Computer Games for Informal Science Education

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http://bit.ly/REynYp

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Science Learning Games (SLG) for Informal Science/Technical Education

Physical interaction quest game: *DinoQuest*

- Life-size dinosaurs models (e.g. T-Rex, Argentinosaursus, Velociraptors)
- Family-based problem-solving and collective learning in physical environment
- Game progress tracked via user-controlled IR transmitters activating embedded sensor net

Web-based SLG: *DinoQuest Online*

- Addresses CA science education standards for K-6 grades
- Interoperates with *DinoQuest*
- Designed for internationalization
- Developed at UCI GameLab

Transforming Science and Engineering via computer games and virtual worlds

Game Web environments can become platforms for experimentally interacting with emerging scientific models or processes (simulations)

Science learning games may create new engine for innovation!

- Global earth systems science game engine
- Nanotechnology device design games
- Fusion energy simulation games
- Supply chain/infrastructure transformation quest

Objective

How best to employ networked computer game technology in ways that integrate

- social learning opportunities
- scientific visualization methods
- external scientific datasets
- science work practices
- playful fun

to develop, deploy, and evolve single/multi-player games for informal science/technical education in different disciplines.

But first, some background on science learning games

Contemporary SLGs

-- *Droidworks* (mechanical system design)

-- *KineticCity* (life science)

-- *Genius Task Force Biology* (ecology simulation, in *German*)

-- *Industry Player* (commodity trading system)

-- *GTR* (motorsports racing simulation)
  – *NASCAR: The Game* (Nov. 2012)

LucasArts *Droidworks*


Reward:
Cybot Galactica
AT-9 Tank
Locomotion
System
#1 The Slippery Slope
Mission Briefing:
Get your droid through the security exit door at the top of the cliff. In the area nearby, there are objects that can help your droid reach its goal. The speed and weight of your droid are important factors.
Droid Info
Mission Goals
#1 The Slippery Slope
pass through security exit door
Droid Requirements
treads and wheels
Ranking:
Apprentice
Designer
Master
Mos Eisley
Jundland Wastes
Tosche Station
1
2
3
4
5
6
7
8


PLAY SCIENCE GAMES NOW!
KINETIC CITY
MISSION TO VEARTH
WHAT IS KINETIC CITY ?
THE MOST AMAZING SCIENCE SITE ON THE INTERNET !
LOGIN OR SIGN UP NOW!
NSF
Kinetic City: Mission To Vearth is produced by the American Association for the Advancement of Science, with major funding from the National Science Foundation. Copyright 2002 AAAS
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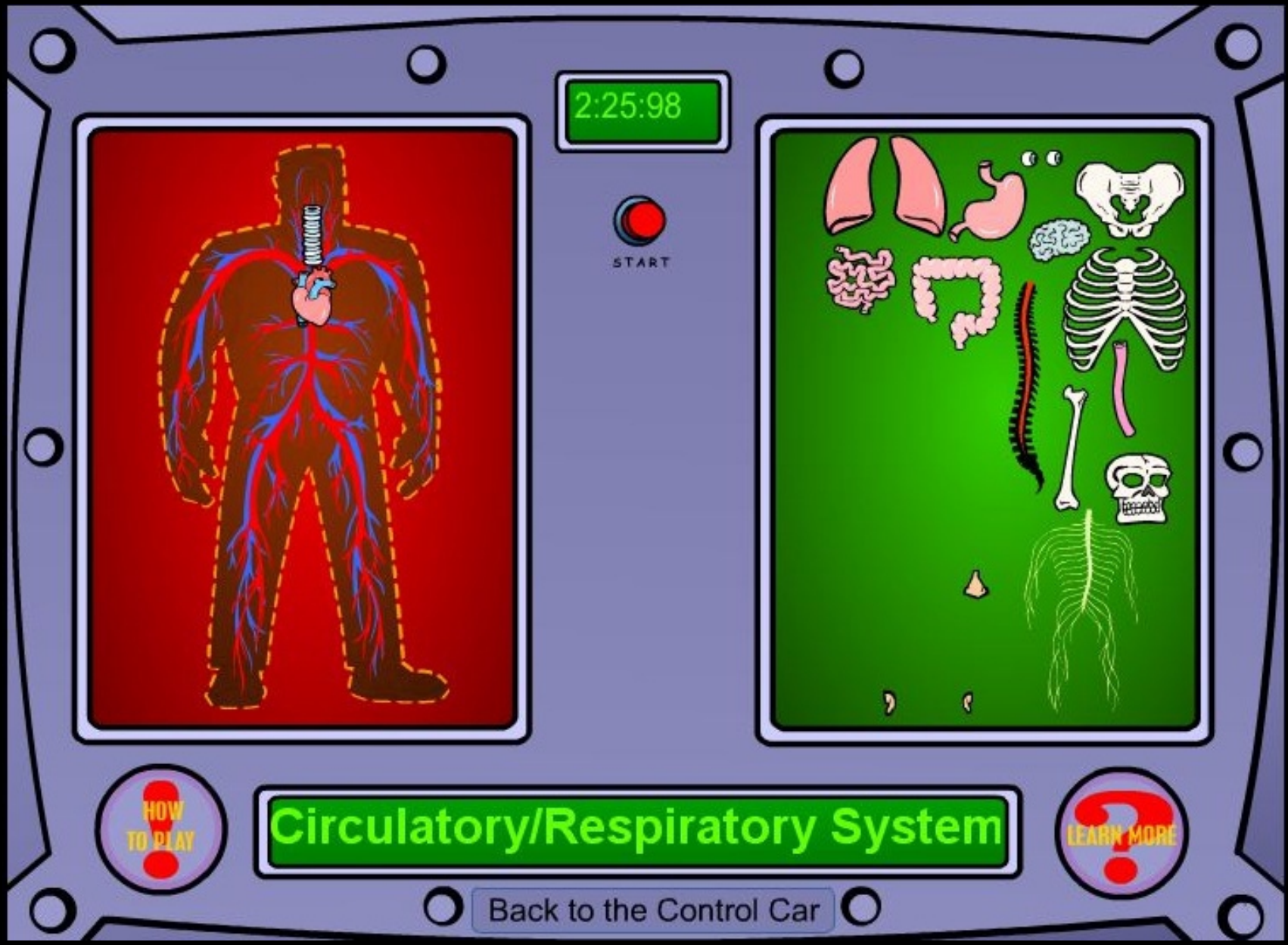
FOR EDUCATORS

