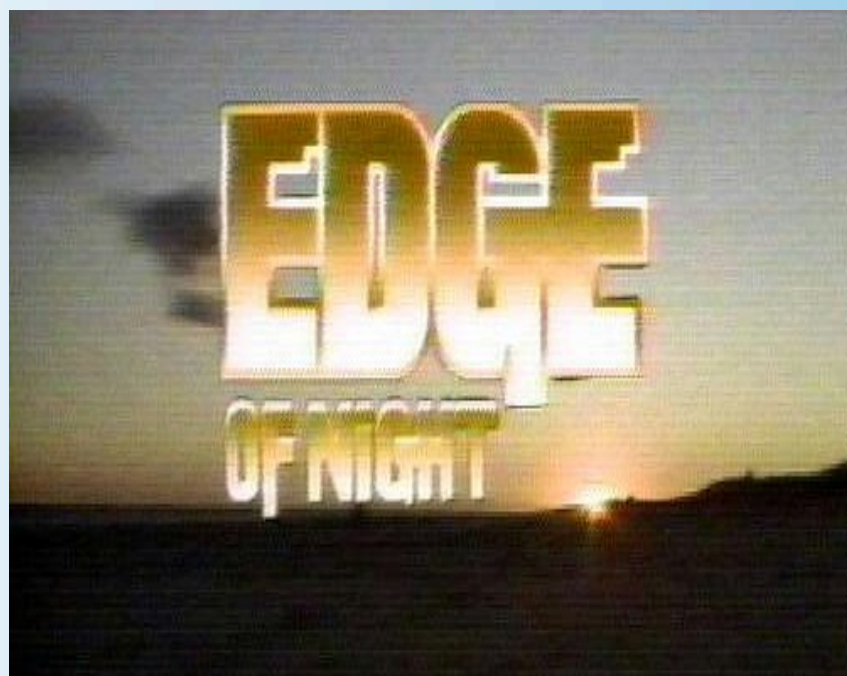
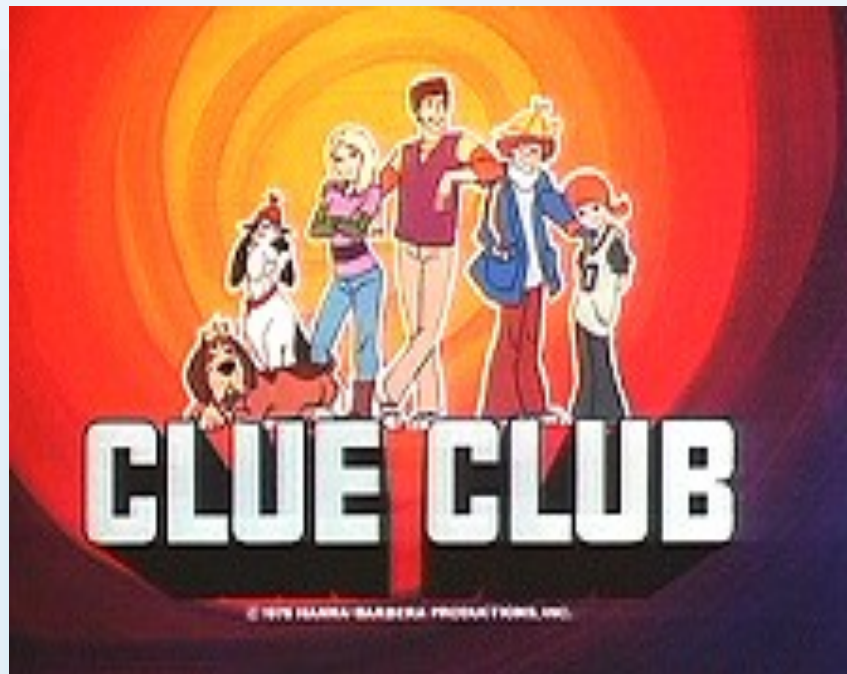




Game-Based Learning, Collateral Learning and Beyond

24th USENIX Security Symposium
Gaming, Games ~~and Gamification~~ in Security Education
Washington, DC
11 August 2015

Lee Sheldon
Professor of Practice
Interactive Media & Game Development
Department of Computer Science
Worcester Polytechnic Institute

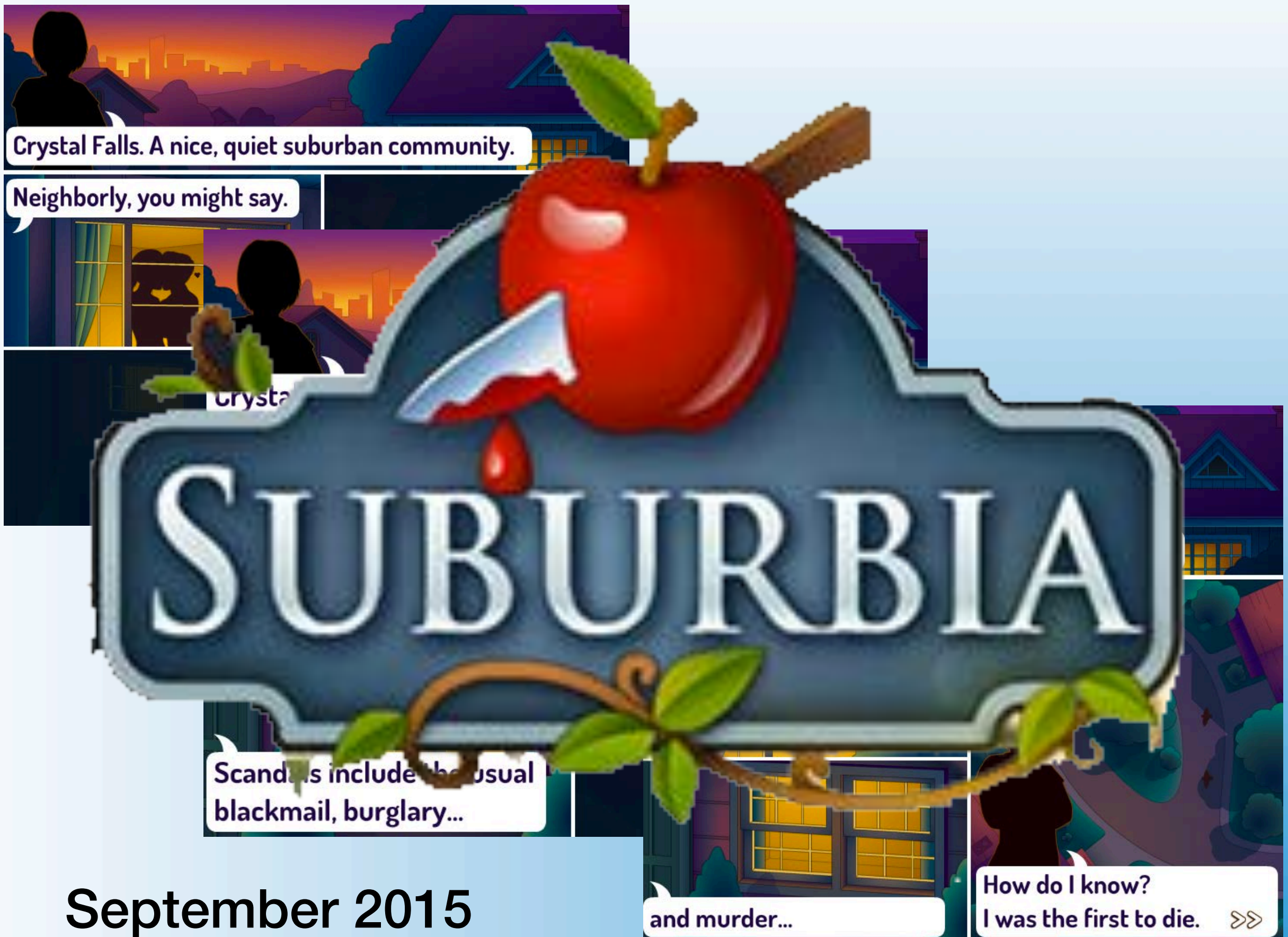


Old Media

New Media



October 2014



September 2015

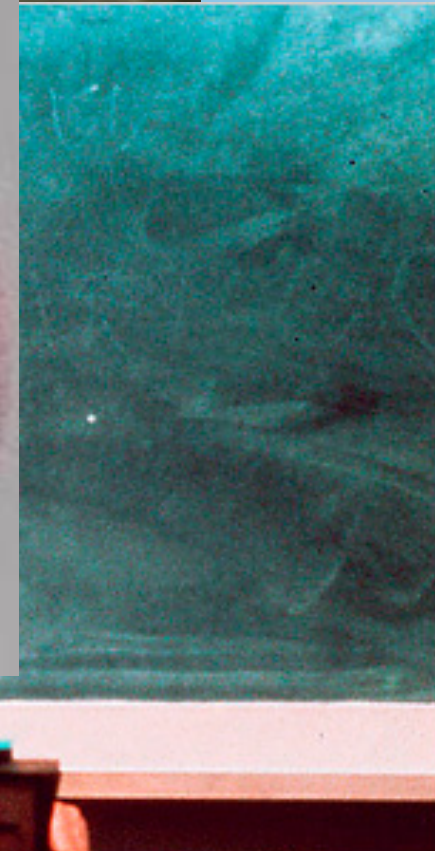
Game-Based Learning







Tradition





How can we get them to focus like that in class???



Games in the Classroom



This is not a new idea...

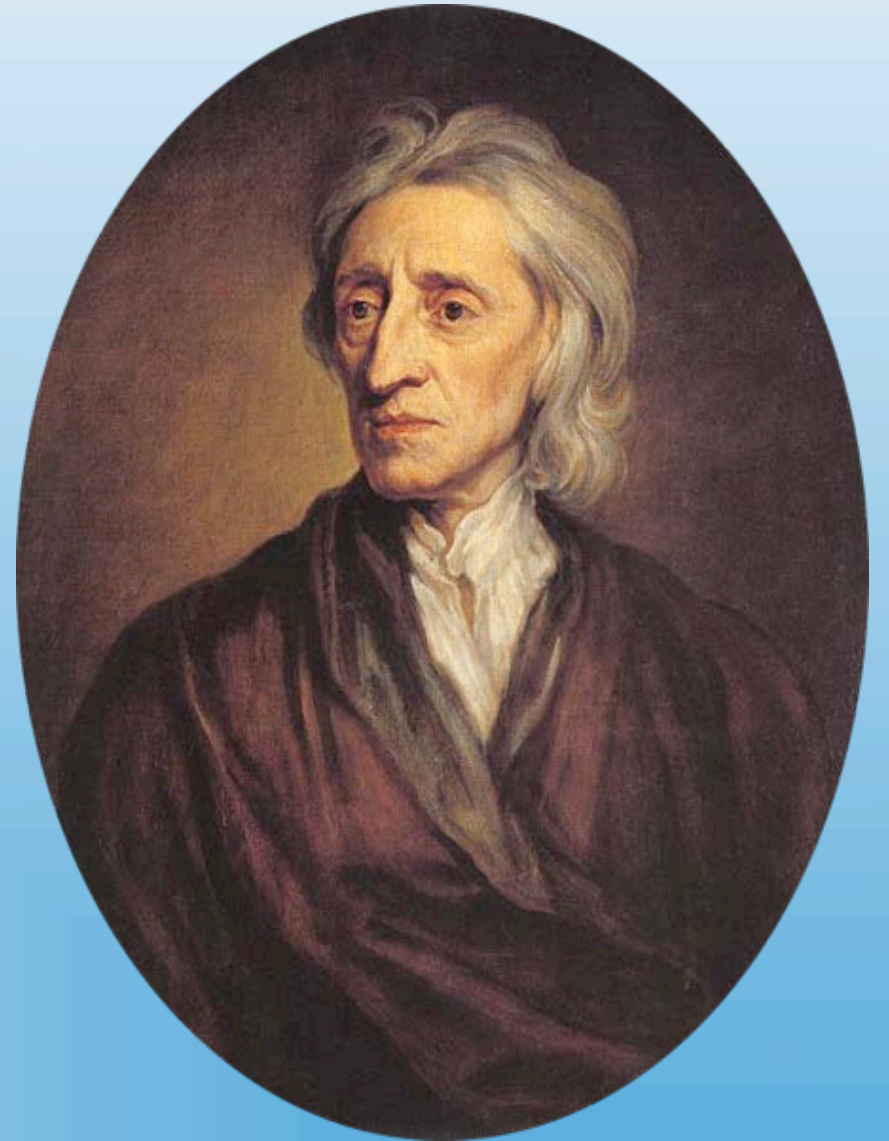
“In [Egypt] arithmetical games have been invented for the use of mere children, which they learn as a pleasure and amusement.”

