



Games for Learning

Lab Bench Supplement

Center for Excellence in Education

The document provides a list of free and inexpensive games that can be used in the classroom or as a homework assignment. It provides information about how the games can be and are being used, their suitability, and how they can be accessed.

Sarina Rapini

7/31/2012

Excellence

Center for Excellence in Education

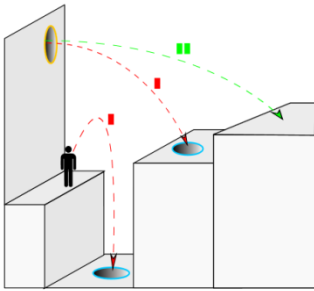
Foreword:

This document is a product of my research in game-based learning that I performed at the Center for Excellence in Education over the summer of 2012. I have plans to continue this research over the next few years and have developed my research into a website. If you are interested in game-based education or would like to see videos of how games can be used in the classroom, please feel free to visit my website. Videos can be found on the “Examples” page. On the “Leaders and Innovators” page, you will be able to find teacher communities sharing lesson plans, support, and ideas. Feel free to e-mail me on the “Contact” page with any questions or clarification. Thank you!

www.gamingforeducation.weebly.com

Sincerely,
Sarina Rapini

Portal and Portal 2



I. **About:** *Portal* and *Portal 2* are challenging commercial puzzle-games where players must use laws of physics, reasoning skills, and scientific inquiry to progress. These games are unique because they also have a rich story line

and meaningful narrative, which can be rare for puzzle games (like Tetris or Chess). Although perhaps irrelevant, these games are also very beautiful with unique science fiction elements.

II. **Suitability:** *Portal* is not violent and has a Teen rating (ages 10+) because some of the challenges can be a bit frightening (jumping over lava or poison pits, for example) and the words “damn” and “hell” can be heard in the background dialogue. However, this is only in the actual storyline. Teacher can create their own puzzles and ignore the storyline if desired.

III. **In the Classroom:** Cameron Pittsburgh, a high school physics teacher, has become a bit famous by using *Portal* in his classroom. Pittsburgh has used *Portal 2* for teaching everything from oscillators to parabolas to the ideal gas law. He has now teamed up with Valve, the creators of *Portal*, and developed TeachwithPortals.com. This website provides several lesson plans in physics, geometry, language arts and chemistry. It is still relatively new, but is growing very quickly. Its development of a wiki page will soon let teachers collaborate about how they are using *Portal*. Valve has also provided teachers with a puzzle-maker for *Portal 2* which gives teachers more control over the design of the game and lets them (or even students) create their own puzzles for students to solve.

IV. **Price and Accessibility: FREE!** If you visit the FAQ page on the TeachwithPortals.com site, you can find out how you can apply and receive *Portal 2* and its puzzle maker for free for your classroom.

Quick Facts:

- **Subjects:** Geometry, Chemistry, Physics, Math, Language Arts
- **Ages:** Middle School, High School, College
- **Price:** Free
- **Platform:** PC

Resources

Valve's Website:

www.TeachwithPortals.com

Cameron Pittsburgh's Website:

www.PhysicswithPortals.com

Game Ratings:

www.esrb.org

Roller Coaster Tycoon

- I. **About:** *Roller Coaster Tycoon* is a commercial construction and management game where players design roller coasters and also the theme park they exist in. Players have to overcome and utilize different forces like momentum, acceleration and gravity. The player's rides must carefully choose the direction, loops (corkscrews, vertical loops, zero gravity rolls), and height of their rides to meet their customers' preferences. If they are careless, the rides can crash and cause injuries, and their park's popularity will plummet.
- II. **Suitability:** This game has been rated E for everyone by ESRB. While playing the game, the only violence or inappropriate elements I have found are roller coaster crashes (which have no gore) and customers vomiting (a signal to the player that a ride is too intense).
- III. **In the Classroom:** While the obvious use is for physics, this game can also be used for finance and math classes. The University of Arkansas' Industrial Engineer Department held a competition open to middle school and high school students to develop a profitable theme park. They provided 5 lesson plans that feature economics, finance, and management (see side bar).
- IV. **Availability:** While this game is not free, the first version can be purchased for \$5.99 off Amazon. The second version is available for \$9.99.



