (C), **C**ause-**E**ffect (CE), **G**eneralization (G)

6

4 **Evaluate** the quality of the evidence as poor, average or good. **Explain** your evaluation.

Reliable

Valid

Objective (no bias)

Controlled Experiment

7 **Evaluate** the quality of the chain of reasoning as poor, average or good. **Explain** your evaluation.

Strength of Authority

Application of Theory

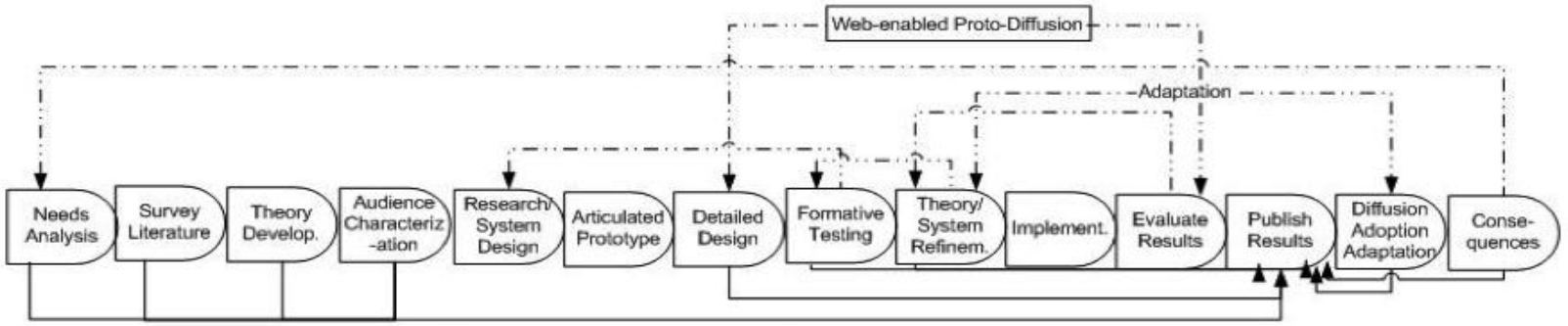
Type of Logic

8 What are your concerns about the believability of the claim? (your counterarguments, rebuttals or new questions)?

9 Accept, reject, or withhold judgment about the claim. **Explain** your judgment.

Integrative Learning Design Framework

Figure 1
Questions and Methods for Design Research by ILDF Phase



ILD	Informed Exploration	Enactment	Evaluation: Local Impact	Evaluation: Broader Impact
Guiding Questions for Research	Questions: What are identified gaps/problems in theory, practice, and/or the marketplace? What information can be gleaned from existing data or research? How can we characterize the problem or learner need? What are the systemic social, cultural, and organizational influences or constraints on design? What are characteristics of the audience?	Questions: What are the learning targets for innovation? What design principles or strategies may be applicable? How to identify and operationalize cognitive and performance processes in design? To what extent does the design embody the theoretical model?	Questions: Is the enacted design usable, valid and relevant? Is the design instance accessible and efficient in delivering instruction or supporting learning? What is the local impact or effectiveness of the design instance? How effective is the design solution in achieving learning targets at its highest fidelity in full context?	Questions: What factors influence diffusion, adoption and adaption of innovation? What are the pragmatic demands of the learning environment that influences adoption of design? What policies and cultures shape participants use of innovation?
Applicable Research Methods	Methods: Benchmarking Performance/needs analysis Interviews Survey of Experts Focus Groups Observations/Role Modeling Case Studies	Methods: Task Analysis Contextual Analysis Designer Logs Expert Review Audience Review	Methods: Usability Testing Expert Review Observation or Video records Interviews Formative Evaluation Pre-post Comparative Studies Quasi-experimental studies	Methods: Analysis of computer log files Multi-site Interviews, Surveys and Observations Data mining Correlational studies Quasi-experimental studies

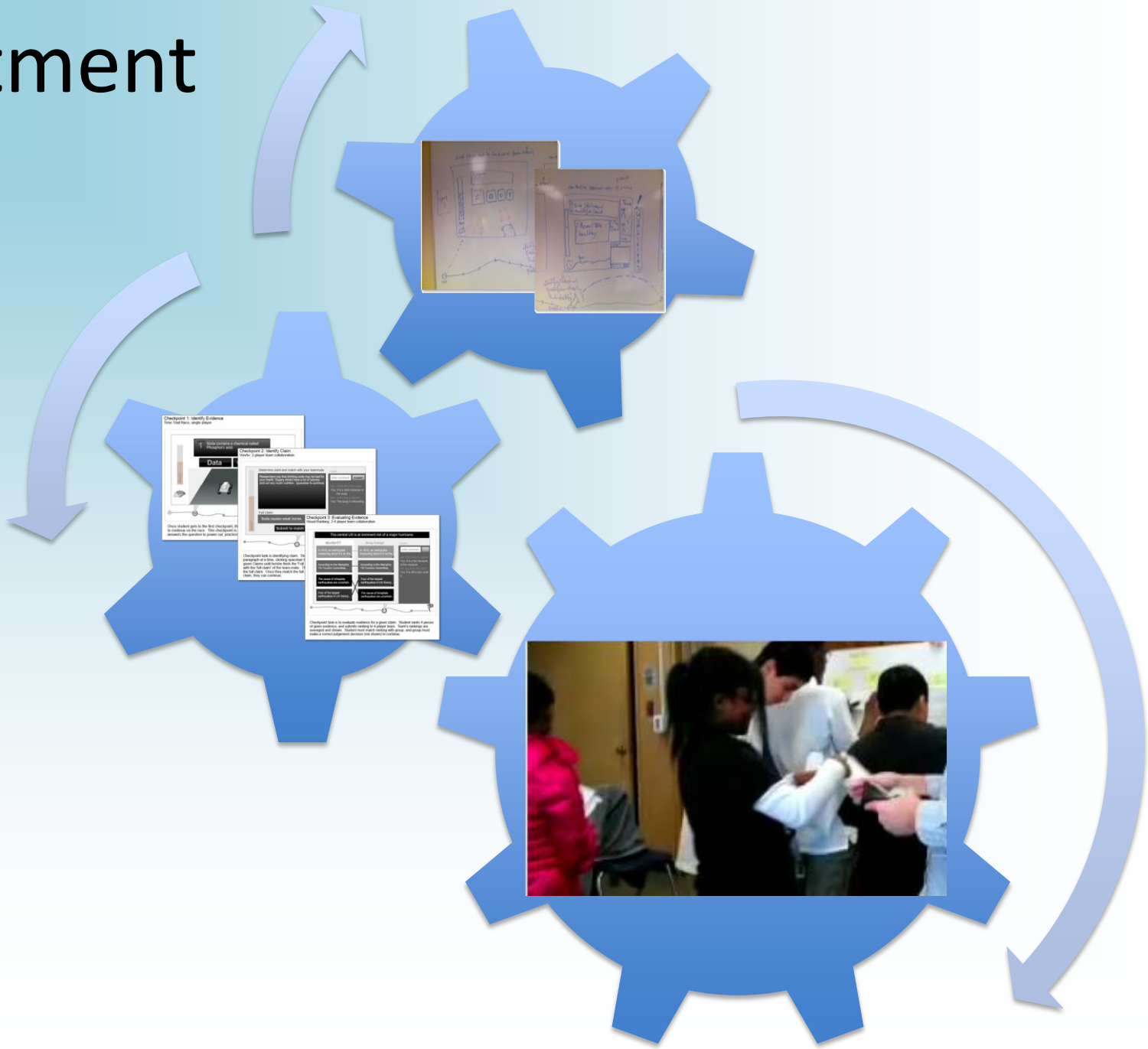
Bannan-Ritland, B. (2003)