Plato 360 B.C.



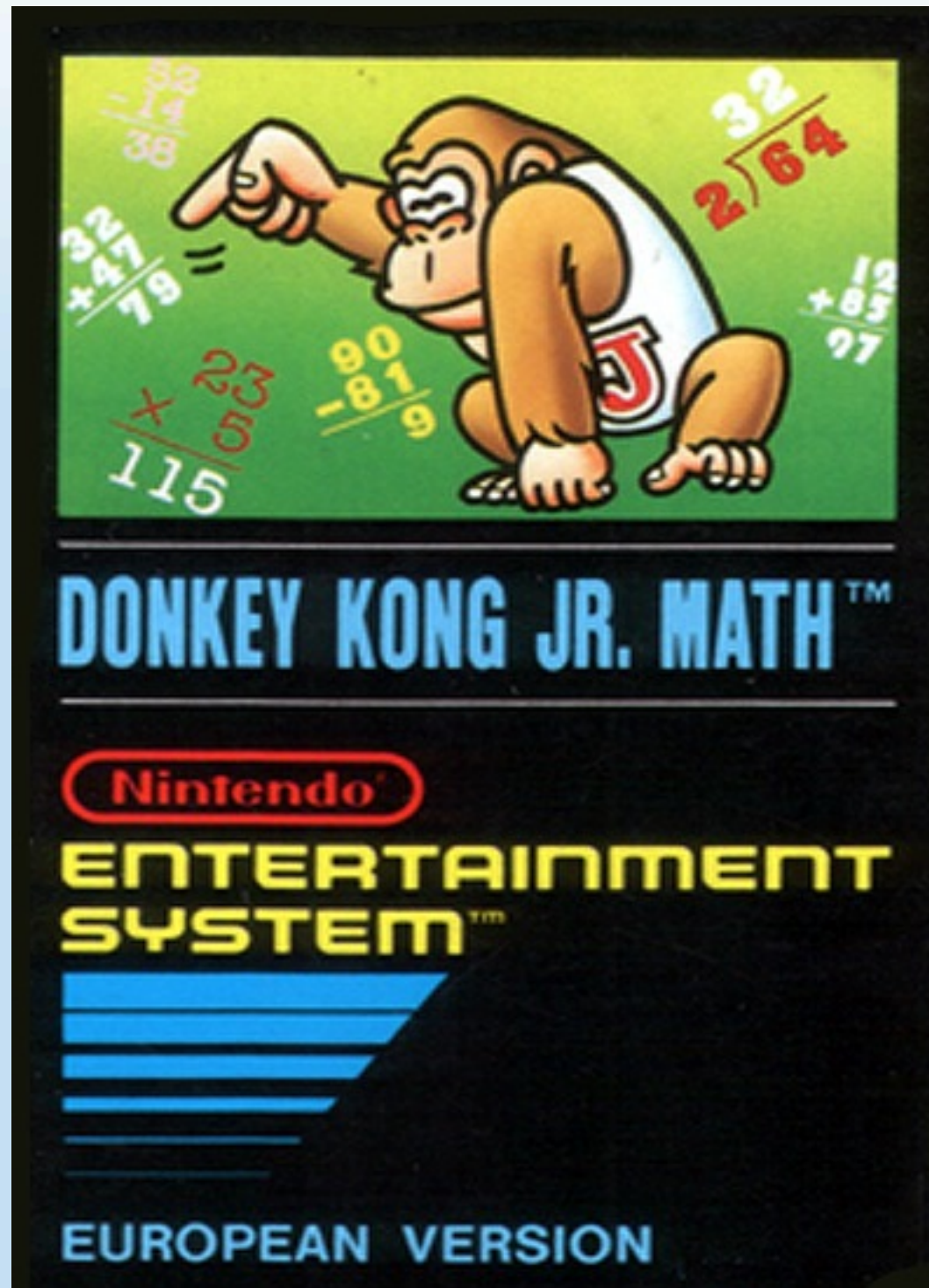
**“There may be dice and play-things,
with the letters on them to teach
children the alphabet by playing; and
twenty other ways may be found,
suitable to their particular tempers, to
make this kind of learning a sport to
them.”**

John Locke 1692





Video Games in the Classroom !!!



1983



1983



2009



2014



2014

A zombie shuffles along while you keep items from hitting the ground. If a homework page or special item touches the ground, you'll get a strike. You get three strikes per level before you lose.

Special items include things like good grades, hard classes, and ambition. These items have parachutes attached to them as they fall, rather than floating down like the homework pages.



Oops!
Missed your
chance for
college!





Virtual Console

Classic Games for Wii

2014

Gamification:

The use of game mechanics to increase user engagement, loyalty and monetization.



Users stay longer



Come back more often



Generate more revenue



Gamification:

Use game mechanics to increase user engagement, loyalty and monetization.

Users stay longer.



Come back more often.



Generate more revenue.







“An intrinsic reward is an intangible award of recognition, a sense of achievement, or a conscious satisfaction. For example, it is the knowledge that you did something right, or you helped someone and made their day better. Because intrinsic rewards are intangible, they usually arise from within the person who is doing the activity or behavior.”

Michael Wu 2014

Game-Based Learning Issues

- Simulations Disguised as Games
- Gameplay defeating pedagogy (Designers teaching)

OR

- Pedagogy ignoring fun (Subject matter experts designing)
- Gameplay & subject matter don't match
- Too literal



Balance



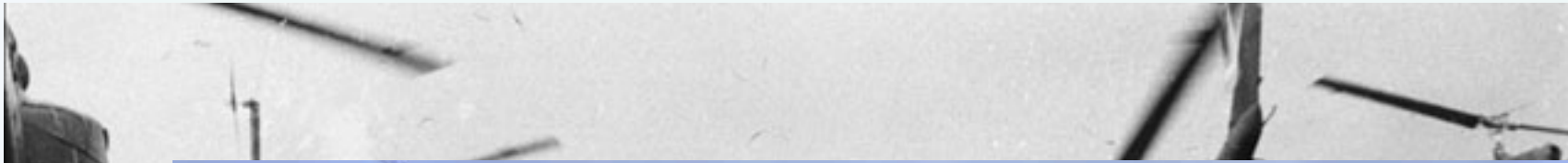
Making Game-Based Learning Better



- **Real games**
- **Gameplay and pedagogy support one another**
- **Gameplay and subject fit together**
- **The sweet spot between literal and abstract**

A simulation is something that is made to look, feel, or behave like something else especially so that it can be studied or used to train people.

A game is structured play, usually undertaken for enjoyment and sometimes used as an educational tool. Key components of games are goals, rules, challenge, and interaction.



**Caveat: security-specific
examples are of products
aimed at the general
public, not security
students or professionals.**

Mission: Laptop Security (Game)



Office of
Justice Programs



MISSION: LAPTOP SECURITY

Click to begin

Good, Smith — you have the laptop. But our double agent also gave you a note with the laptop's password written on it. Now what should you do?

A. Attach the sticky note to the laptop screen

B. Hide the password inside the laptop carrying case

C. Commit the password to memory and destroy the note

D. Save the password on a removable hard drive device or 'flash' memory stick

Good, Smith — you have the laptop. But our double agent also gave you a note with the laptop's password written on it. Now what should you do?

A. Attach the sticky note to the laptop screen

B. Hide the password inside the laptop carrying case

C. Commit the password to memory and destroy the note

D. Save the password on a removable hard drive device or 'flash' memory stick

Well done, Agent Smith. The password will be safe with you.

CONTINUE

Well, you've made it to your hotel room — but now you're due to meet an asset in the hotel lobby... without the laptop. What's your best course of action?

A. Stow the laptop under the bed, and pull down the bedspread to completely hide it

B. Secure it with a laptop security cable to a heavy piece of furniture, and hang a "do not disturb" sign on the door

C. Place it in your room's hotel safe

D. Place it inside your suitcase, and place the suitcase casually by the desk

Excellent choice, Smith. You also could have used a security cable to attach it to a heavy piece of furniture, and hung the sign on the door. Naturally, taking it with you is generally safest, all things being equal.

CONTINUE



- Real games
- Gameplay and pedagogy support one another
- Gameplay and subject fit together
- The sweet spot between literal and abstract





Professionals Successfully Collaborating



- Real games
- Gameplay and pedagogy support one another
- Gameplay and subject fit together
- The sweet spot between literal and abstract





1983



2014



- Real games
- Gameplay and pedagogy support one another
- Gameplay and subject fit together
- The sweet spot between literal and abstract





The Lost Function (Advanced Training & Learning Technologies 2013)



**BALANCE!
BALANCE!
BALANCE!**

Let's look at some more security “games”...





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FOR DIGITAL AND
MEDIA LITERACY

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[Digital & Media Literacy](#) » Educational Games



Educational Games

In this section, you can find...

Educational computer games that introduce kids to key ideas in media and digital literacy. These games are a great way to start a conversation on media issues in the home or classroom, and you can play most of them right here on our website.





How cyber-savvy are you?

Test your knowledge about the cyber security risks you face every day.
Take the 11-question quiz to find out how cyber-savvy you are!

Good luck and have fun!



Start



How cyber-savvy are you?

Question 1

Your favourite band's new album drops today! There's a message from the online music store you use in your inbox offering you a special deal on it. What should you do?

- ☐ Click on the link in the message to get the deal
- ☐ Go to the site and check it out
- ☐ See if anyone's uploaded it to any file-sharing sites yet

Next



How cyber-savvy are you?

Question 4

You're just about to enter a store when you spot a memory stick sitting on the ground. Do you:

- ☐ Leave it there
- ☐ Take it home and use it
- ☐ Format it and run a virus scan on it before using it

Give it to an employee and hopefully the owner will return?