Quick Facts:

- **Subjects:** Physics, Engineering, Economics, Finance
- **Ages:** Middle School, High School, College
- **Price:** \$5 - \$10
- **Platform:** PC, 3DS, Xbox

Resources

Roller Coaster Tycoon Website:

<http://www.rollercoasterycoon.com/>

Game Ratings:

<http://www.esrb.org/>

Economics/Finance Lesson Plans:

<https://sites.google.com/site/iechallengecompetition/home/5-lesson-plans-for-math-literacy>

Sim City

- I. **About:** *Sim City* is a commercial city-building simulation game that allows players to build and design a city. There is no specific goal to achieve; instead, players must manage their commercial, industrial, and residential zones while expanding their city and nurturing their economy. The player must simultaneously keep an eye on crime levels, power supply, population, and traffic congestion. Natural disasters and power plant accidents may interrupt the player's efforts. The player is also evaluated by the citizens depending on the production of public goods and tax rates.
- II. **Suitability:** This game is rated E for Everyone by ESRB. The only violence I found included natural disaster hitting a city; however, there is no gore or graphic representation.
- III. **In the Classroom:** Teachers have used *SimCity* to teach city management, resource scarcity, economics, geographic features, and the effects of humankind on nature (side bar). Teachers can also set up scenarios for students (which often come with the game) to explore a particular subject; for example, the effects of high population, the effects of a natural disaster on an economy, the effects of high pollution, and effects of sudden resource scarcity.
- IV. **Availability:** *SimCity* is not a free game, but it can be found for extremely low prices, especially for older versions. Amazon sells used *SimCity 2000* games (one of the older versions) for as low as 75 cents. The applications for Android and iOS are often priced at around \$5. New copies or recent versions are between \$15 to \$20.



Quick Facts:

- **Subjects:**
Economics, Management, Finance, Geography
- **Ages:** *Middle School, High School, College*
- **Price:** *\$1 - \$20*
- **Platform:** *PC, Xbox, PS3, PSP, iOS and Android Applications*

Resources

SimCity Website:

http://www.simcity.com/en_US

Game Ratings:

<http://www.esrb.org/>

Lesson Plans:

<http://www.fi.edu/fellows/fellow3/apr99/simcity2000/why.htm>

“Green” City Lesson Plans:

<http://www.scribd.com/doc/4962410/Green-City-Lesson-Plan-Full>

The UVa Bay Game

- I. **About:** The UVa Game is a large-scale participatory simulation created by the University of Virginia and based on the Chesapeake Bay watershed. The game allows players to take the roles of stakeholders, such as farmers, developer, watermen, and local policy-makers, make decisions about their livelihoods or regulatory authority; and see the impacts of their decisions on their own personal finances, the regional economy, and watershed health. It is an adaptable educational and learning tool for raising awareness about watershed stewardship anywhere in the world; a tool for exploring and testing policy choices; and a tool for evaluating new products and services.
- II. **Suitability:** The game has no violence or inappropriate aspects. It is a simulation of a real world problem.
- III. **In the Classroom:** The University of Virginia has implemented this game across multiple disciplines, including business, architecture, environmental studies and resource management. Since students are live agents of diverse stakeholders, it truly encompasses every subject.
- IV. **Availability:** Free! I had the pleasure of interviewing Mr. Jeffrey Plank, the Associate Vice President for Research, who has worked on the game. They are currently working on creating a generalized template so the game can be developed for any watershed and be open source to other universities. They would be delighted to work with interested teachers for the K-12 sector. Please feel free to contact Mr. Plank if you are interested in working with him: jp4q@virginia.edu.



Quick Facts:

- **Subject:** Multi-Disciplinary
- **Ages:** Middle School, High School, College
- **Price:** Free
- **Platform:** PC

Resources

UVa Bay Site:

<http://www.virginia.edu/vpr/sustain/BayGame/>

YouTube Demo:

http://www.youtube.com/watch?v=Sz_06n10jd4

Urgent Evoke



- I. **About:** *Evoke* is an augmented reality game, meaning it takes place in real life but uses a digital medium to provide a storyline. It calls itself a “crash course in changing the world” and was developed by the World Bank Institute. You act as a secret agent presented with different videos, pictures, and documents about your “mission” which is a current world issue. All missions are presented in an engaging comic book style. You browse for evidence or create your own ideas to solve the problem, which you post online. You then browse the evidence others have collected and vote on their ideas. When others vote on your evidence, you will gain “powers”, such as collaboration, creativity, local insight, sustainability, and resourcefulness.
- II. **Suitability:** This game does not have any violent themes; however, these **are** real world problems. Students will also be working with strangers on the internet, which may mean they see occasional inappropriate comments. When I played the game, these occurrences were very rare and dealt with by moderators quickly.
- III. **In the Classroom:** *Evoke* is a ten-week course. This would be great as a summer program or a semester project. Students could get in teams or pairs to tackle a world problem and compete with their peers. Current “missions” include Water Crisis, Future of Money, Empowering Women, Crisis Network, Energy Sustainability, and Food Security.
- IV. **Availability:** FREE! It is free to play and open to anyone, anywhere. All you need is internet access and a computer (or tablet/smartphone with a browser).