KineticCity MiniGame--Body System Identification

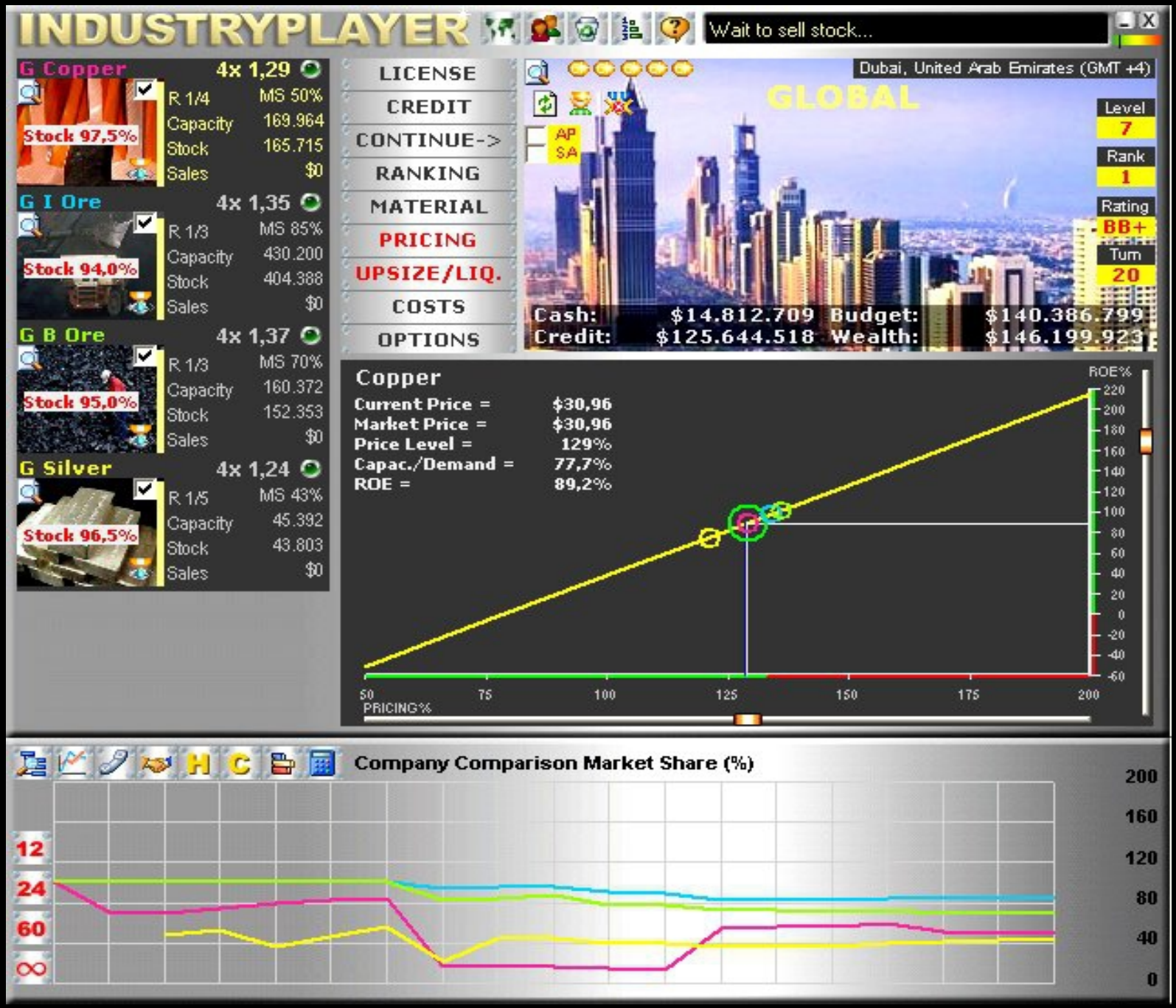


KineticCity Body System *Identification Game* Play-to-Learn techniques

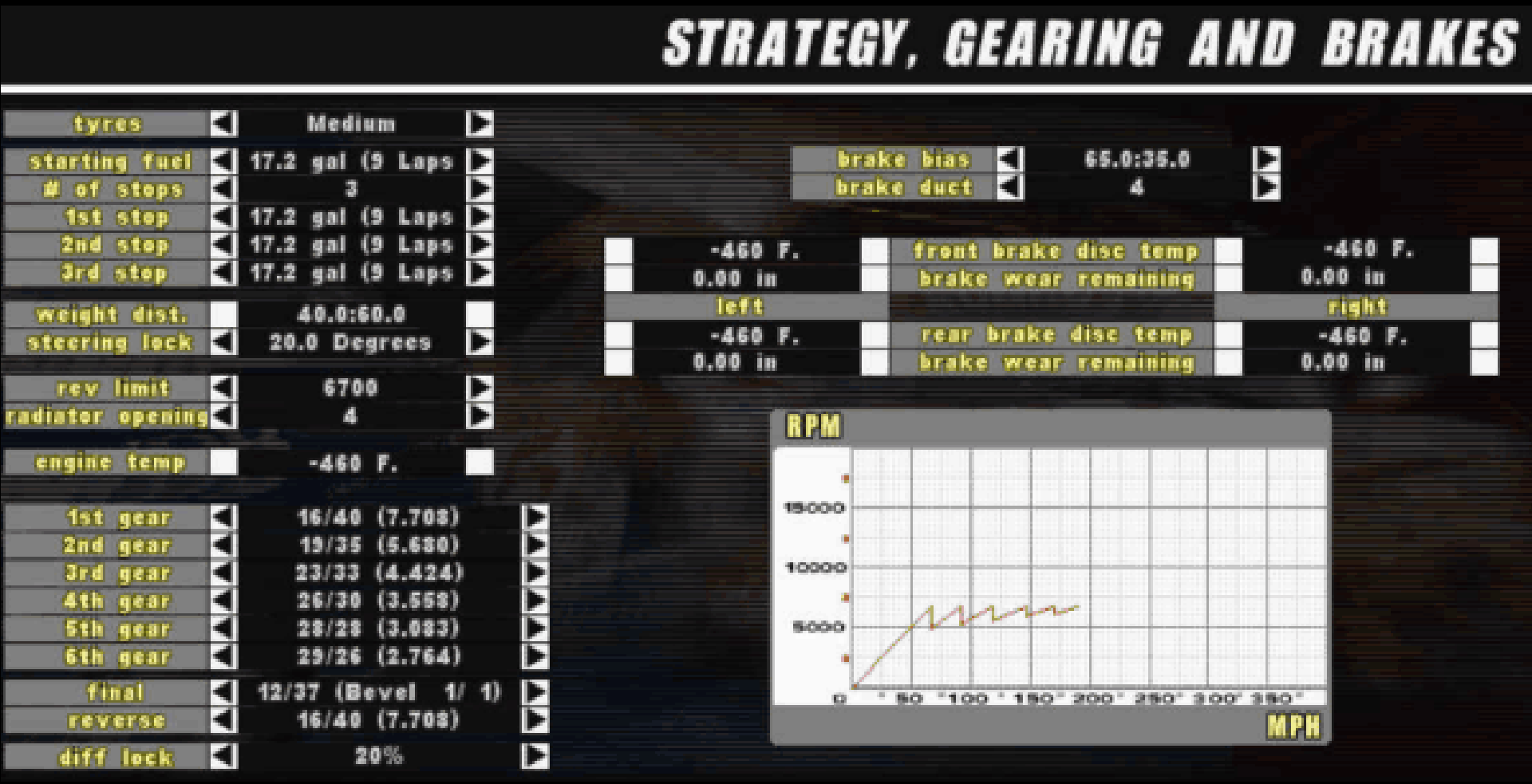
- Given prompt (e.g., *Circulatory/Respiratory system*) select, drag, and place system components into correct locations
  - System component identification (e.g., heart, arteriole-venal network, esophagus, lungs) and location
    * By iconic form/shape (no names)
- Placing all correct system components allows advancement to next system; any mistake resets (removes) placed components requiring iterative play.
  - Failure-driven (trial+error iteration) and spatial-shape reasoning
    * Play-learning anomalies
      - Some components resize, others don't
        * Nerve and arteriole-venal networks resize on placement (automatically), but bones don't
      - Systems are partial--why some components, but not others?
      - Which system -- cardio-pulmonary system vs. "circulatory/respiratory" system?