Back

Next





Games



Grow an Online Reputation

Growing a positive online reputation can be tough. Do you know what it takes?



Betty's Netiquette Quiz

Are you a good Cyber Citizen? Take Betty's Quiz to test your netiquette know-how!



Alan's Online Gaming Safety Challenge

Do you know how to stay safe when playing online games? Try Alan's Challenge and find out!



Cyber Defense Quiz

The Academy challenges you to a battle of smarts! Test your Cyber Defense knowledge with this Quiz!



Academy Scavenger Hunt

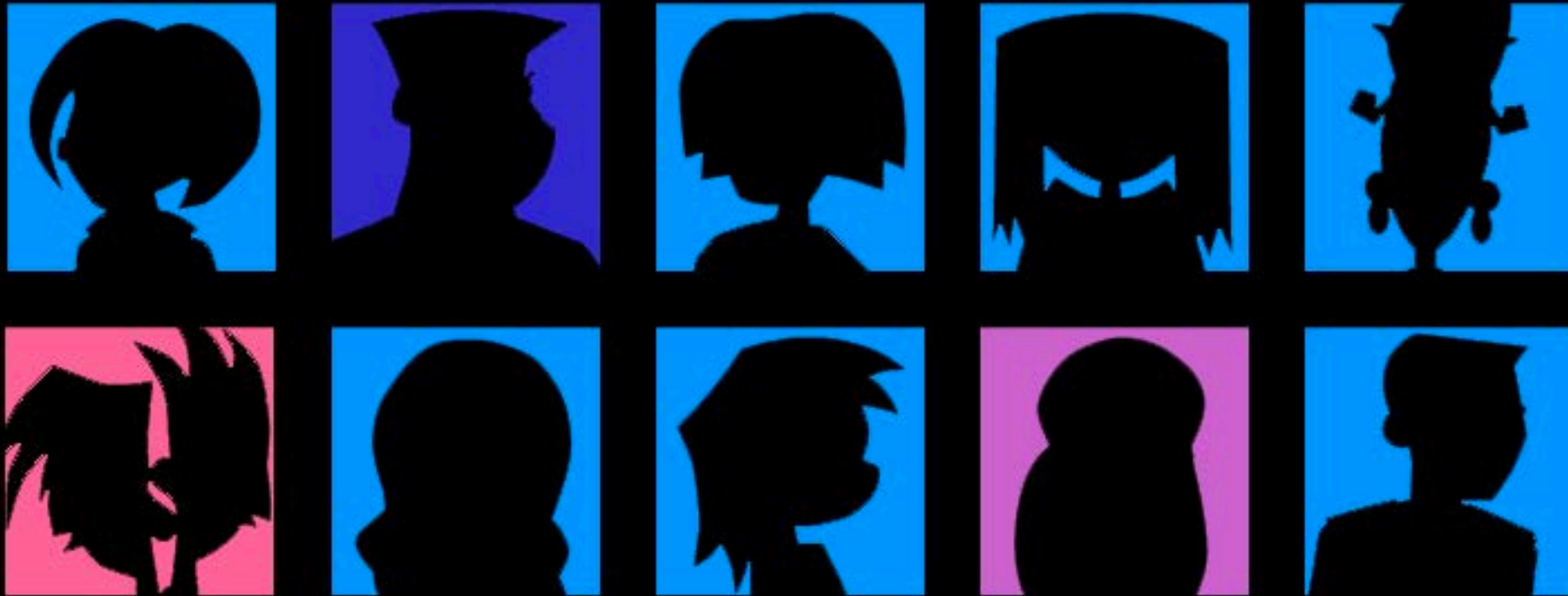
Follow the clever clues and use the decoder to unlock secret puzzles and win bonus prizes.



Cyber Defense Cryptograms

Can you solve all of Dr. Keen's challenging cryptograms?

← BACK TO FUN STUFF



Carnegie Cyber Academy

Cyber Defense Quiz



← BACK TO FUN STUFF



Hey there, I'm Trey. I'm the Message Center Supervisor. Emails are a very convenient way to send someone a message in Cyberspace, but sometimes Cyber Villains can cause problems with email. You have to learn how to prevent those problems.

← BACK TO FUN STUFF



James Smith wants to create a new password to protect his new computer. Which password is the strongest? His birthday is June 22, 1997. His classmates know his birthday.

A 7moJ6Bz9

B 622smith

C Jim1997

D 97coolJB

← BACK TO FUN STUFF



Correct: 1

Incorrect: 0

Accuracy: 13 %

That's correct. Good job!

Click another character for the next question.

Cybersecurity Lab

Take cybersecurity into your own hands. In this Lab, you'll defend a company that is the target of increasingly sophisticated cyber attacks. Your task is to strengthen your cyber defenses and thwart the attackers by completing a series of cybersecurity challenges. You'll crack passwords, craft code, and defeat malicious hackers.

PLAY GAME

VIDEO INTRO

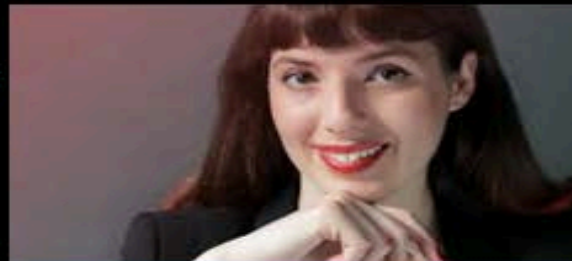
ABOUT THE LAB

EDUCATION GUIDE



Cyber Video Quizzes

Discover why the Internet is insecure. See how codes can protect your online secrets and what motivates hackers to hack. And learn why you should be careful about what you post online.



Meet the Experts

Find out how experts working in cybersecurity started out, get a sense of what a typical day in their job looks like, and see what they recommend to those who want to follow in their footsteps.



Video Library

Go to the library of all the NOVA Labs videos, including the Cybersecurity Lab videos: Cybersecurity 101, Cyber Codes, The Secret Lives of Hackers, and A Cyber Privacy Parable.

Join NOVA Labs

Create your personal profile. Track your progress. Become a part of a community. Sign up or log in.

JOIN

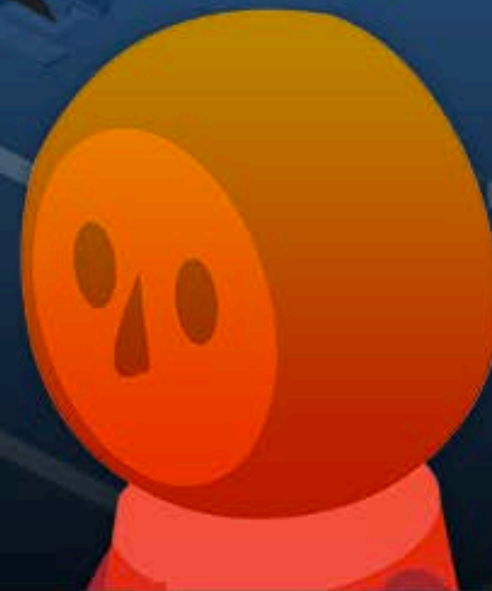


snapcat

USERS 113

LEVEL

We don't really have...any...cybersecurity in place yet.




NEXT

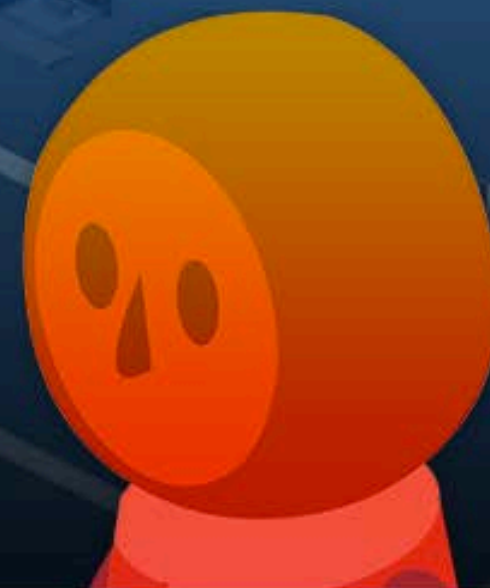


snapcat

USERS 113

LEVEL 

INCOMING CYBER ATTACK



NEXT

Your job is to invest in the strongest defenses based on what you know about the attack. Some defenses are more effective than others.



Click on the "i" for more information about each defense.

HELP

CLEAR

 x 3

BATTLE

You will spend all of your coins on defenses.

NEXT

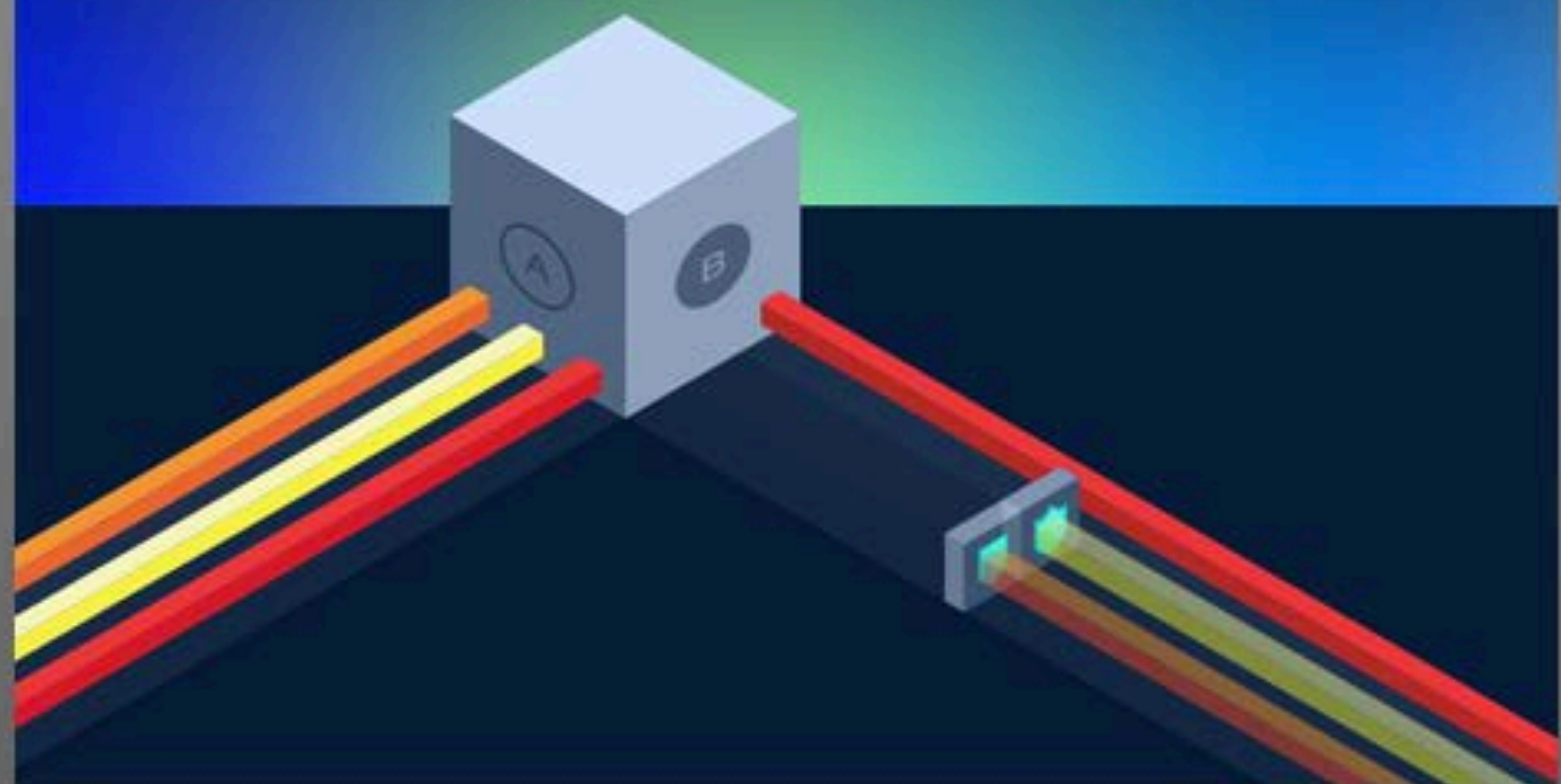


In this battle, the A side on the left is undefended and the B side is partially defended.