Informed Exploration



Always Present	Sometimes Present	Never Present
Making content relevant to students – Stories – Sports examples Varied classroom activities – Lectures – Students working in groups/pairs – Experiments/Labs - Written instructions	Prompting a hypothesis – Asking "what if" questions Questioning techniques Use of engaging technologies Use of game-like classroom activities	Argumentation vocabulary – Claim – Evidence -- etc. Discussion about evidence as it relates to accepting or refuting a claim or hypothesis Use of technology-based games

Enactment


Checkpoint 1: Identify Evidence
Data
Checkpoint 2: Identify Claim
Checkpoint 3: Evaluating Evidence

Argumentation Game

Version 1.1

START

Enter Username

Enter a username below.

Username:

CONTINUE

Game Setup

Click on a game below to join. If no game is listed, create a game for others to join.

Join Game List

Create Game

JOIN	ALTEC's Game	In Game 1/20 players

Click your car to change its color.
Click Start when ready!


player_1


player_2


player_3


player_4

START


player_5


player_6


player_7


player_8

Race to the first Pit Stop by tapping in the right direction!


player_9


player_10


player_11


player_12


player_13


player_14


player_15


player_16


player_17

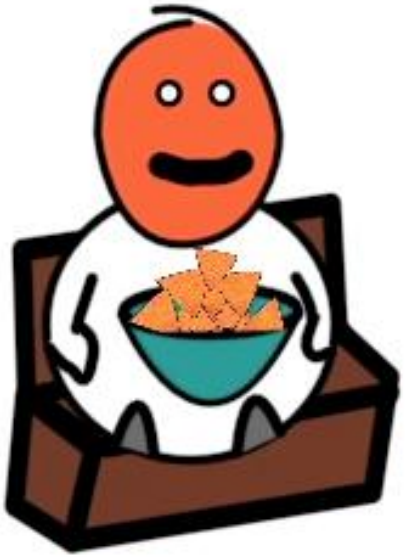

player_18


player_19


player_20

Comin g Soon!

DID YOU KNOW?



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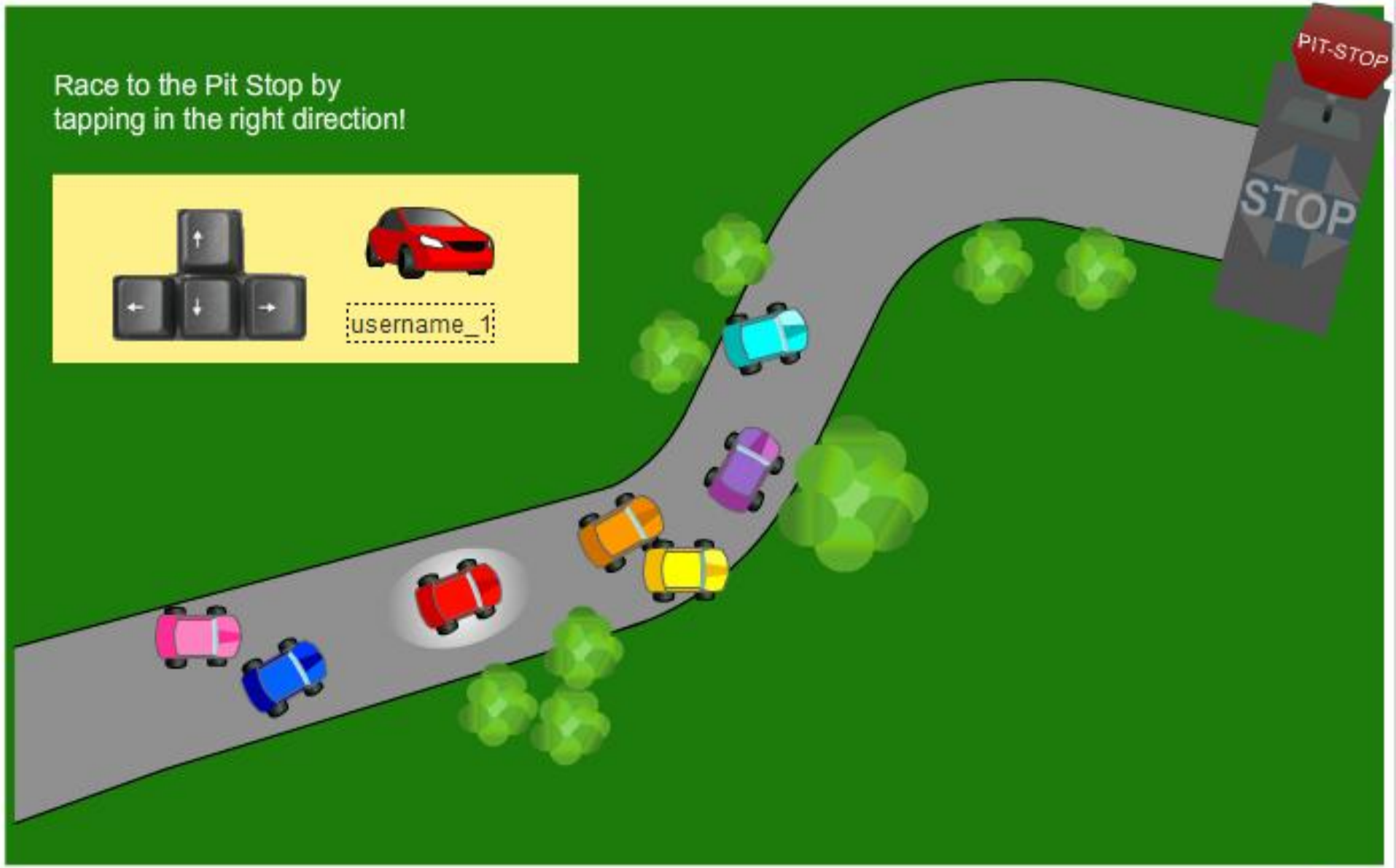
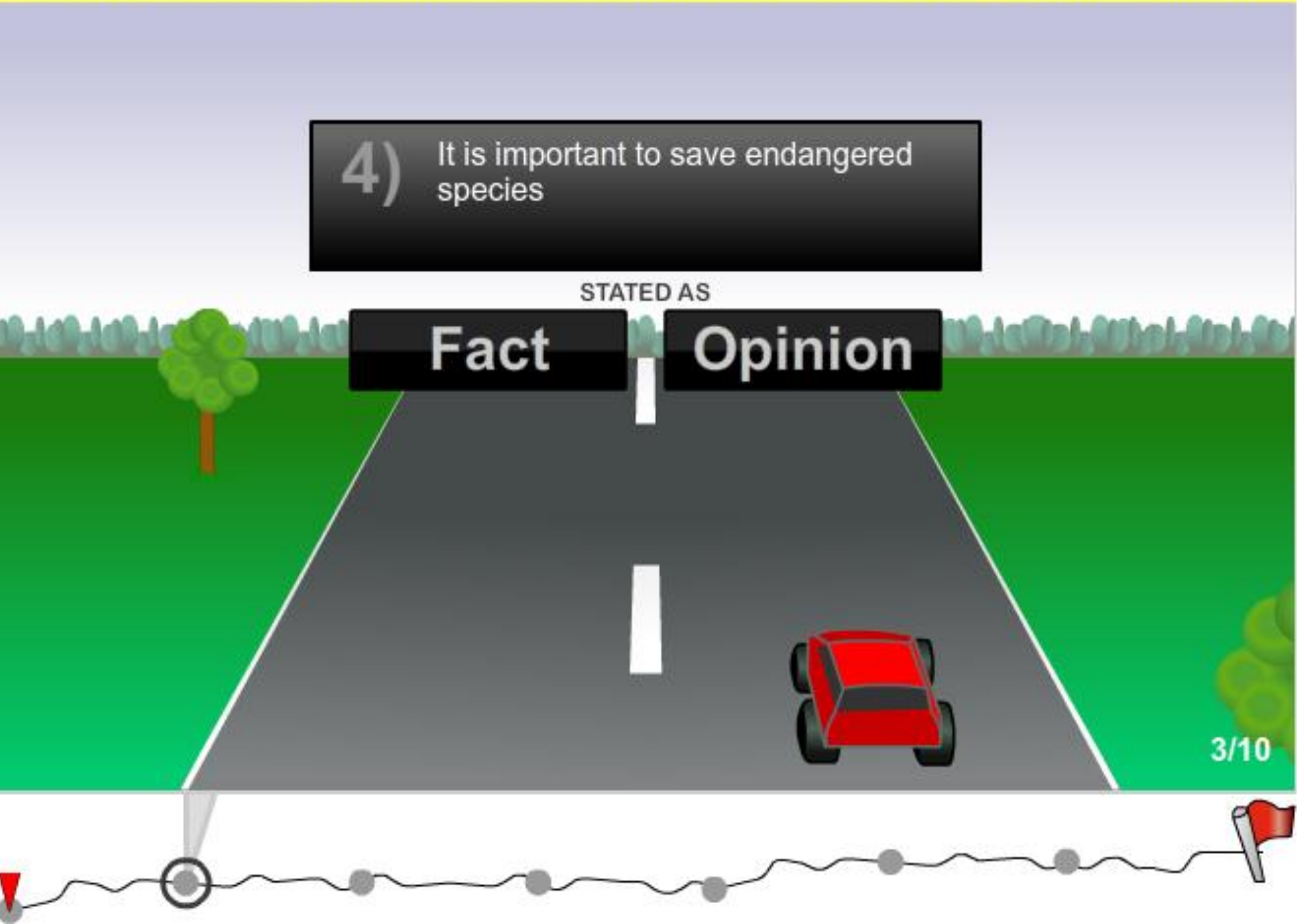