Quick Facts:

- **Subjects:** *Sociology, economics, resource management, psychology, earth sciences*
- **Ages:** *Middle School, High School, College*
- **Price:** *Free*
- **Platform:** *PC, Mobile*

Resources

Urgent Evoke:

<http://www.urgentevoke.com/>

Quest Atlantis

- I. **About:** *Quest Atlantis* is an international online 3-D game with many different units that encourage children to take on the roles of scientists, doctors, reporters and mathematicians. Most of the units inspire social action, such as the Taiga Water Quality unit. In this unit, the Taiga National Park has a serious ecological problem resulting in many fish dying. They have to consider their conceptual tools (i.e. understanding eutrophication, erosion, and overfishing) in order to make a recommendation about what to do (i.e. stop the indigenous people from farming, tell the loggers they can no longer cut trees in the park, or shut down the game fishing company).
- II. **Suitability:** This game was developed as an educational research project and so it was specifically designed for ages 9 to 15.
- III. **In the Classroom:** There are several different units in *Quest Atlantis*. The Ander City statistics unit explores data sets and how they can be used deceitfully. Another unit explores ethics and language arts by using the book *Frankenstein* as a platform. Students have to decide whether to use a scientist's living creation as a test subject for a cure that could save the city's citizens.
- IV. **Availability:** Free! You can download the latest version on their website for free (see sidebar).



Quick Facts:

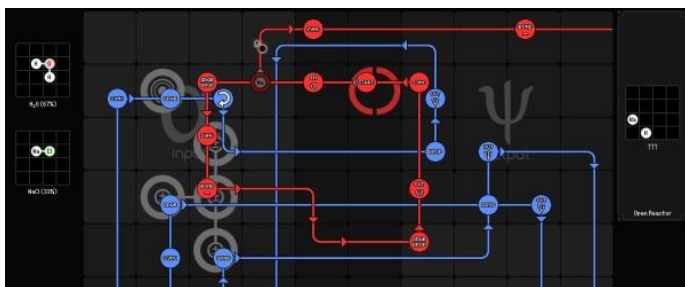
- **Subjects:** *Statistics, Ethics, Earth Sciences, Biology, Journalism, Language Arts*
- **Ages:** *9 to 15*
- **Price:** *Free*
- **Platform:** *PC*

Resources

Quest Atlantis Site:
<http://atlantisremixed.org/>

Download Game:
<http://atlantisremixed.org/site/view/Educators/#61>

SpaceChem



- I. **About:** *SpaceChem* is a very challenging "problem-solving centric" puzzle game by Zachtronics Industries. It combines the logic of computer programming with the scientific domain of chemistry, set in an original science fiction universe. Players build machines using mechanics similar to visual programming that assemble and transform chemical compounds. Players later connect those machines together to form complex pipelines, and ultimately construct special pipelines to fight back against space-monsters that threaten humanity.
- II. **Suitability:** The game creators gave their game a Teen rating due to character deaths. This game is also quite challenging. For these two reasons, I would recommend it primarily for high school students or advance junior high students. Creators note the violent aspects can be removed when purchased.
- III. **In the Classroom:** The creators put together a useful and detailed guide for educators on how to use *SpaceChem* in the classroom. It is important to note this is a **fictional** universe and there are some imaginary elements to the game. It can also be used to practice problem-solving skills or as a motivator for students.
- IV. **Availability:** If purchased directly from Zachtronics Industries, *SpaceChem* is available at an educational discount price of \$10 per license when 10 or more licenses are purchased.

Quick Facts:

- **Subjects:** Chemistry, Computer Programming
- **Ages:** High School, College
- **Price:** Educator Discount Available
- **Platform:** PC

Resources

SpaceChem Site:

<http://www.spacechemthegame.com/about>

Educators' Guide:

<http://zachtronicsindustries.com/SpaceChem%20-%20A%20Guide%20for%20Educators.pdf>

If interested in purchasing, please contact

zach@zachtronicsindustries.com for more information about educator discounts.