If you earn 6 coins on later levels you will be able to block all of the attacks.

Cyber Attacks

- Strong Attack
USER LOSS HIGH
- Medium Attack
USER LOSS MODERATE
- Weak Attack
USER LOSS LOW



3 OF 3

END




snapcat

USERS 113


LEVEL



Virus attack! Buy cyber defenses to protect SnapCat against the imminent cyber attack. Click on any of the 6 ports below to spend your 3 coins. A is the left side of your network cube and B is the right. For each defense, A and B are equally powerful.







Upgrade Antivirus Software






AB





Back Up Company Files



AB





Phishing Email Detection Training



AB

HELP

CLEAR



BATTLE



snapcat

USERS 75

LEVEL 



- 25

USERS

Half of your company's files were damaged by a [ransomware virus](#) from an infected website, but you can replace some of them with the [backups](#) you made.



- 12

USERS

You needed more up-to-date [antivirus software](#). Two malicious viruses entered the company [network](#).



- 1

USERS


Two of your colleagues missed the [phishing email](#) training and downloaded a computer [virus](#) from a [phishing email](#).

NEXT



snapcat

USERS 75

LEVEL 

You did it! We're still standing.



NEXT



snapcat

USERS 75

LEVEL

Just barely. I didn't have enough resources to properly protect us.



NEXT

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FAQ

Syllabus

Download the CyberCIEGE Brochure in PDF (3 mb PDF)

Learn about the game engine via the [Scenario Development Tool User's Guide](#)

[Site Map](#)

CyberCIEGE

an innovative video game and tool to teach computer and network security concepts

CyberCIEGE enhances information assurance and cyber security education and training through the use of computer gaming techniques such as those employed in SimCity™. In the CyberCIEGE virtual world, users spend virtual money to operate and defend their networks, and can watch the consequences of their choices, while under attack.

Cyber Security Simulation

In its interactive environment, CyberCIEGE covers significant aspects of computer and network security and defense. Players of this video game purchase and configure workstations, servers, operating systems, applications, and network devices. They make trade offs as they struggle to maintain a balance between budget, productivity, and security. In its longer scenarios, users advance through a series of stages and must protect increasingly valuable corporate assets against escalating attacks.

CyberCIEGE includes configurable firewalls, VPNs, link encryptors and access control mechanisms. It includes identity management components such as biometric scanners and authentication servers. Attack types include corrupt insiders, trap doors, Trojan horses, viruses, denial of service, and exploitation of weakly configured systems. Attacker motives to compromise assets differ by asset and scenario, thereby supporting scenarios ranging from e-mail attachment awareness to cyber warfare.

Active Learning with CyberCIEGE

This [paper](#) describes the game for educators and trainers who may want to incorporate the game into their courses. Also see our notional [syllabus](#).

Development and Availability

Development of CyberCIEGE was sponsored by the US Navy, the Naval Education and Training Command, the Office of Naval Research, the Biometrics Task Force, the Office of the Secretary of Defense, and the National Science Foundation. Numerous NPS students have participated in tool and scenario development.

CyberCIEGE is available at no cost to agencies of the US Government by contacting cyberciege@nps.edu. Educational licenses are available at not cost to

What Is CyberCIEGE?

[Introduction Movie](#)

View videos:

[Sample Game Play](#)

Who uses CyberCIEGE? [View installation map.](#)

Students say:

"A phenomenal teaching tool"
"Great training"
"Fun lab and very informative"



You are the CIO of a paramilitary force tasked with protecting an international carbon credit cartel.



Larry wants you to meet his on-line "date" ... but you better first check you new objectives.

Click [here](#) to download the

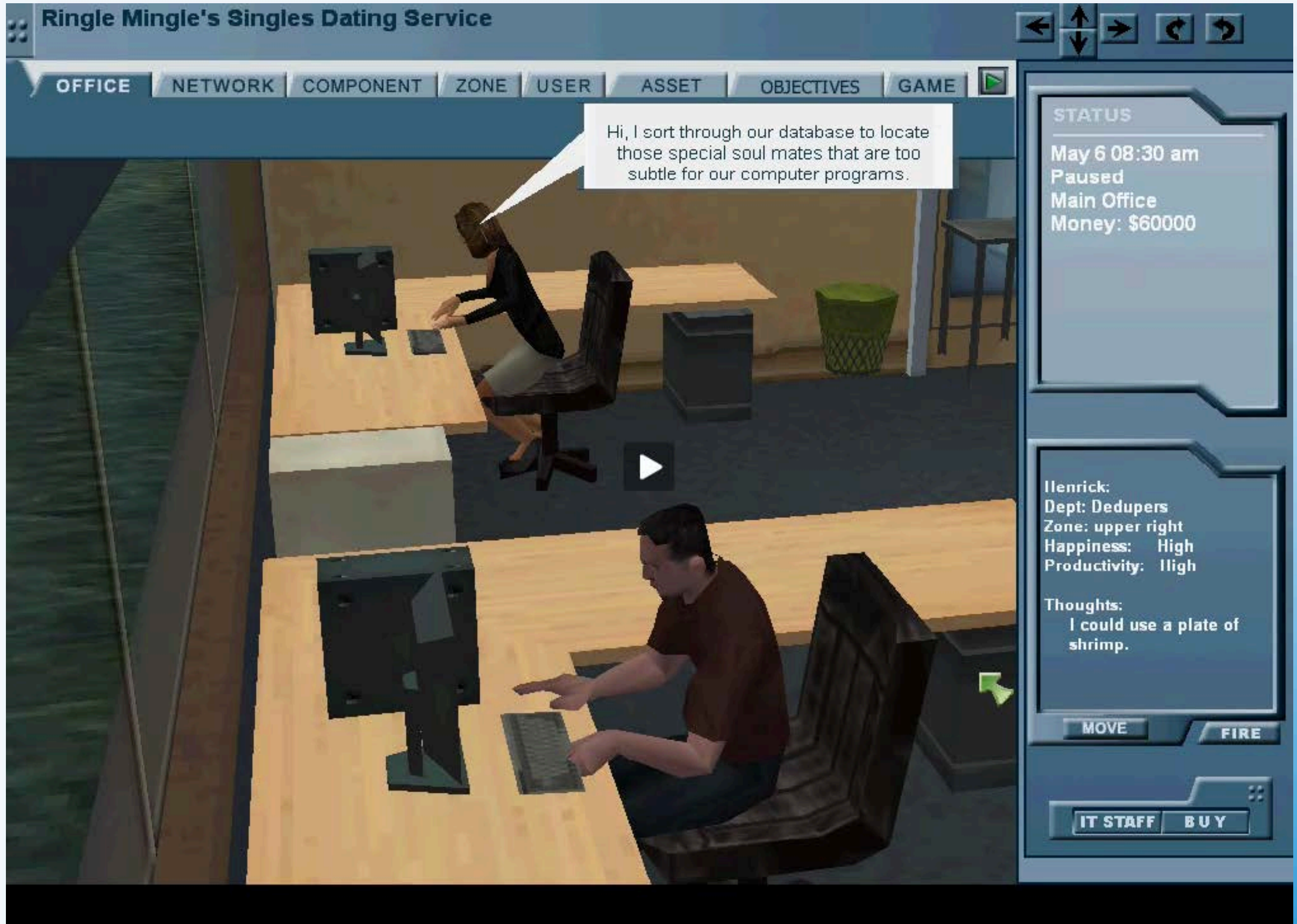
[Latest Update](#)