Race to the Pit Stop by
tapping in the right direction!
username_1
PIT-STOP
STOP

Pit Stop Task: Determine if the sentence is stated as fact or opinion. (10 correct answers)



Race to the Pit Stop by
tapping in the right direction!

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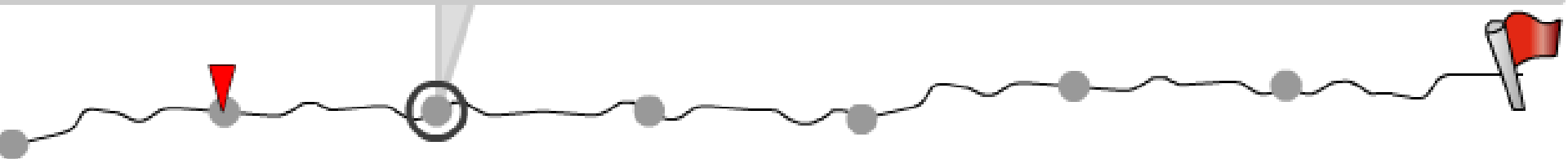
Pit Stop Task: Determine the best claim for the article.

Engineers can make fuel from plants, but the best plants for this biofuel are also the plants we need for food. In order to make fuel from grass and other waste material, scientists turned to nature. Pandas may have the key to the problem, in their poop! Bacteria in a panda's stomach create an enzyme that breaks down bamboo and other plant fibers. Scientists could replicate panda bacteria enzyme for the fuel industries. With this, biofuels could be made from grasses or waste plant material instead of food crops.

Choose the best claim:

3) Pandas convert food to fuel in their stomachs

Submit



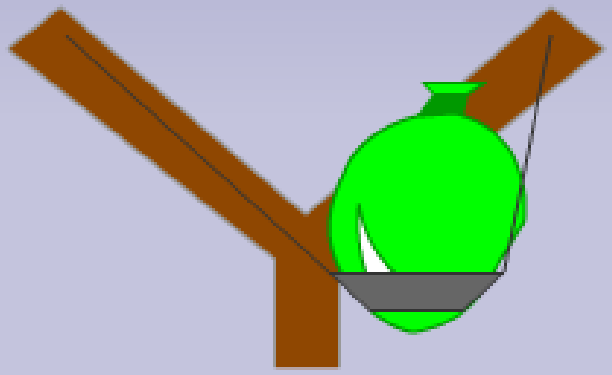
Race to the Pit Stop by
tapping in the right direction!

username_1

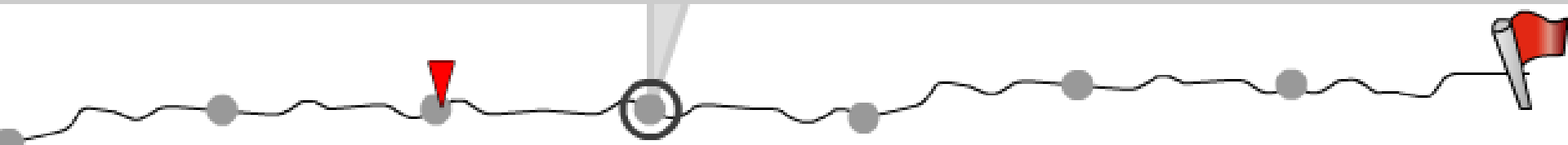
Pit Stop Task: Splash the qualifier in the claim. (3 correct answers)

An enzyme created by bacteria from pandas may

be useful in creating biofuel from waste plants



1/3



Race to the Pit Stop by
tapping in the right direction!

username_1

PIT-STOP

STOP

Pit Stop Task: Rank the statements by how well they support the claim.

An enzyme found in panda poop could be replicated to help convert plant matter to biofuel

BEST SUPPORT

1

Bacteria were harvested from pandas living at the Memphis Zoo.