GENIUS

TASK FORCE BIOLOGIE


INDUSTRYPLAYER
Wait to sell stock...
G Copper
4x 1,29
Stock 97,5%
R 1/4
MS 50%
Capacity
169.964
Stock
165.715
Sales
$0
G I Ore
4x 1,35
Stock 94,0%
R 1/3
MS 85%
Capacity
430.200
Stock
404.388
Sales
$0
G B Ore
4x 1,37
Stock 95,0%
R 1/3
MS 70%
Capacity
160.372
Stock
152.353
Sales
$0
G Silver
4x 1,24
Stock 96,5%
R 1/5
MS 43%
Capacity
45.392
Stock
43.803
Sales
$0
LICENSE
CREDIT
CONTINUE->
RANKING
MATERIAL
PRICING
UPSIZE/LIQ.
COSTS
OPTIONS
Dubai, United Arab Emirates (GMT +4)
GLOBAL
AP
SA
Level
7
Rank
1
Rating
BB+
Turn
20
Cash: $14.812.709 Budget: $140.386.799
Credit: $125.644.518 Wealth: $146.199.923
Copper
Current Price = $30,96
Market Price = $30,96
Price Level = 129%
Capac./Demand = 77,7%
ROE = 89,2%
ROE%
220
200
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
50
75
100
125
150
175
200
PRICING%
Company Comparison Market Share (%)
12
24
60
∞
200
160
120
80
40
0

GTR racing simulation



DinoQuest at DSC

Fast Facts about *Discovery Science Center*

Located in Santa Ana, California

<u>At the Center:</u>

500,000+ annual visitors (2011)

100,000 annual field trip visitors from schools

Provides in-service science teaching training to 1000+ K-12 teachers/yr.

<u>In the Schools (via Outreach programs):</u>

150,000 annual students in science outreach programs

Inspire Youth of Today in Science

via science adventure quests

– Blending video game culture and physical exhibits
– Puts visitors into a science adventure video game
– $7Million expansion at DSC
– Dinosaur themed, but focused on (K-6) Life Science

Discovery Science Center Goals

Create a physical exhibit that blends:
- Natural history museum collection,
- Interactive, hands-on science exhibits,
- Video game culture,
- Science research practices via "*collaboratories*"

Create a *Cyberinfrastructure* for distance learning over the Internet.

Engage and explain CA/National Science Education Standards.

Create electronic performance tracking ability for better evaluation capabilities.

Workforce development

Create a mechanism that continues to drive visitors between a brick & mortar science center and the Internet/Web site multiple times.

Increase repeat usage of science center exhibits and increase visitation.

Create a replicatable and sustainable model.

DINO QUEST
DISCOVERY SCIENCE CENTER

DINO QUEST
DISCOVERY SCIENCE CENTER
ONLINE

Technology:

Embedded sensors and wireless (IR) transmitter Activation

Go to *Field Station* and *Select a Mission* by site or lab

8 Educational Missions:

- Aimed at California Science Education Standards for grades K-6
- Mission topics: Predator / Prey, Trace Fossils, Anatomy, Habitats, Identification
- Missions selected, tracked, and completed at networked multi-media kiosks
- Provides family-friendly science learning experiences

Field Site

BioMech Lab

Zoology Lab

Habitat Lab

DinoQuest in-game research team and collaboratories: diverse science *role models* (ethnicity, age, gender)

Role play (see oneself as a scientist)

After selecting a mission, head out to the dig site!

DINO QUEST
DISCOVERY SCIENCE CENTER

Situated role play

Search dig site and identify objects in the mission.

Computer and sensor network automatically tracks your progress and success.

Video game play mechanics

"Upload" data collected to collaboratories via on-site networked kiosks

Earn *Research Points* for each item found.

Obtain fossils with encoded DNA as reward for completing each mission.

Ability to save data and come back another day.

DinoQuest Online

UCI
University of California, Irvine

Online Science Learning Games

- Distance learning,
- Expands on science topics,
- Additional, in-depth science missions,
- Earn points and Dino DNA by completing missions.
- Level-up into multi-player dinosaur ecology simulation (*Dinosphere*)

DinoQuest Online (released in Summer 2007)

– Log in with password online or from DSC

– Go to each collaboratory

– http://www.dqonline.org

register OR enter “demo” “demo”