World of Goo



- I. **About:** *World of Goo* is a commercial physics-based puzzle game. Players must build bridges, towers and other structures using goo balls and balloons. The structures must overcome forces working against them, such as gravity, while avoiding obstacles like other structures, hills, and spikes.
- II. **Suitability:** The game is rated E for Everyone. The only inappropriate elements may arise when you have to navigate through hazards, like sharp spikes, or a churning stomach.
- III. **In the Classroom:** There are many teachers using *World of Goo* in many different ways. One teacher had students play *World of Goo* and then build structures in similar manners using marshmallows and dry spaghetti sticks (sidebar). Other teachers have used it to teach trial-and-error scientific inquiry, having students keep a journal of their experiments.
- IV. **Availability:** *World of Goo* is not free, but it is not expensive since it is an indie game. You can purchase the PC version on Amazon for \$7.99. If tablets or smartphones are available, the game is \$4.99 on both iTunes and Google Play.

Quick Facts:

- **Subjects:**
Engineering, Physics
- **Ages:** *Middle School, High School*
- **Price:** *\$4.99 to \$7.99*
- **Platform:** *PC, iOS, Android*

Resources

World of Goo Site:

<http://2dboy.com/games.php>

Lesson Plan:

<http://www.ictsteps.com/2010/using-world-of-goo-to-explore-forces/>

ESRB Ratings:

<http://www.esrb.org>

CandyFactory

- I. **About:** *CandyFactory* is a game developed by Virginia Tech that teaches the concept of fractions to middle school students based on splitting operations with partitioning and iterating. The game is unique in that it teaches concepts rather than just reinforcing material that students already know. That is, this is not a drill-and-skill game, a concept so common with math games. By coordinating actions of partitioning (slicing) and iterating (copying) candy bars, students learn to conceive of fractions as sizes relative to the whole. The idea is that students begin to understand partitioning and iterating as inverse operations. The game consists of 5 lessons that build on each other and are described on the Virginia Tech website listed on the sidebar.
- II. **Suitability:** *CandyFactory* was developed for middle school students and features no violence, cursing, or other inappropriate aspects.
- III. **In the Classroom:** *CandyFactory* has been used as a substitute to regular classroom curriculum and also as a supplement. The unique aspect of *CandyFactory* is that it teaches concepts and is not simply a drill-and-skill game.
- IV. **Availability: FREE!** The second version of *CandyFactory* is open source and available for free in the Apple store for the iPad.



Quick Facts:

- **Subject:**
Mathematics
(Fractions)
- **Ages:** *Middle School*
- **Price:** *Free*
- **Platform:** *iPad*

Resources

CandyFactory Website:

<http://ltrg.centers.vt.edu/candyFactoryR2.htm#Description>

Download at:

<http://itunes.apple.com/us/app/candyfactory-educational-game/id53321389>

Plant Tycoon

- I. **About:** Plant Tycoon is a gardening sim game where you nurture plants and experiment with increasingly rare and valuable species. The object is to breed and cross breed plants until you find the 6 Magic Plants of Isola and solve the genetic puzzle. You start with a couple of dollars, a handful of seeds, some soil and water. Grow plants, organize and harvest seeds, monitor your plants' health, age and maturity and protect your plants from dehydration and infestations. Sell some of your creations to fund your research, buy better supplies to use in your Nursery and purchase ornaments to customize your virtual garden.
- II. **Suitability:** This game features no violence or inappropriate behavior and is rated E for Everyone.
- III. **In the Classroom:** Plant Tycoon places a heavy emphasis on its genetic puzzles, which could serve as a great supplement to Mendel's genetic principles. There are over 500 species to create. The game is also set in real-time, meaning that plants grow as real days go by; this could be a great introduction to how plants grow and how to sustain and encourage that growth.
- IV. **Availability:** Plant Tycoon is \$9.99 for the PC and \$9.99 in the apple store. I would strongly recommend the PC version over the iOS. A free hour demo is available at their website.



Quick Facts:

- **Subject:** Biology, Botany, Genetics
- **Ages:** Middle School, High School
- **Price:** \$9.99
- **Platform:** PC and iOS

Resources

Plant Tycoon Website and Free Hour Demo:

www.ldw.com/plant_tycoon.php

USA Today Article about Plant Tycoon Teaching Genetics:

http://www.usatoday.com/tech/columnist/jinnygudmundsen/2007-09-27-plant-tycoon_N.htm