2

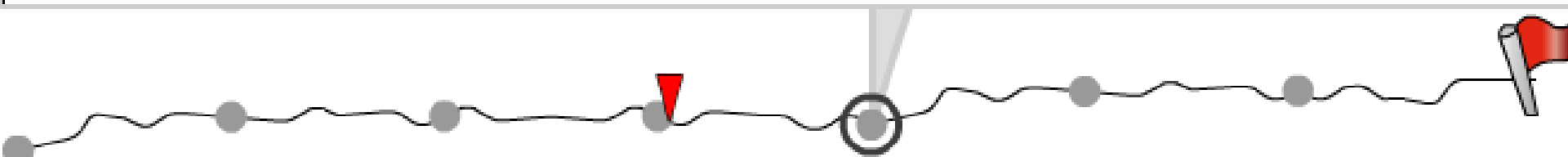
Panda poop is the most pleasant poop to work with.

3

Panda stomachs are full of bacteria that can efficiently turn the woody bamboo stalks into simple sugars.

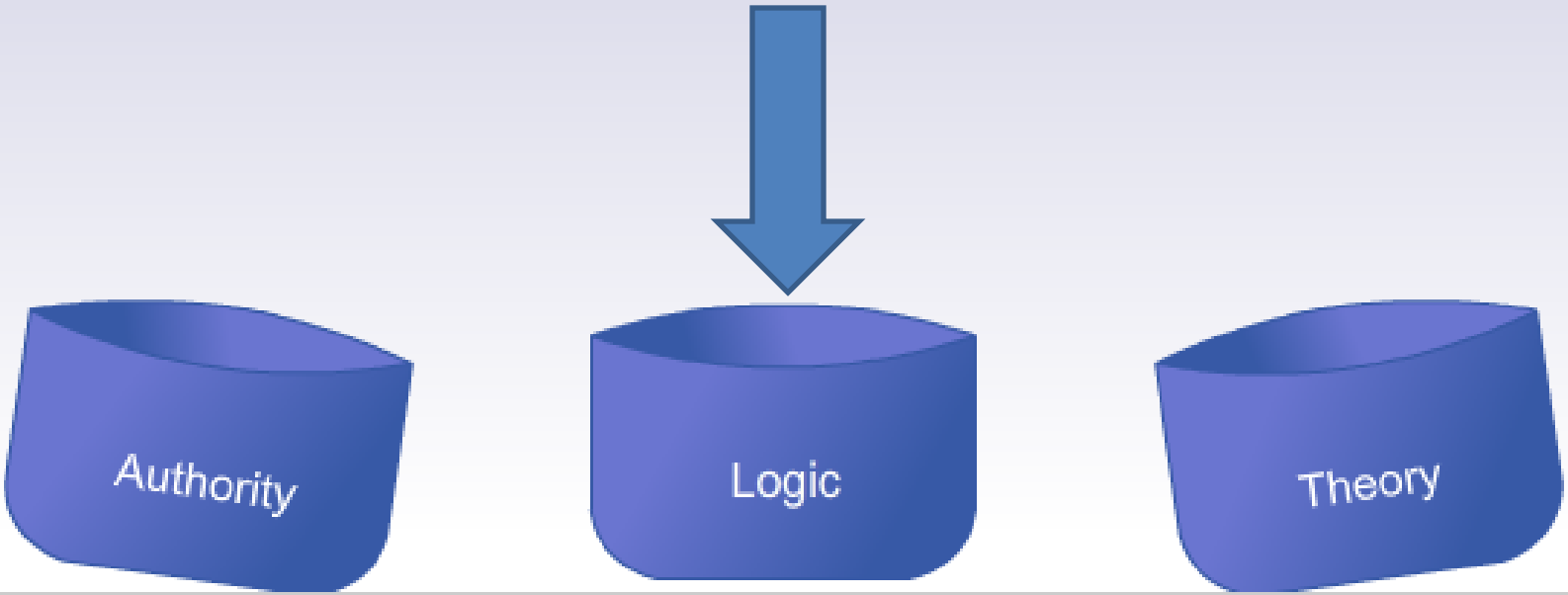
WORST SUPPORT

SUBMIT YOUR RANKING



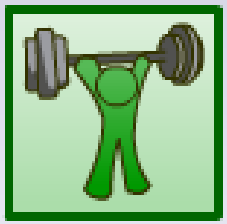
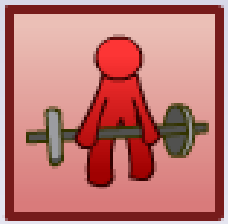
Pit Stop Task: Determine the type of warrant.

Genetically engineered enzymes should be able to work as well as natural enzymes

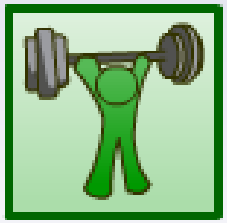
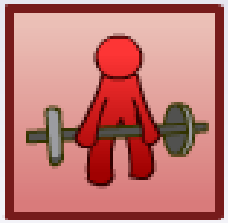


Pit Stop Task: Evaluate whether the quality of the warrant is strong or weak.

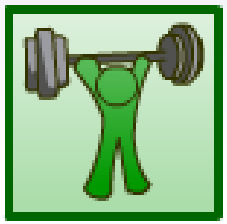
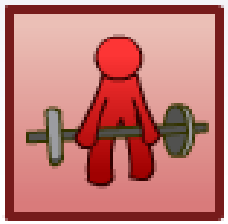
1) The study was supported by the Mississippi Corn Promotion Board

2) The researchers are scientists at Mississippi State University

3) Current biofuel production requires high temperatures and pressures

PitStop Task: Determine if the new information makes you question the claim.

CLAIM: How much we eat is partly determined by how empty our plate or bowl is.

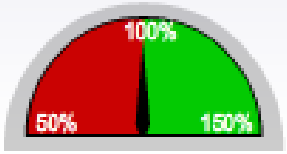
Comin g Soon!

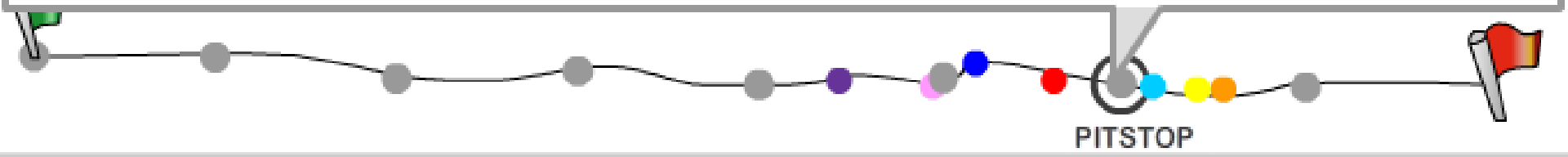
Select whether the new information shown below makes you question the claim.

1) A recent study involving soup bowls with rectangular shapes also increased the amount of soup eaten during the sitting.

YES	The new information makes me question the claim
NO	The new information does not affect the claim

SUBMIT





PitStop Task: Read the article and accept or reject the article's claim.