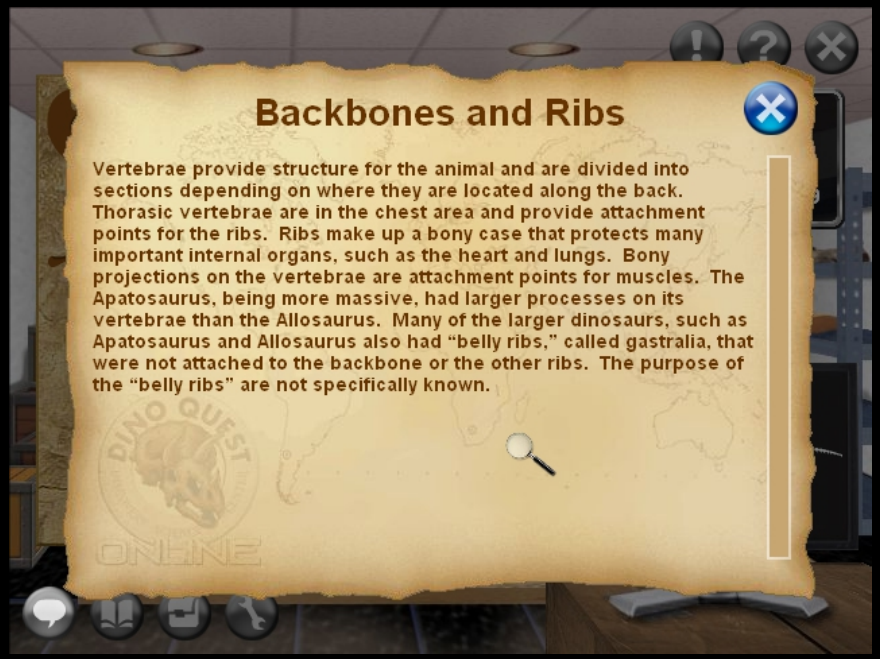
– Same scientists as **DinoQuest** at DSC

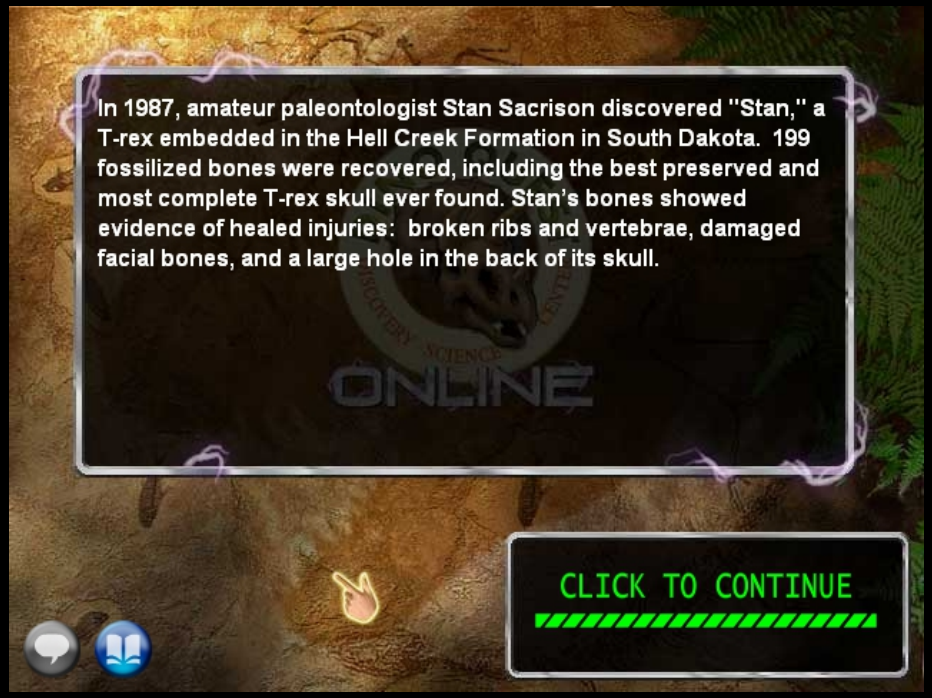
– Expand upon science education standards in each lab

Multiple science learning games: *Dinosaur Dig Pit* field site collab game

Different objectives for each game.

Multiple science learning games: Narrative content

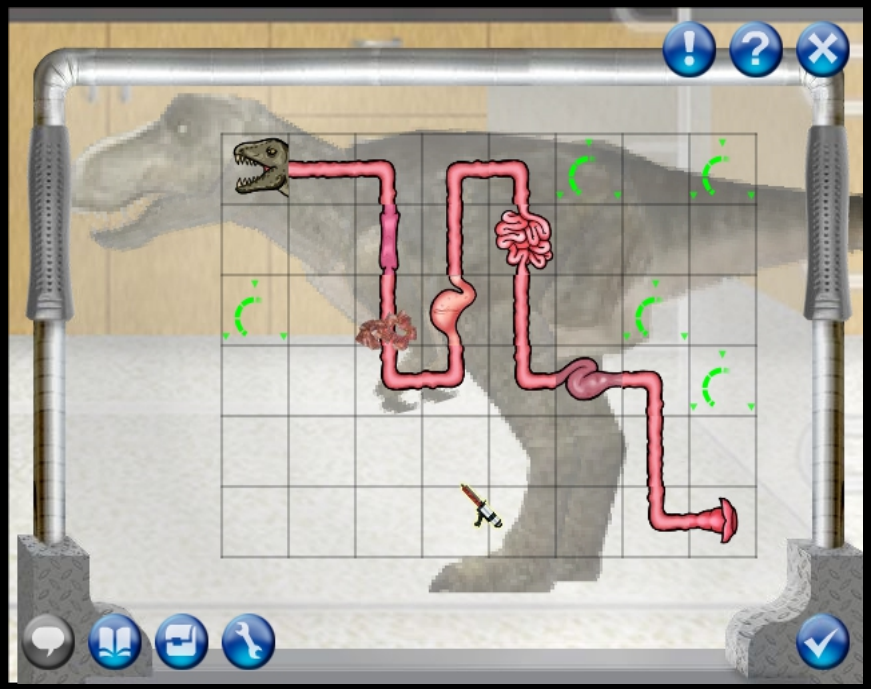




DinoQuest Online *Reconstruction* Lab

DinoQuest Reconstruction Laboratory (in-game tutorial/help view)