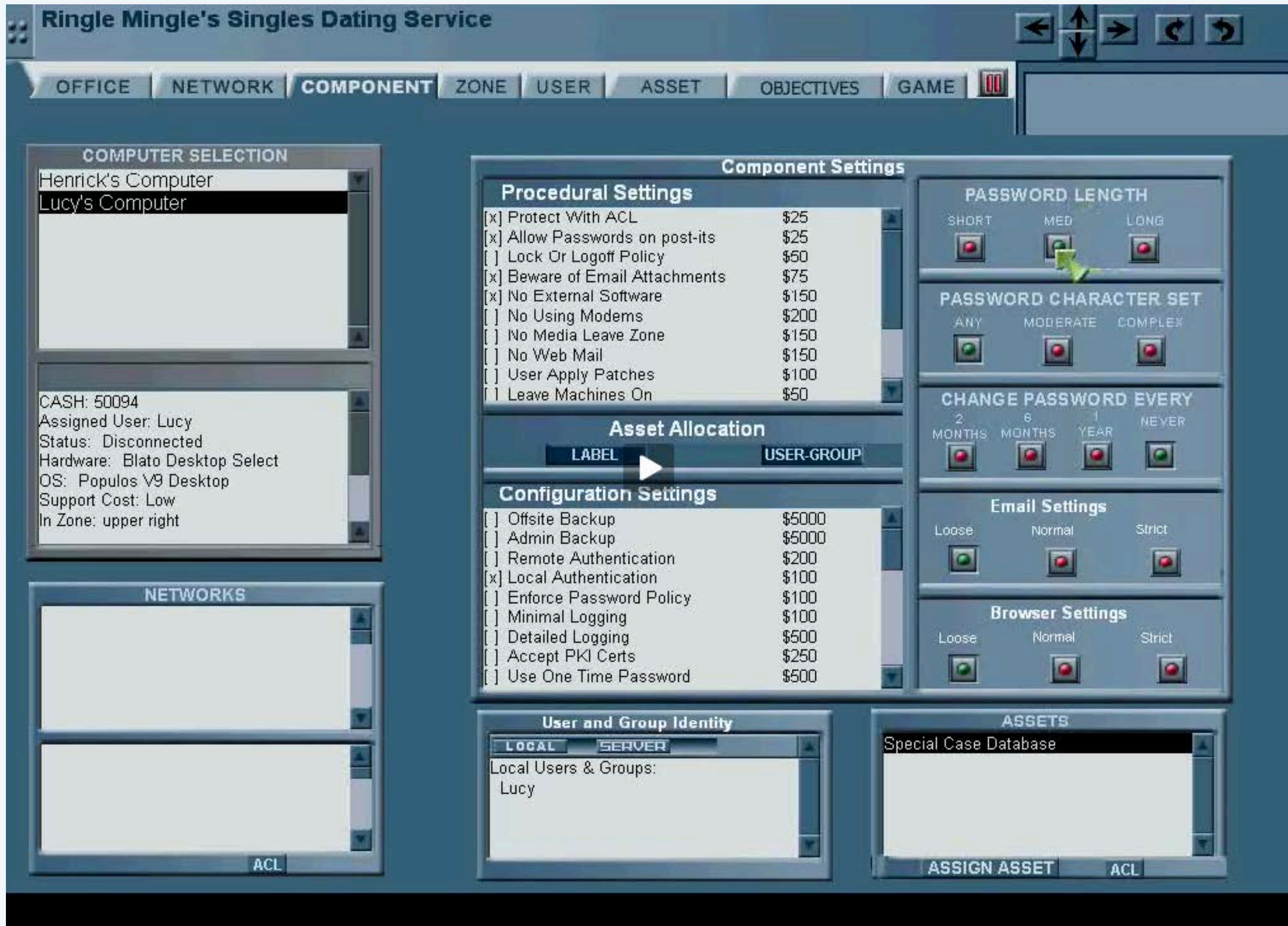
Click [here](#) to download the

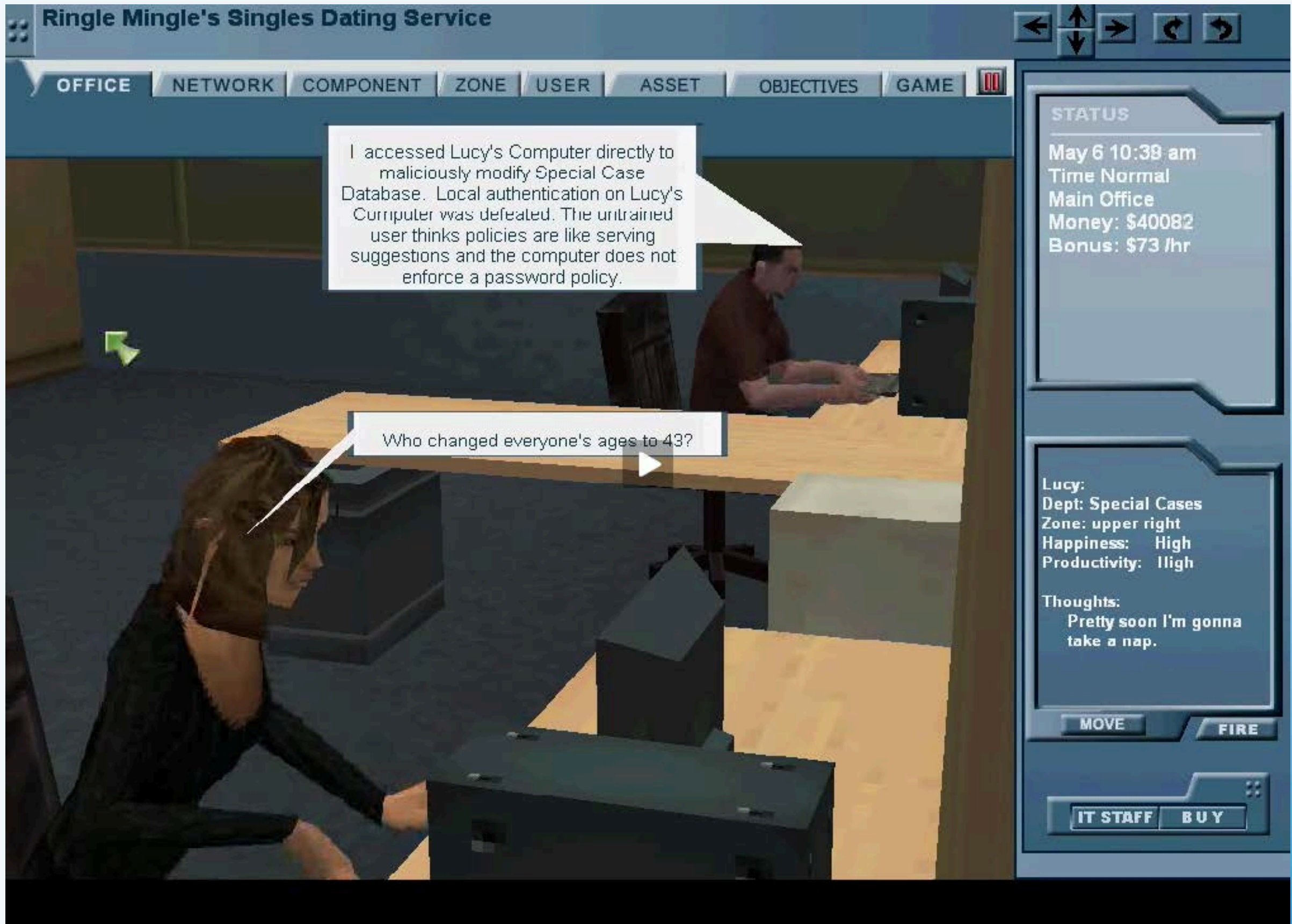
[Free Evaluation Copy](#)

NPS Scholarship for Service in Cyber Security and Cyber Operations

Do you want to obtain a Master's degree, receive a stipend, and other







Ringle Mingle's Singles Dating Service

OFFICE

NETWORK

COMPONENT

ZONE

USER

ASSET

OBJECTIVES

GAME

I accessed Lucy's Computer directly to maliciously modify Special Case Database. Local authentication on Lucy's Computer was defeated. The untrained user thinks policies are like serving suggestions and the computer does not enforce a password policy.

Who changed everyone's ages to 43?

STATUS

May 6 10:38 am
Time Normal
Main Office
Money: \$40082
Bonus: \$73 /hr

Lucy:
Dept: Special Cases
Zone: upper right
Happiness: High
Productivity: High

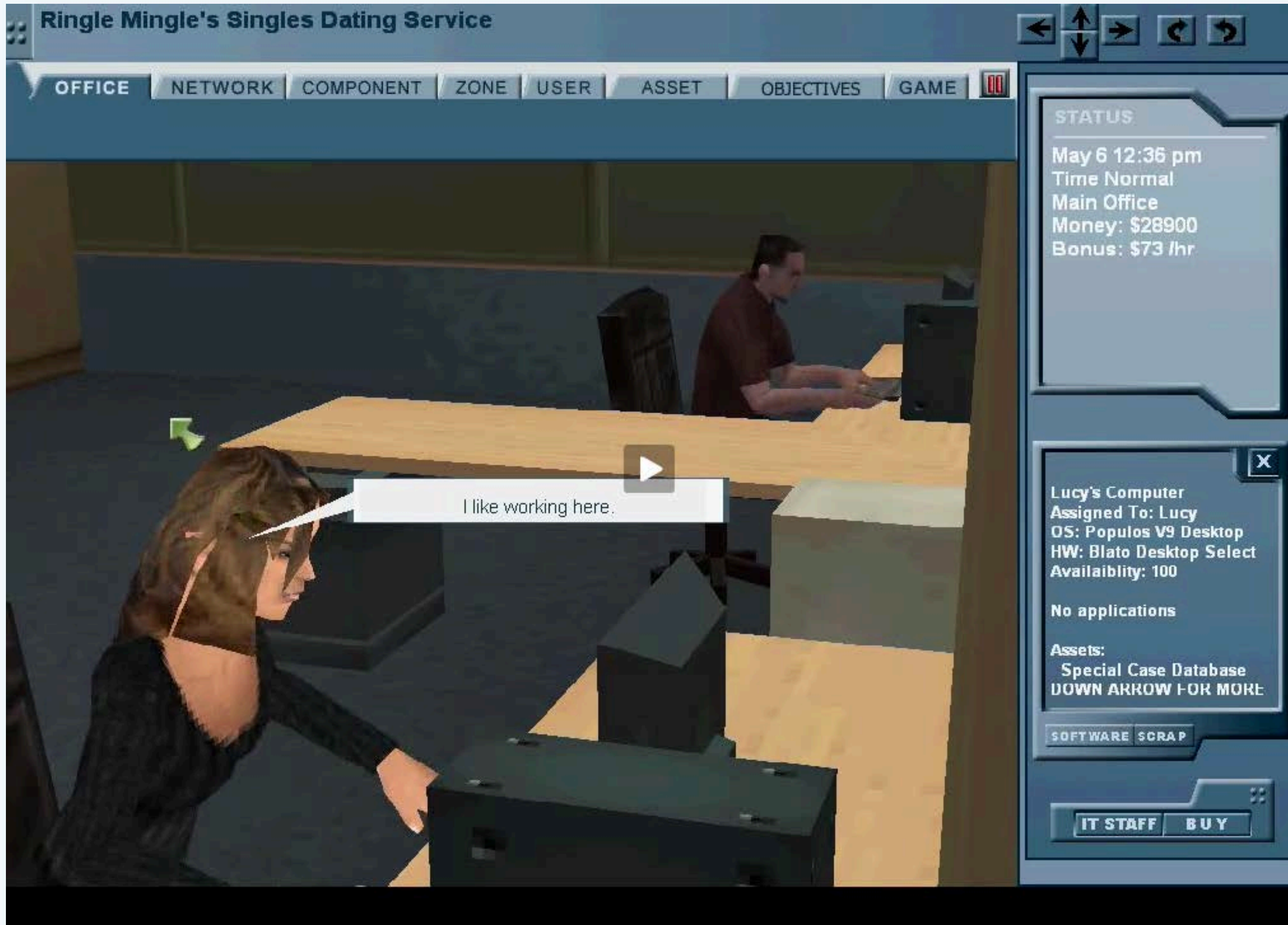
Thoughts:
Pretty soon I'm gonna
take a nap.