CLAIM: A massive eathquake will strike the central US in the next 5 years.

Kentucky, Tennessee, and Mississippi. Four of the largest earthquakes ever recorded have occurred in this region.

Most earthquakes are caused when parts of the Earth's crust, called plates, collide or rub against one another. These are called interplate earthquakes. However the New Madrid area is right in the middle of the North American tectonic plate. Earthquakes in this region occur when pressure under the Earth is released through a crack, and are referred to as intraplate earthquakes.

Comin g Soon!

○ **Accept** ○ **Reject** ○ **Withhold**

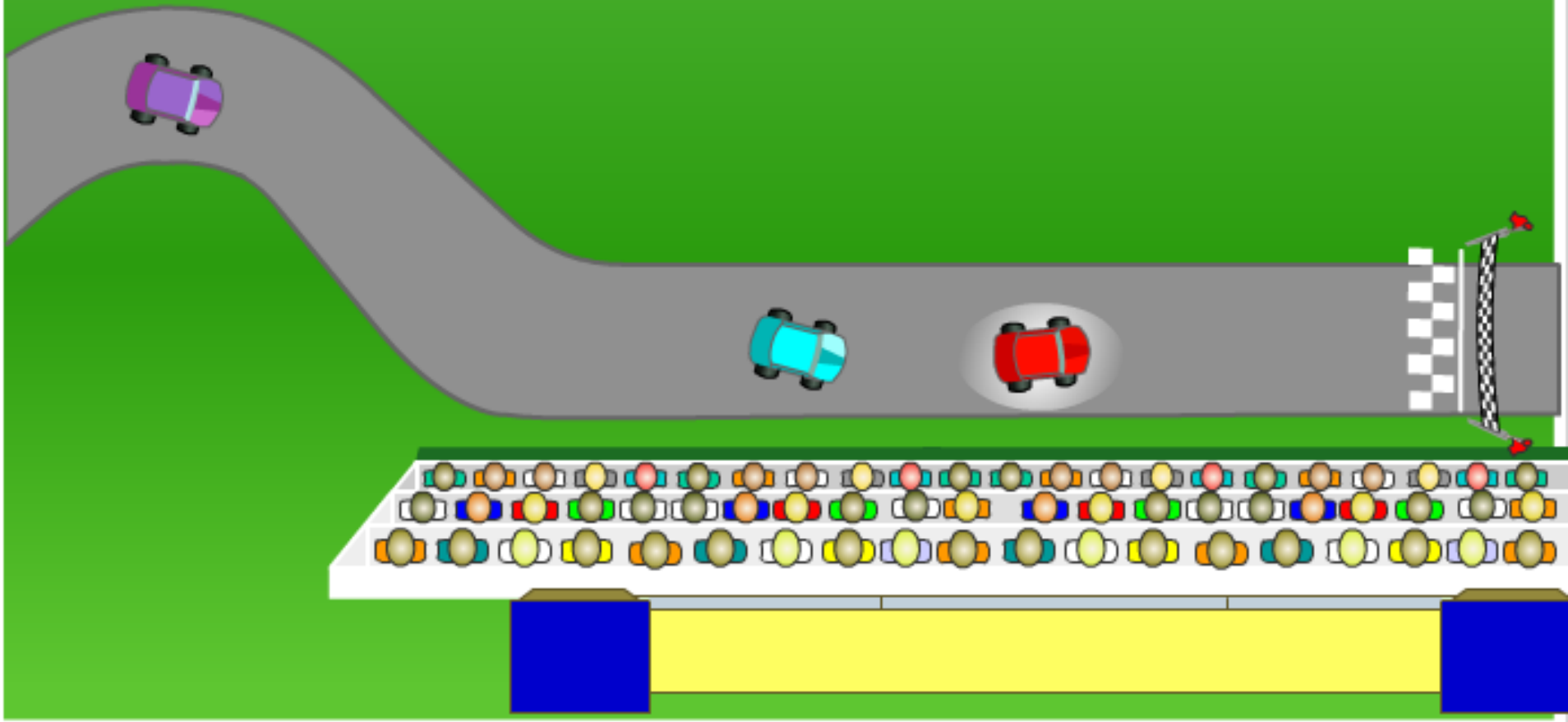
Briefly justify why you accepted, rejected, or withheld the claim (20 words max) then click Submit

SUBMIT

The other game players and your teacher will read your answer.

Race to the Pit Stop by tapping in the right direction!

username_1



Results

Extra Points!
Like and comment for points.
+1 for like, -1 for dislike.

50 + 14 − 2 | Total: 62pts

View Claim | View Article

1st 14.23 min 50 pts

player_1

4
ACCEPTED BECAUSE
"All the evidence points to it happening in the near future."
4 0

2nd 14.23 min 30 pts

dougDude

4
ACCEPTED BECAUSE
"Too many opinions, not enough facts."
2 0

3rd 14.23 min 20 pts

speedy

4
ACCEPTED BECAUSE
"The main researcher is from a trusted university."
4 0

4th 14.23 min 10 pts

player_6

4
ACCEPTED BECAUSE
"The scientists say its likely, they know best."
1 0

5th 14.23 min 10 pts

player_1

4
WITHHELD BECAUSE
"I'm in first place! Woohoo"
0 5

from DougDude
"I agree. Thats a big risk."
0 0

from maultRacer
"I don't think the researcher has enough cred."
1 0

player1
"He's from a big university."
2 0

from player6
"The article says he was from a corporation, not a school"
1 0

Comin g Soon!

enter comment

POST

Race Results

2nd: *15.17*

player_2

3rd: *18.17*

player_3

4th: *22.17*

player_4

5th: *22.17*

player_2

6th: *22.17 sec*

player_5

7th: *22.17*

player_6

8th: *22.17*

player_7

9th: *22.17*

player_8

10th: *22.17*

player_6

11th: *22.17 sec*

player_9

12th: *22.17*

player_10

13th: *22.17*

player_11

14th: *22.17*

player_12

15th: *22.17*

player_10

16th: *22.17 sec*

player_13

17th: *22.17*

player_14

18th: *22.17*

player_15

19th: *22.17*

player_16

20th: *22.17*

player_14

Current Scenario Topics

- How much we eat is partly determined by how empty our plate or bowl is.
- Pluto is/is not a planet.
- Greenhouse gas buildup may have an impact on severe weather events in the United States.
- Using some types of sunscreen can prevent skin cancer.
- Sunscreen usage may lead to weaker bones.
- The shape of a Pinewood Derby race car is probably not an important factor in its speed.