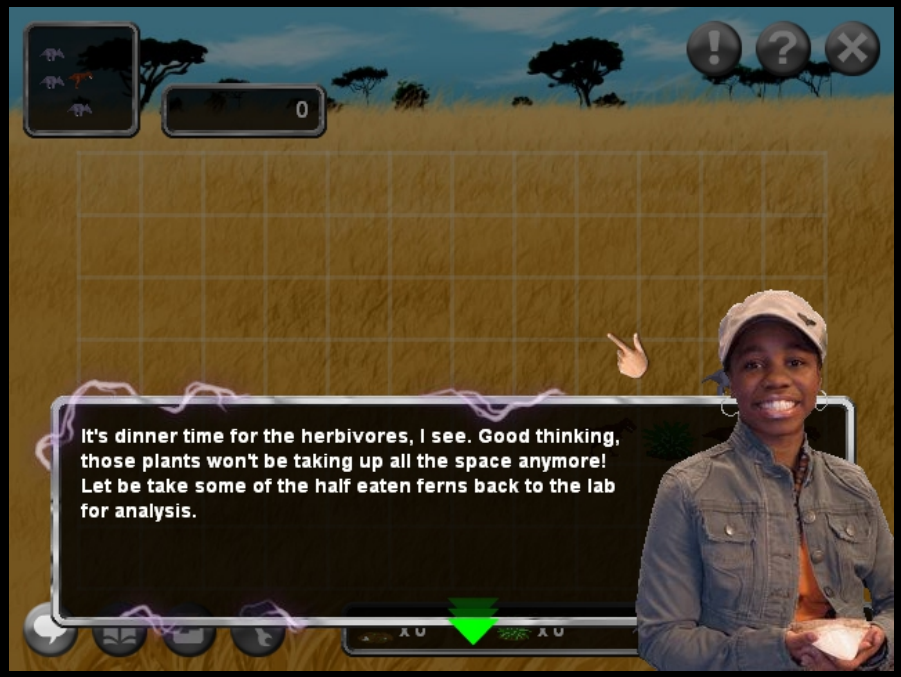
Multiple science learning games: *Zoology and Systems* collab games



– Build a working digestive system out of available organs and “connnectors”

– Move *Oxygen* and *CO2* through a cardio-pulmonary system

Multiple science learning games: *Ecology/Habitat* collab game

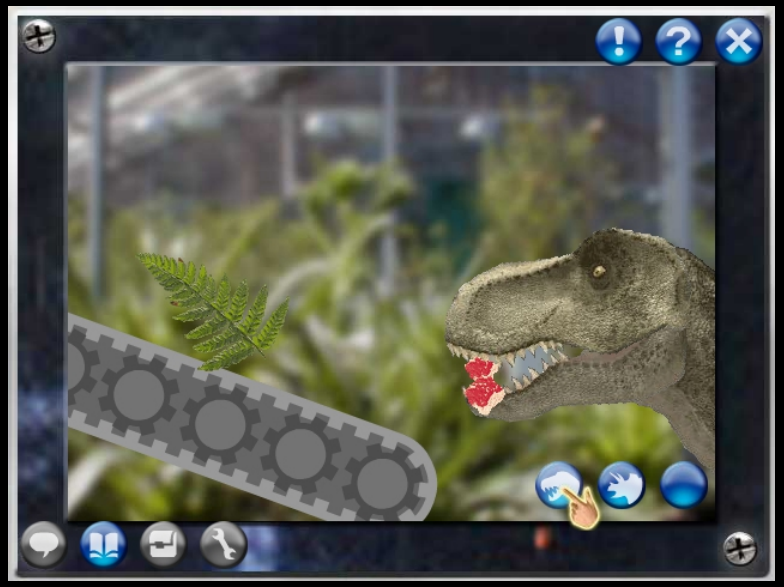


Gain points by matching prey/predator and food chain relations via *Tretis*-like game play

Multiple science learning games: *Biomechanical* collab mini games

Mass and balance

Proportion and speed



Matching anatomical structures to diet

Multiple science learning games: Resource interaction collab game spaces

MyLab - shows missions completed both online and at the DSC

DinoSphere – allows building of your own Dinosaur with DNA collected from missions.

Go back online or go to DSC to obtain different DNA by completing more missions!