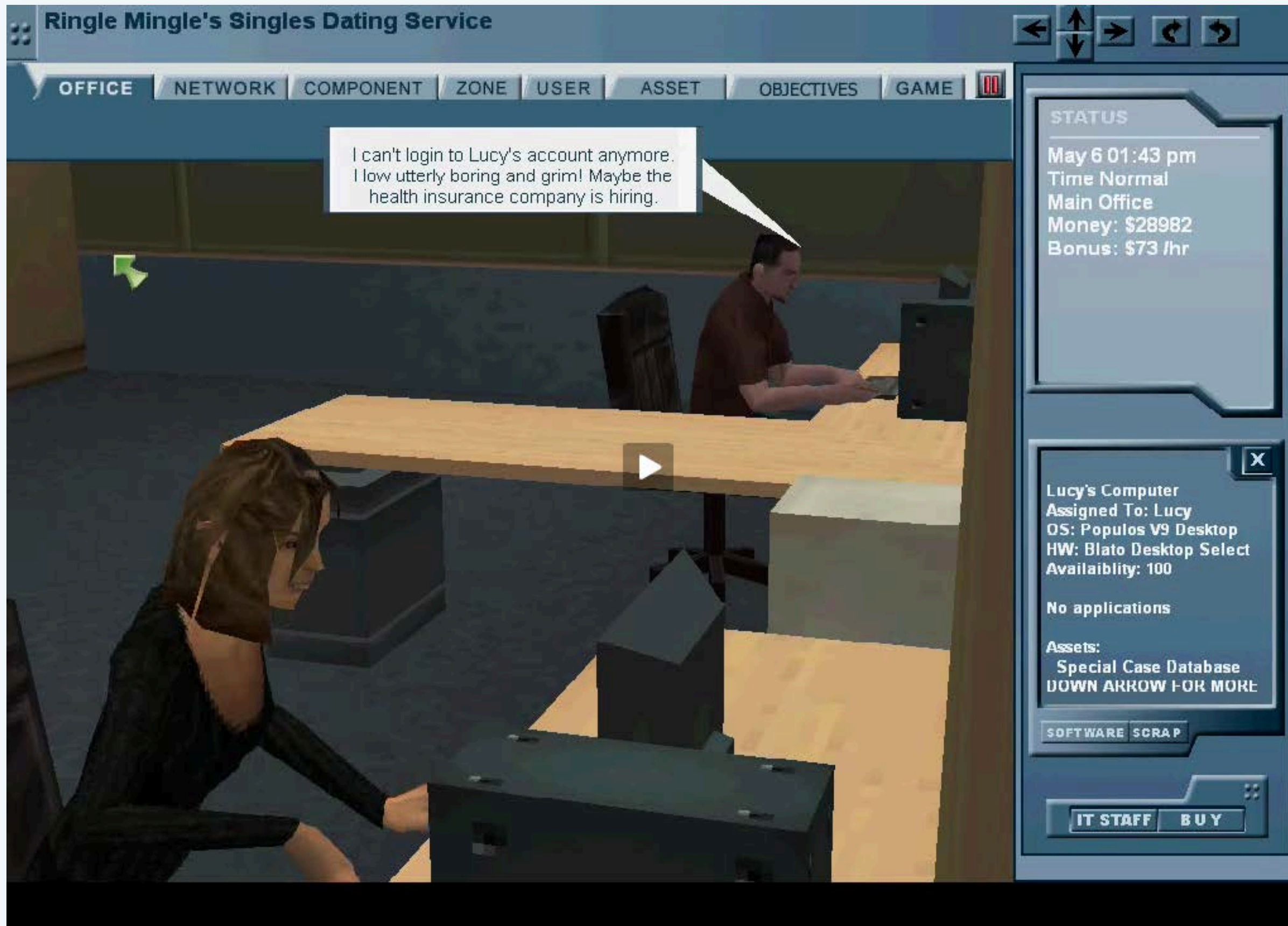
MOVE

FIRE

IT STAFF

BUY





Ringle Mingle's Singles Dating Service

OFFICE

NETWORK

COMPONENT

ZONE

USER

ASSET

OBJECTIVES

GAME

I can't login to Lucy's account anymore.
I low utterly boring and grim! Maybe the
health insurance company is hiring.

STATUS

May 6 01:43 pm
Time Normal
Main Office
Money: \$28982
Bonus: \$73 /hr

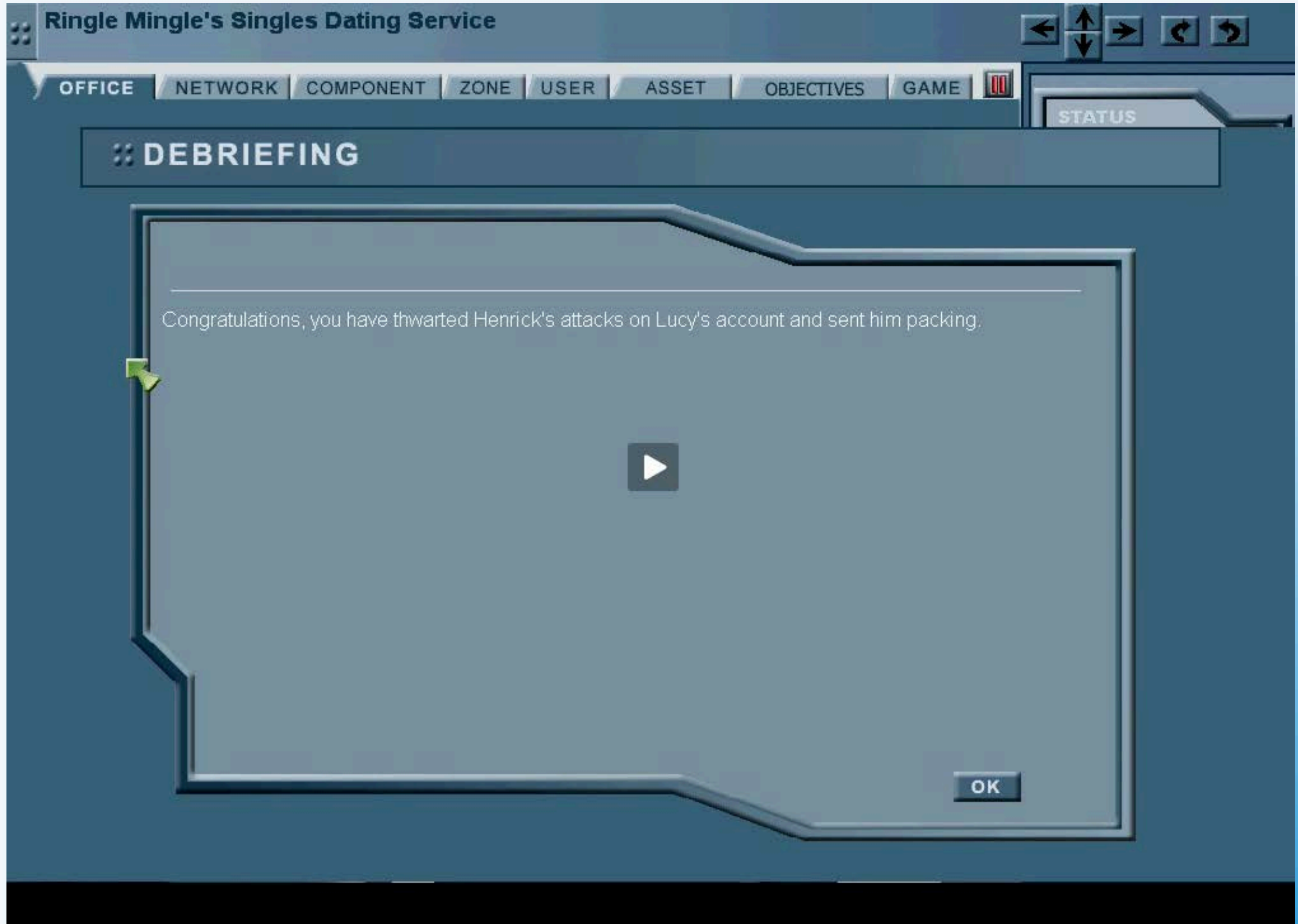
Lucy's Computer
Assigned To: Lucy
OS: Populos V9 Desktop
HW: Blato Desktop Select
Availability: 100

No applications

Assets:
Special Case Database
DOWN ARROW FOR MORE

SOFTWARE SCRAP

IT STAFF BUY



Cybersecure Contingency Planning



This game module is intended to raise awareness and increase understanding of common privacy and security issues related to health information technology. It is not an exhaustive representation of all the privacy and security issues a practice may encounter. The information contained in this game module is not intended as legal advice nor should it substitute for legal counsel. For additional information or advice specific to the needs of your organization, consult an attorney or IT professional.

continue

Cybersecure

Contingency Planning



In this game you will learn about an important part of protecting your practice – Contingency Planning. While contingency planning does include preparing for a disaster such as a hurricane or flood, it also includes being ready for power outages, fires or other events that might damage health information or make it unavailable to you. This game is not designed to cover all aspects of contingency planning but rather to raise your awareness of this important responsibility. During the game you will be provided with resources to learn more.

continue



Round 1

Week

1

2

3

4

5

6

7

8

9

10

11

12

13




14

Cybersecure

Contingency Planning

140

Your Score

Scenario		Score	Feedback	Links
1	<p>Small practices</p> <p>Last week I attended a conference that our Medical Society held for small practices. They talked about how we need to develop a Contingency Plan so we can prepare for emergencies and other events that might damage our health information system or make our information unavailable.</p> <p>Physician: We're a small practice, are you sure we are required to do this?</p>	 10	<p>The HIPAA Security Rule requires Covered Entities and Business Associates to have a Contingency plan in place that includes</p> <ul style="list-style-type: none">- Data Backup Plan- Disaster Recovery Plan- Emergency Mode Operation Plan <p>In addition, Covered Entities and Business Associates must address whether it is reasonable and appropriate to (1) implement testing and revision procedures and (2) perform an applications and criticality analysis. See 45 CFR § 164.308(a)(7).</p>	
2	<p>Location</p> <p>We aren't located in a flood plain or where there are a lot of hurricanes. We don't have to worry about any other kinds of risks, do we?</p>	 10	<p>The Security Rule requires that Covered Entities and Business Associates develop a Contingency Plan for events that may damage the organization's information systems. Some examples of events that have this potential include fire, vandalism and power outages as well as natural and man-made disasters. See 45 CFR § 164.308(a)(7).</p>	
Total Score		140 / 140	You won!	
 start over		 hide		



Round 3

Week

1

2

3

4

5

6

7

8

9

10

11

12


13

14

Cybersecure

Contingency Planning

 start over

 show

140

Your Score

secured



Round 3

Week

1

2

3

4

5

6

7

8

9

10

11

12

13

14

The Multiplayer Classroom



“Good morning, you all have an F.”



“However you can all level up.”



Creating avatars (Investment)



Students teaching students (Agency)



Learning by failing



Grading by accretion

Level	Skillz	XP ¹
Level Twenty		1000
Level Nineteen		930
Level Eighteen		900
Level Seventeen	5	870
Level Sixteen		830
Level Fifteen		800
Level Fourteen	5	770
Level Thirteen		730
Level Twelve		700
Level Eleven		670
Level Ten	5	630
Level Nine		510
Level Eight		410
Level Seven		320
Level Six		240
Level Five	5	170
Level Four		110
Level Three		60
Level Two		20
Level One		0

Rewarding Attendance



Intrinsic rewards



**Some things the multiplayer
classroom does not need...**



We do not need video games!

We do not need badges!





We do not need computers!

**We do not even need
classrooms!**



Research Results

- Over 14,000 students and over 900 teachers in 14 countries
- Traditional approach success rate: 71% of students received A, B or C
- Game-Based approach success rate: 93% of students received an A (NO B's, C's or D's)
- Students completed 2X the curriculum in 30% less time

Situational Storytelling



CyberCIEGE
Can you keep the network alive?

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Game Scenarios

The following games are included in the CyberCIEGE distribution. If you have created a scenario that you would like to share, email the project directory to cyberciege@nps.edu.