Additional Scenario Topics

Horsepower is the best measure of a car's performance

Energy/sports drinks are good for you

Best way to deal with invasive species

Sleep deprivation and testtaking

Nuclear power vs solar vs geothermal vs wind… safety vs cost vs efficiency

Carpal tunnel syndrome

Dangers of "fracking"

TSA "backscatter" scanners are/are not safe

Ball lightning is a myth

texting & driving

Cell phones and driving

The Large Hadron Collider could destroy the earth

Headphones/ear buds and hearing loss

Pandas are going extinct primarily due to hunting

Placebos are getting more effective

Cell phones and cancer

Pandas are going extinct due to loss of habitat

LED lightbulbs are the most efficient

Teacher Role in Using Data Games

Rick Gaston,
Research and Project Manager
KCP Technologies
June 14, 2012

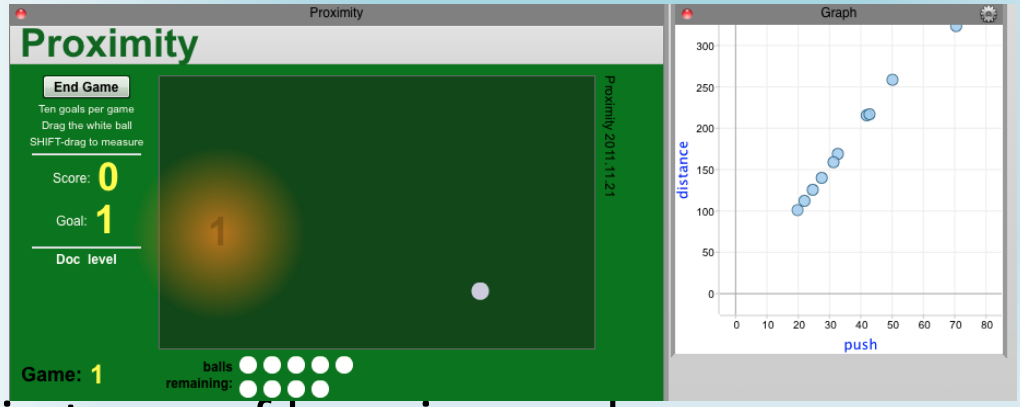
Project Overview

- Last field test year of DRK-12 project
- Bringing data analysis functionality of desktop programs Fathom and TinkerPlots to Web
- Create games where students motivated to learn to analyze data and say :

  "I like math – it helps me win!"
- Release of final materials in September, 2012

Data Games and Learning

- www.kcptech.com/datagames



- Two main types of learning goals:
  - Data analysis skills with graphs, tables
  - Math content from Algebra 1 and other
- Supporting materials developed:
  - Student videos and activity sheets
  - Teacher notes and videos

Emily Moore

Ariel Paul, Noah Podolefsky, Katherine Perkins

PhET Interactive Simulations

- Suite of **Interactive Simulations** (over 100!)
- Levels: **Middle School**, High School, Undergraduate
- Topics: Physics and Chemistry
  (some in Biology, Earth Science & Math)
- **Research-based** and **User Tested**
- **Free!** Online or downloadable (size ~ 100 Mb)
- **Intuitive** to Use

Sim Use

- PhET Sims are flexible tools
  - Can be used: students, teacher (demo) & homework
- Focus On:
  - Classroom Use
  - Middle School
  - Students working in pairs with a computer

Build a Molecule Sim

- Learning Goal
  - Determine the meaning of **subscripts** and **coefficients** in chemical formulas

Teacher Role During Use

- Active
  - Facilitating group & classroom discussions
  - Observing
  - Utilizing observations for discussion

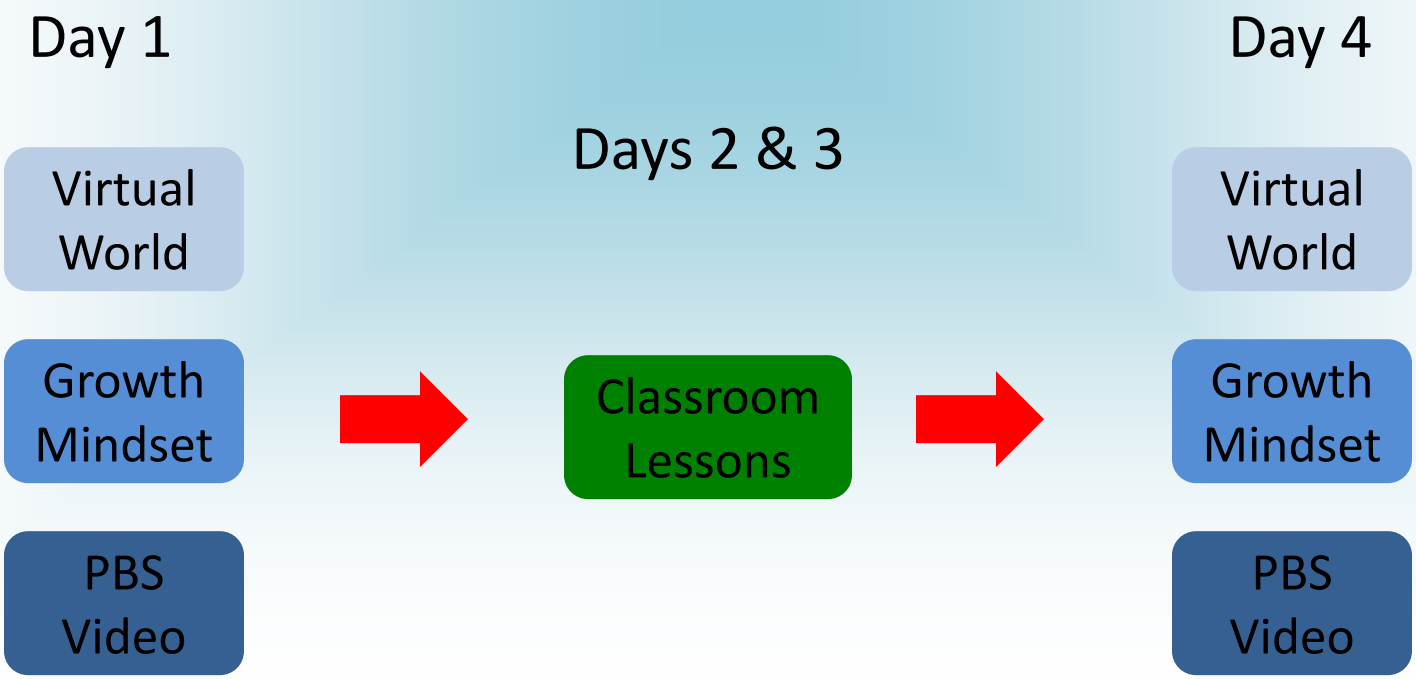
Transforming the Engagement of Students in Learning Algebra (TESLA)

Jason Chen

Transforming Engagement of Students in Learning Algebra

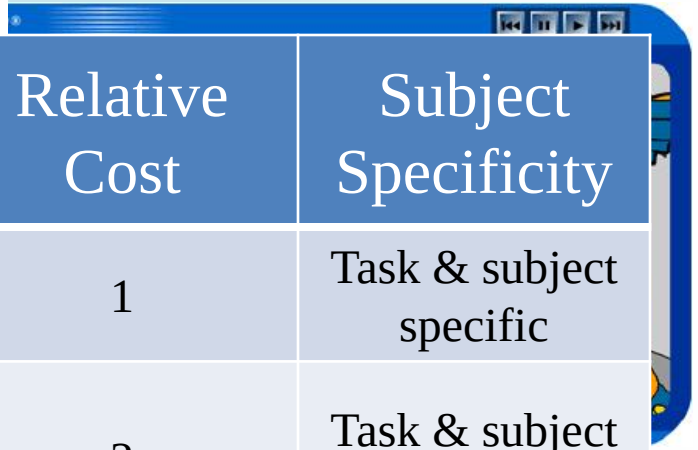
Harvard Graduate School of Education

Which types of technology-based activities benefit whom, and under what types of conditions?