Evaluation Potential

– DinoQuest and DinoQuest Online allow for the following evaluations:

– *Player Centered*: scores and missions completed identify progress and feedback in context.
– *Exhibit Centered*: ability to test content comprehension by player quiz upon completing mission.

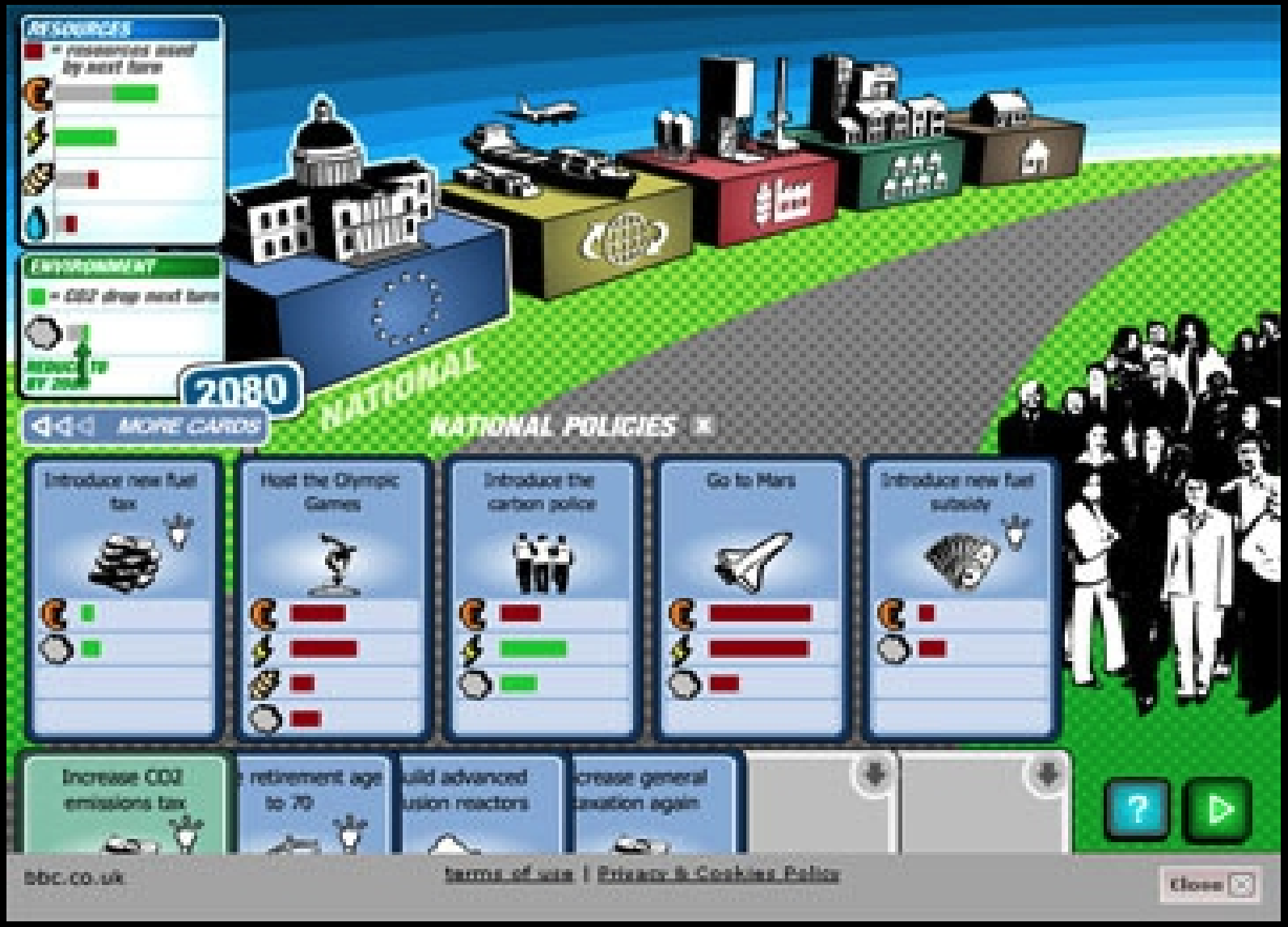
Challenge the Professor!

– *Independent Evaluation*: to ask which method is best and why: physical exhibit, online learning games, or both?