Scenario Name	Description
Stop Worms	Highlights risks of malicious software within email attachments. A good initial scenario for introducing some of the CyberCIEGE interfaces
Life with Macros	Describes risks of macro viruses and the use of antivirus tools to reduce these risks in environments that must handle many external documents.
Identity Theft	Help protect a home computer user from the perils of identity theft.
Passwords	Define password policies for an online dating service.
Introduction	Simple tutorial scenario that walks the player through the mechanics of the game and introduces the player to a number of the CyberCIEGE security concepts.
Physical Security	Introduces CyberCIEGE zones and methods of physically protecting assets.
Filters	Explores issues arising from connecting networks to the Internet and the use of filters to protect assets.
Patches	Highlights the need to have a patch management plan.
PCA	Help the Professional Croquette Association protect their secrets using a DMZ.
Link Encrypt	Introduces link encryptors, basic key management issues and assurance.
Key Types	Some differences between symmetric and public key encryption. Introduces password hash cracking



Hot town. Summer in the city. Public transit strike so you're on the sidewalk. Good exercise. Too bad there's a garbage strike on, because that's on the sidewalk, too.

Crimson Dilemma (Indiana University 2014)



Robert

Her employer let her go. We've filed a lawsuit. But I'm looking after more and more on the home front. I'm tired and spaced. There aren't enough hours in the day.


Can I help? With groceries maybe? Watching the kids? I'm not an accountant, but I might be able to take something off your plate here.

{I need to report this. For Robert and for the company.} That's terrible. Have you talked to anyone else here at Bylantic?

{I feel for him, but there are too many unknowns in the situation, lines I'm not supposed to cross.} You should try HR again. I'm sure they could arrange family leave or something.



And It's clear Joyce in HR is a lady with an edge to her. She hasn't smiled since Bastille Day. Now she wants to talk to you again...



Joyce

It's obvious THEY have better luck with convenience stores than a desk job.

{Maybe I'm misunderstanding. Better to keep quiet.} I'm sure Robert has a good reason for not reporting in.

{I'm not going to get into it with her. Not while she's got those knitting needles. But her boss needs to know.} I'm sure Robert has a good reason for not reporting in.

{I have to say something.} Joyce, you're way out of line.

Collateral Learning



Collateral learning occurs at the convergence
of two distinct undeniable forces:

gameplay and storytelling

And the human attributes of

curiosity and imagination

That hunger for both.



**The Skeleton Chase 2: The Psychic
(Indiana University 2009)**





**The Lost Manuscript
(Rensselaer Polytechnic Institute, 2011)**

Final Mandarin exam: A police interrogation





**Lost Manuscript 2: The Summer Palace Cipher
(RPI Emergent Reality Lab 2014)**



“Greetings from the future! I tried for quite awhile to figure out how to open this video. I wanted to be impressive and welcoming. But when I finally said it on camera it sounded kind of silly. Oh well, hopefully you’re still watching!

My name is Audra Casey. And I am speaking to you from...get ready for it...the year 2084! I kid you not!”

Video Script



**Secrets: A Cyberculture Mystery Game
(Excelsior College 2015)**

Scientists, philosophers, humanitarians, futurists
Build a world free from hate, strife, war, and hunger



“Primal Empathy or PE is a kind of psychic harmony that allows us to connect with one another, not really telepathic, but an ability to form a tight, instinctual empathetic bond that transcends national, cultural and racial differences.

If all humankind can learn to strongly identify with one another then hatred and war will be evils of the past.”

Video Script

**Haves = The Collective = The Elitists
1%**



**DNA Upgraded
know what's best**

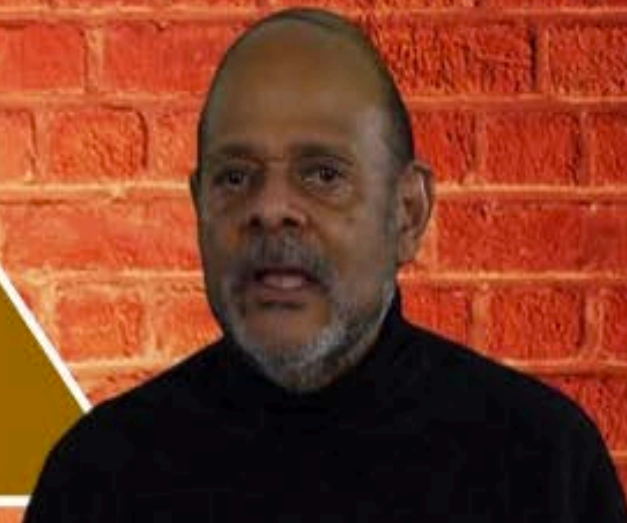


**Thought leaders,
politicians, scientists,
their families, and friends**

**The Collective
1%**

**The Rest
99%**

**Have Nots treasure being
different-wacky or
politically incorrect**



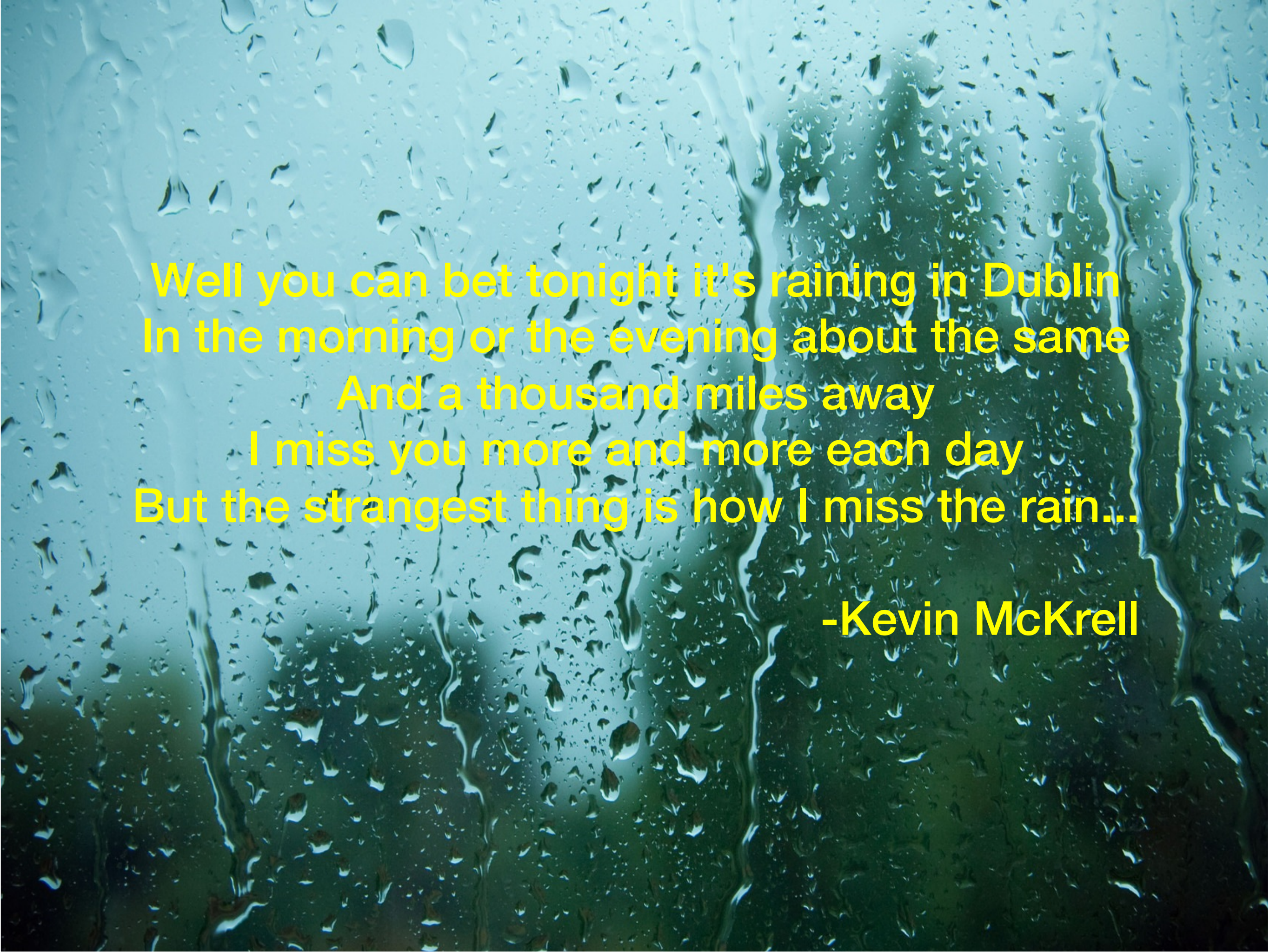
Secrets Online



Tom Wetherall is a likable, intelligent member of the class who works for an Organic Health Food Company. Or does he?

Ann Bennett is another likable, intelligent student in the class who teaches English. Or does she?

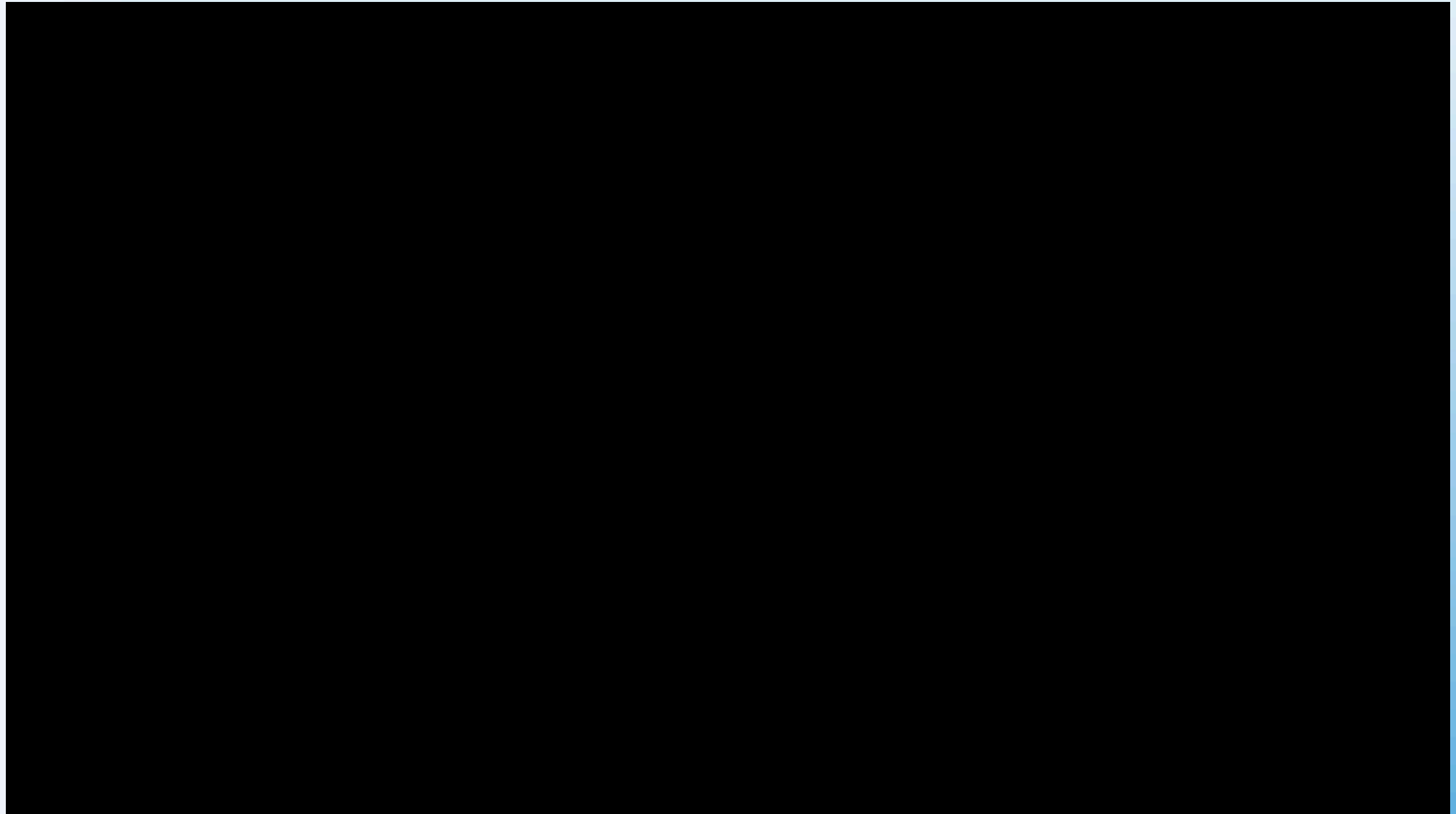




Well you can bet tonight it's raining in Dublin
In the morning or the evening about the same
And a thousand miles away
I miss you more and more each day
But the strangest thing is how I miss the rain...