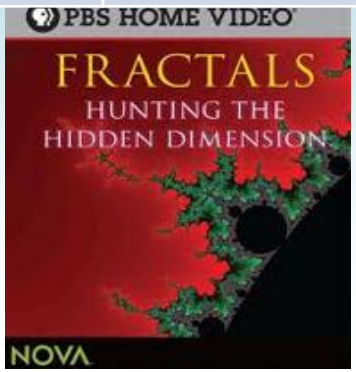


Induction 1:
Immersive World

Induction 2:
Abridged Growth
Mindset Module



Induction	Constructs Targeted	Tech. Used	Relative Cost	Subject Specificity
Virtual Environment	Self-Efficacy	Immersive virtual world	1	Task & subject specific
Abridged Growth Mindset	Implicit Theories of Ability	Web-based learning modules	2	Task & subject general
PBS Videos	None	Video	3	Subject specific



www.mathsnacks.com

Goal: The **goal** of this project is to **create and evaluate effectiveness of innovative animations and games** specifically designed to: Increase students' conceptual understanding of ratio, proportion, number sense, scale factor and other difficult middle school math concepts.

MATH SNACKS Activities

- **Development**:
  - The Learning Games Design Model is used throughout the process.
- **Outreach:**
  - Summer Camps and In School PD offered.
- **Testing:**
  - Students and teachers are also involved throughout the development process.

Research

2011-2012 Pilot Study

- 9 teachers
- 400 students

- **Research Questions**
  - Will students show learning gains in target areas?
  - How will teachers use Math Snacks when given different support materials?
- **Research Design**
  - Pre-Post Test
  - Observations
  - Focus Group Interviews
  - Teacher/Student Surveys
- **Findings**
  - All subgroups of students showed gains
  - Teacher support materials need to offer various entry points and levels of support.

2012-2014 Expanded Study

- 40 Teachers (20 MS, 20 without)
- 2000 students in NM

- **Research Questions**
  - Will students in MS classroom show learning gains in target areas?
  - How will teachers use Math Snacks when given support materials?
- **Research Design**
  - Pre-Post Test
  - Observations
  - Focus Group Interviews
  - Teacher/Student Surveys

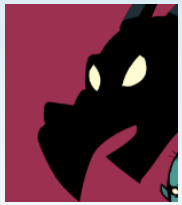
www.mathsnacks.com



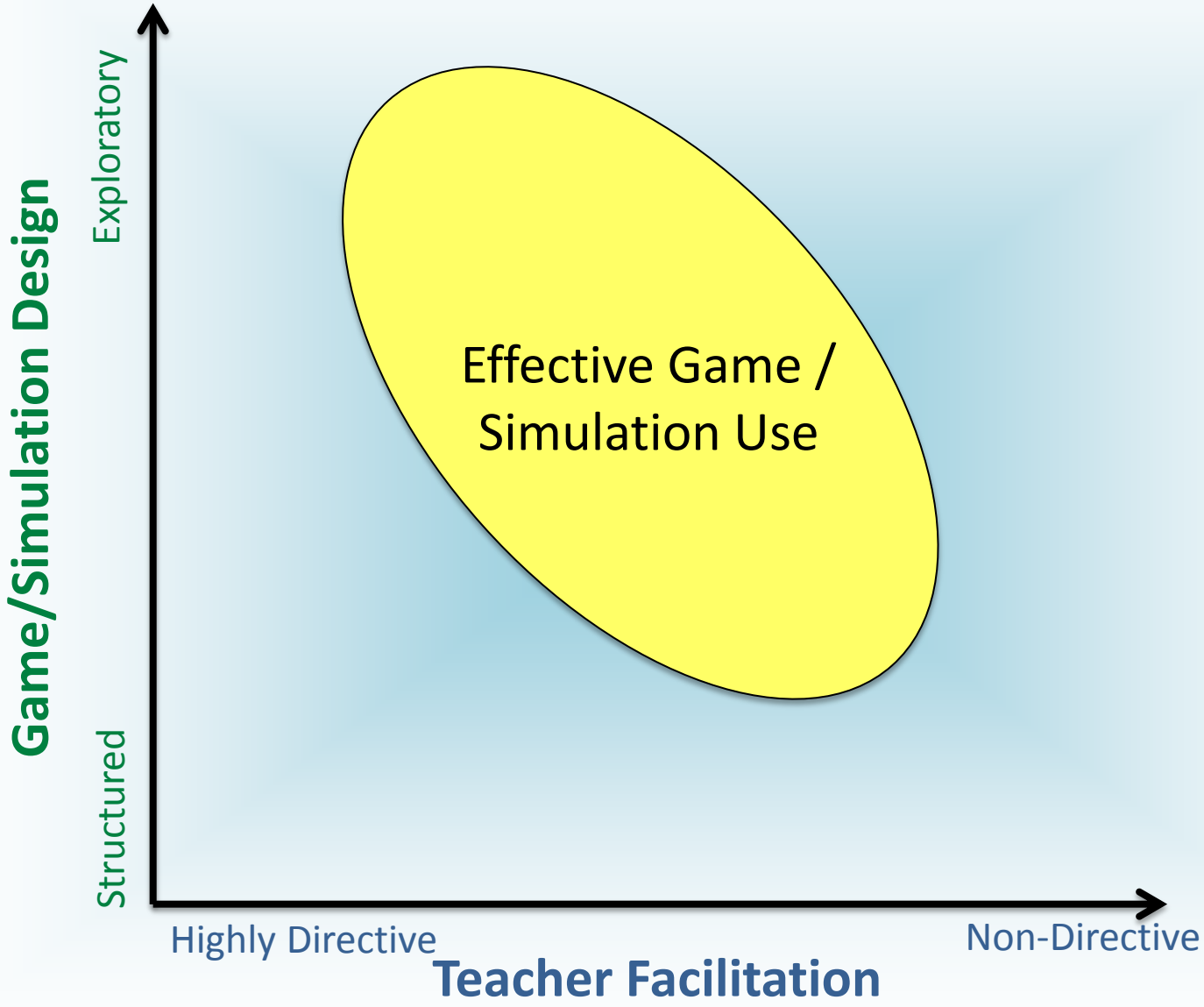






Student Engagement and Learning

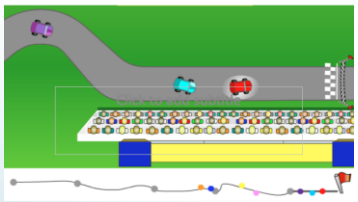


Learning Games Design Model

- Who
  - Content area specialists
  - Animators and programmers
  - Education Specialists
  - Teachers
  - Students
- How
  - Collaborative meetings, ideas, sharing, revisiting, testing Beta versions with kids
  - Teachers observed using products
  - Create support materials based on observations, suggestions