Games can employ advanced scientific models, simulations, visualizations

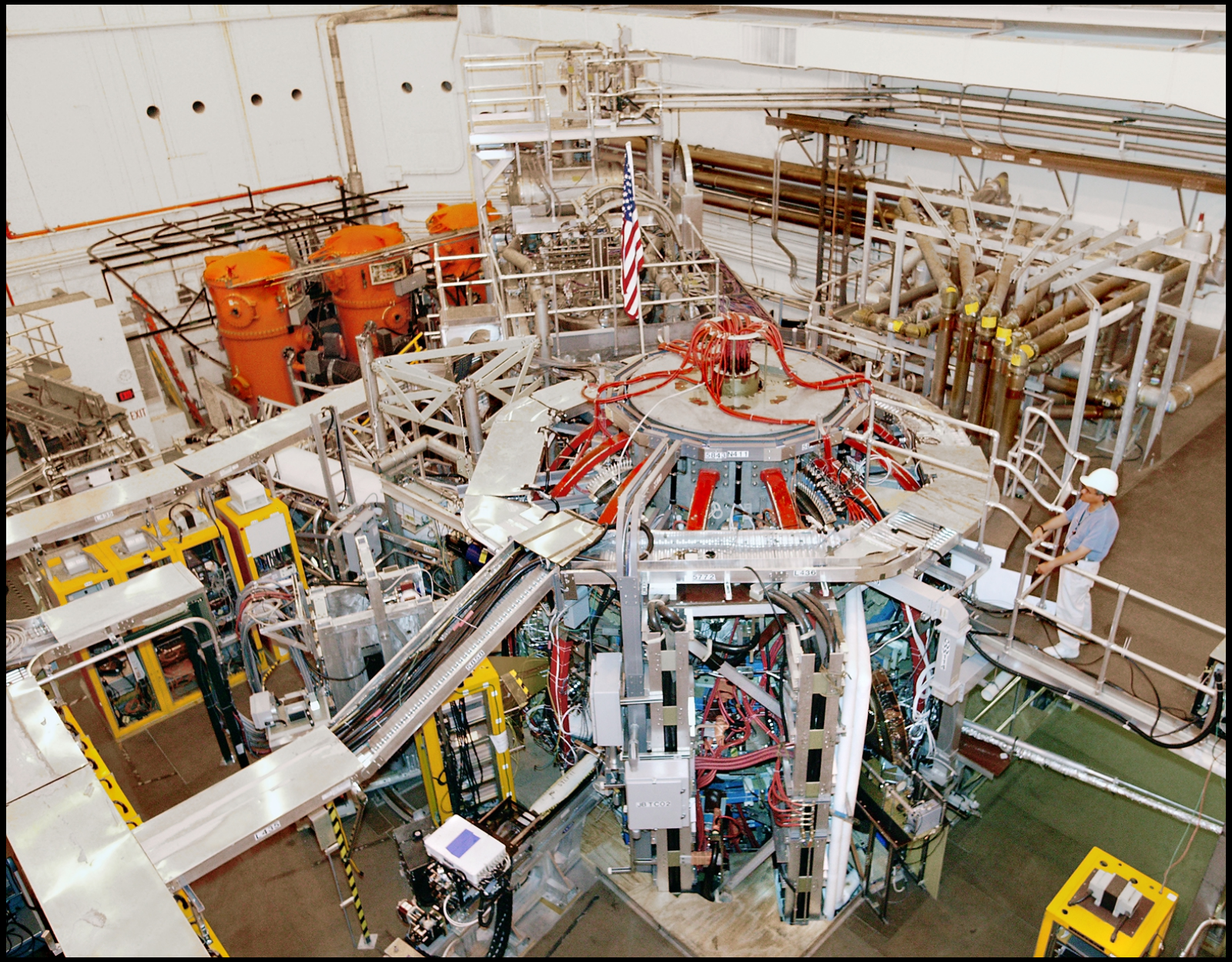
- Global climate change game
- Nanotechnology-based “incredible machines” design game
- Plasma fusion energy game
  - (what about “cold fusion” or low-energy nuclear reaction games?)

BBC *Climate Challenge* game



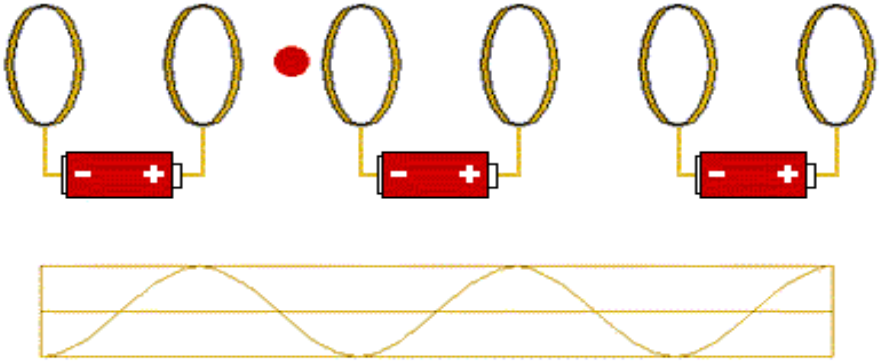
Incredible (nanotech) machines

Plasma fusion simulation exploration game



TOOLS

Accelerate the Particle



PLAY GAME

(may take a few moments to load)

game created by CERN

THE HEART OF THE MATTER

Research at CERN that garnered a Nobel Prize in 1984: Carlo Rubbia and Simon Van der Meer for the discovery of the "W and Z particles, communicators of the weak interaction."

Thank You!

This presentation can be found on the Web at the following location:

http://www.ics.uci.edu/~wscacchi/Presentations/GameLab/Games-Science-Learning-Nov12.pdf

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