-Kevin McKrell

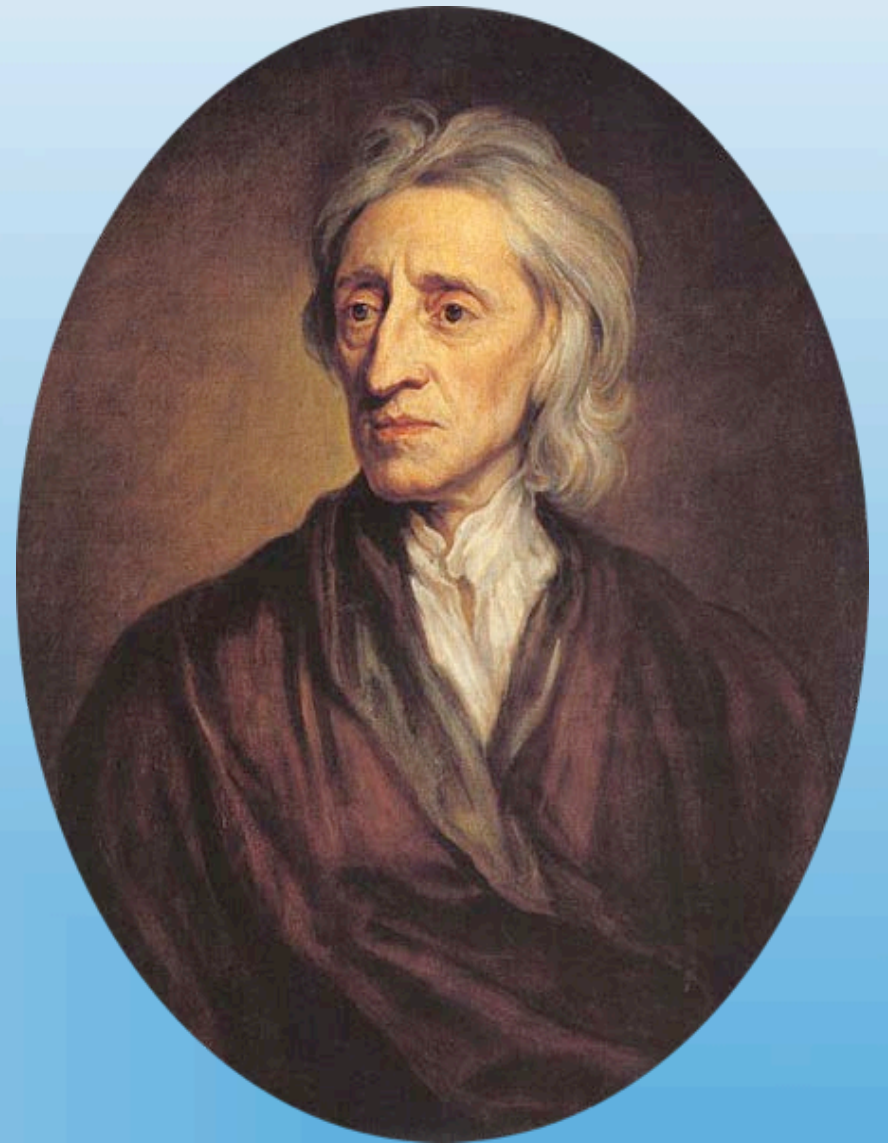
Emotion



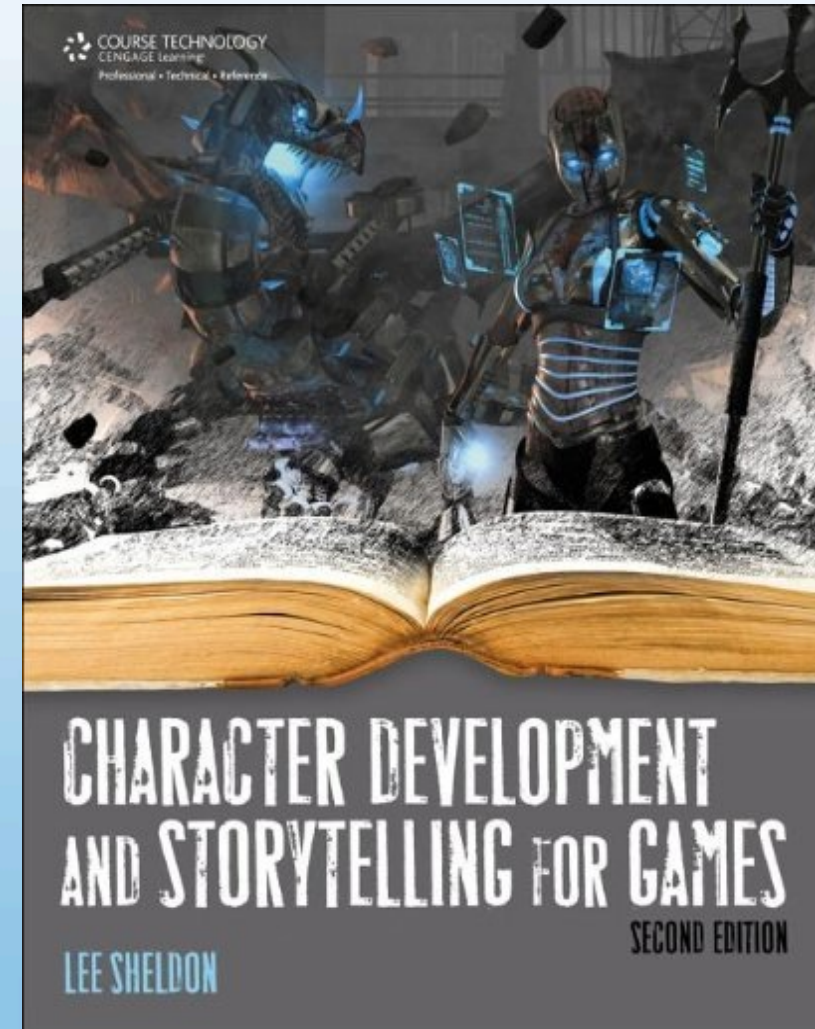
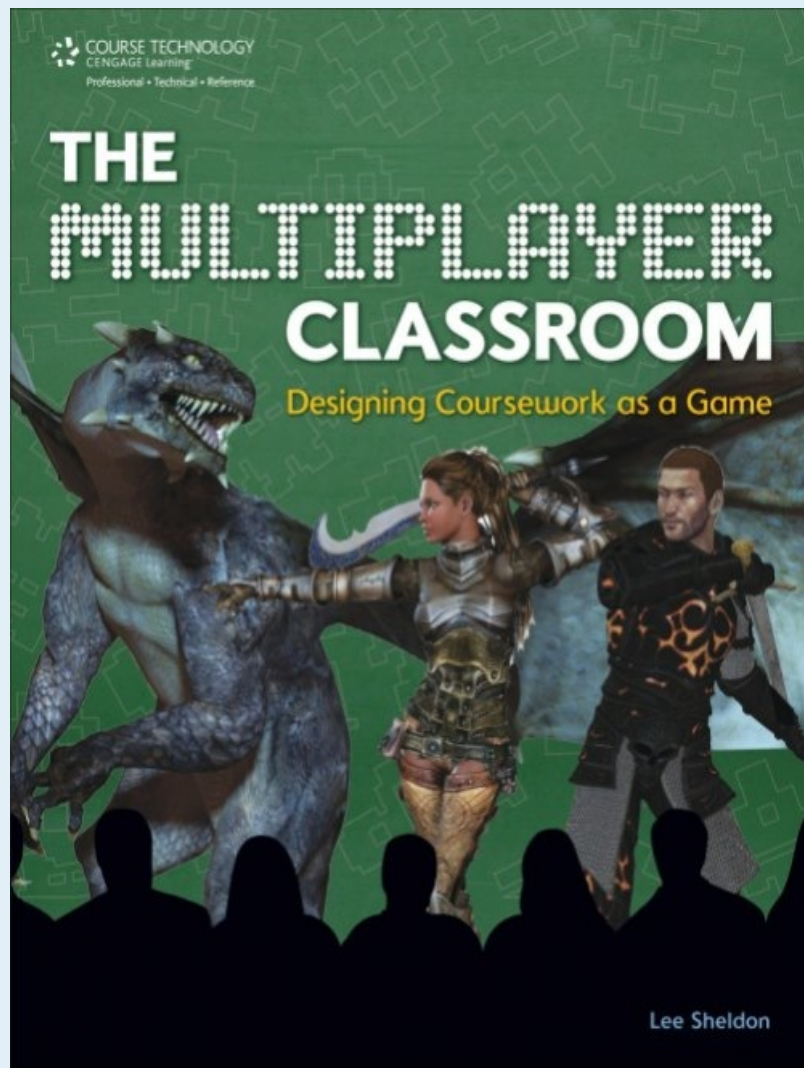
These Far Hills
(Rensselaer Polytechnic Institute 2015)

“The improvement of understanding is for two ends: First, our own increase of knowledge; secondly, to enable us to deliver that knowledge to others.”

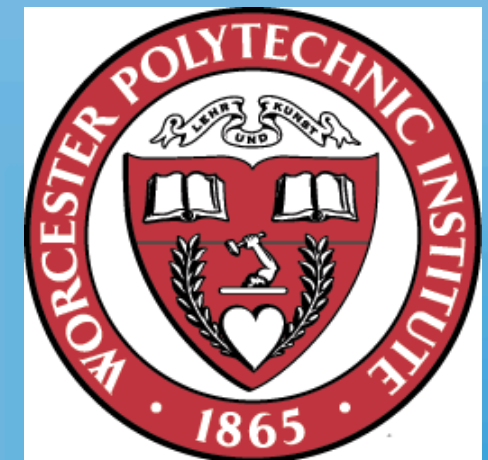
John Locke Still 1692



Thank you!



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