The Design

The Evidence Game



Key challenge

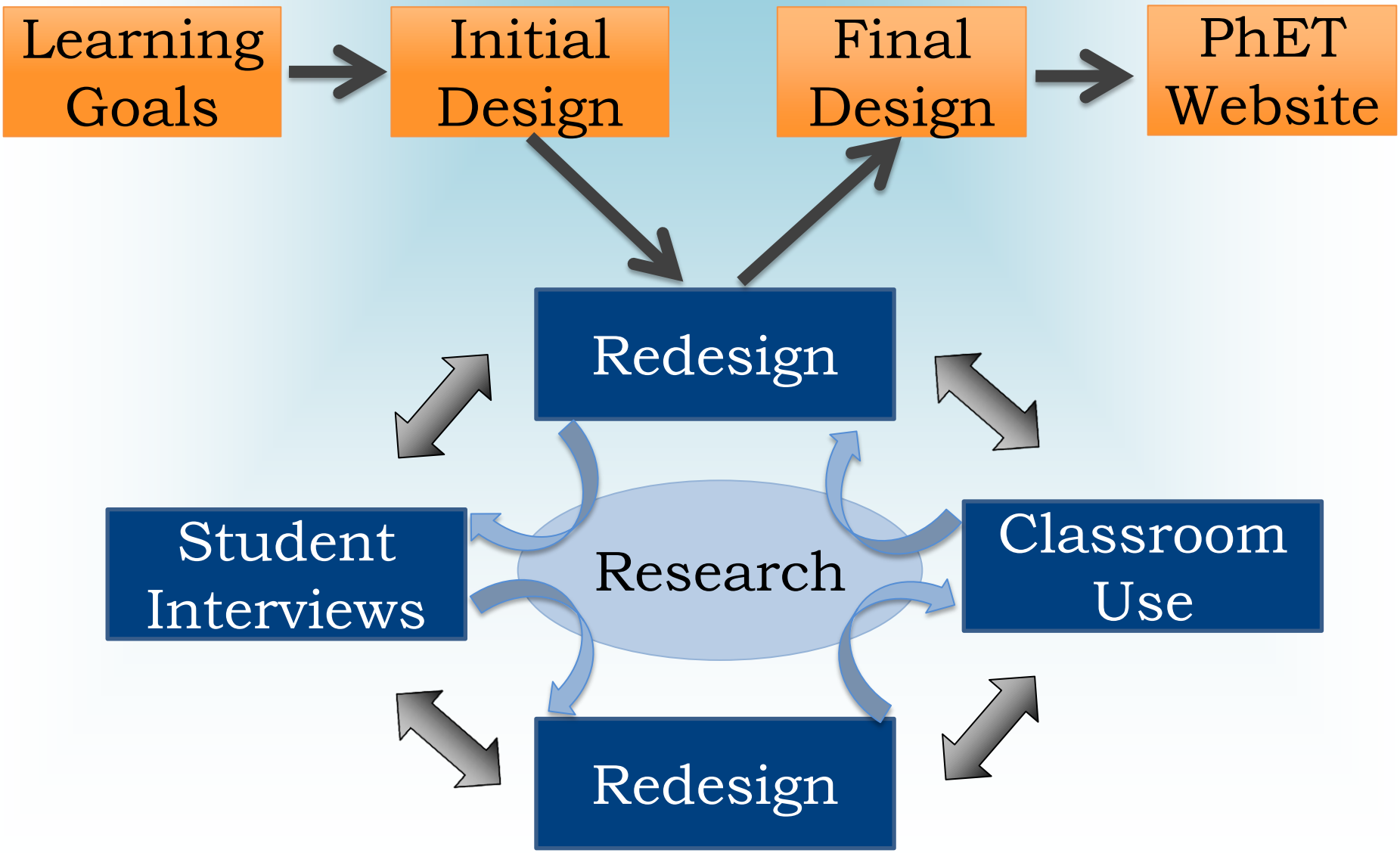
- Find the “sweet spot” in balancing :
  - Game software directiveness, scaffolds, and interventions;
  - Teacher direction and interventions;
  - Activity sheet directiveness and scaffolding

  so that each game:
  - Is accessible to all students (who have some prerequisite skills)
  - Is contructivist in its orientation
  - Provides differentiated challenges
  - Helps all students achieve teachers’ learning goals
  - Is fun and motivates student learning

Considerations about Teacher Role when Designing Software

- Considerations of appropriate roles
- Example of locked levels in games
- Designing who does what when students get "stuck" – Proximity game example
- Related research
  - Clements, et al., 2008
  - Olive & Lobato, 2008
  - Egenfeldt-Nielsen, 2006

PhET Sim Development Cycle



Design Process for TESLA Game

- Who
  - Math content area expert
  - Instructional designer
  - Motivation expert
  - Students

- How
  - Collaborative meetings, ideas, sharing, revisiting, testing
  - Tested bits of game in pilot studies with students
  - Create support materials based on observations, suggestions

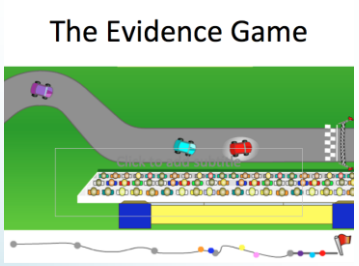
The design process is often MESSY!

Challenges?

TESLA: Teacher Support Materials

- Designed a 7-hour PD for teachers mostly focused on the actual teaching of math curriculum.
- 30 minutes dedicated to going through the tech.
- Produced a mini-handbook of FAQs and tips on what to do if students “get stuck.”

Teacher Supports



The Teacher…

- Assigns the game scenario to students
- Background knowledge in Teaching Scientific Argumentation
- Skills/Strategies to follow up with class discussions

Materials Needed…

- Teaching Scientific Argumentation “Course”
- manual – set up, play, and interpreting data
- frequently asked questions
- discussion board

Teacher Support Materials

- **Teacher's Corner**
- **Standards alignment**
- **Teacher guides for each animation/game**
  - Learning goals/objectives
  - Discussion questions
  - Bonus activities
- **Learner guides**
  - Support learning goals
  - Combination of direct and open ended questions
  - Can be used for assessment purposes
- **Spanish translations**
  - 2012-2014
- **Instructional videos for each animation**
  - 8-10 min video showing effective teaching strategies for animations
- **Instructional videos for each game**
  - 2013-2014

PhET Teacher Resources

- Workshops at conferences
- Online Materials:
  - Webinars
  - Teacher Tips for each sim
  - FAQs for new sims (new!)
  - Workshop materials
  - Sample lessons
- Email us! phethelp@colorado.edu
- Coming Soon:
  - Short video clips of facilitation
  - Suggested guidelines for effective facilitation and activity development

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Thank you!
Please feel free to ask questions!

Q&A Session:

How do we think of teachers' role in a more fluid context (i.e., tablets in classroom so no more "computer lab time").