Attracting Kids to Computer Science via Programming in Virtual Worlds

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Duke Virtual Reality and Serious Games Symposium

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Motivation

- Taulbee Survey 2006-07 - CS BS majors decline
  - 50% drop in enrollment since 2001
  - 11.8% female
  - 5.3% hispanic
  - 3.6% african american
- Many other studies show the low number of interest in CS by females and underrepresented minorities

How do we Introduce and Teach Science?

- Physics – experiments

- Chemistry - experiments

- Biology - experiments

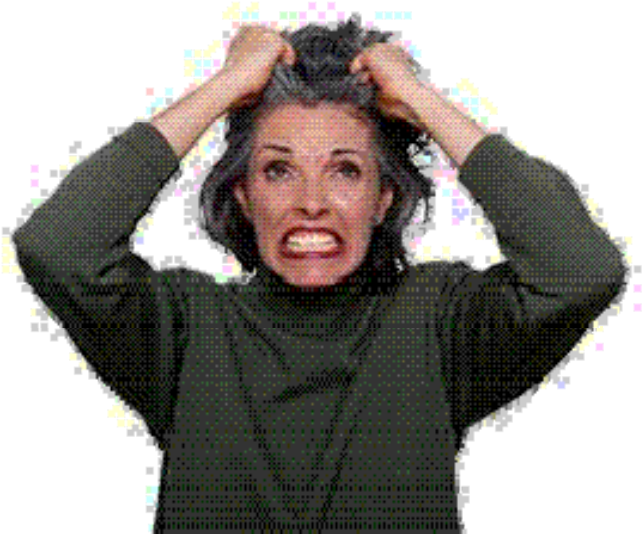
How do we Introduce Computer Science?

```
public class Simple {

    public static void main(String[] args) {
        System.out.println("Hello World!");

    }

}
```

- Write a calculator
- Write a banking program
- Etc…

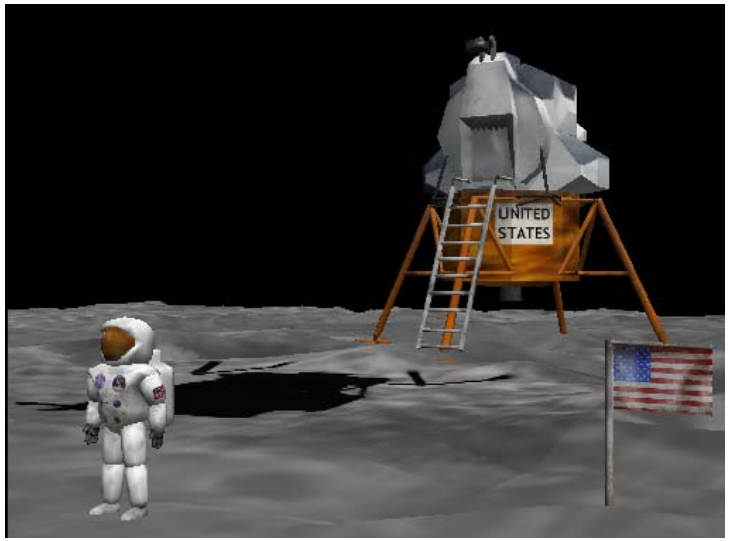
Why Can't the Introduction of Computer Science be exciting?

- Programming – it's always been
  - Hands-on
  - Interactive
  - Frustrating!
- What's missing?
  - Not Getting Exciting Results
    - Easily, right away
  - Not appealing to today's kids in which media and technology are a part of their life!



Bring on Alice Virtual Worlds!

- Alice is
  - Hands-on!
  - Interactive!
  - Exciting Results right away!



- Alice has the potential to excite kids about computer science in the same way that experiments excite kids about chemistry, physics and biology!

Alice Programming Language

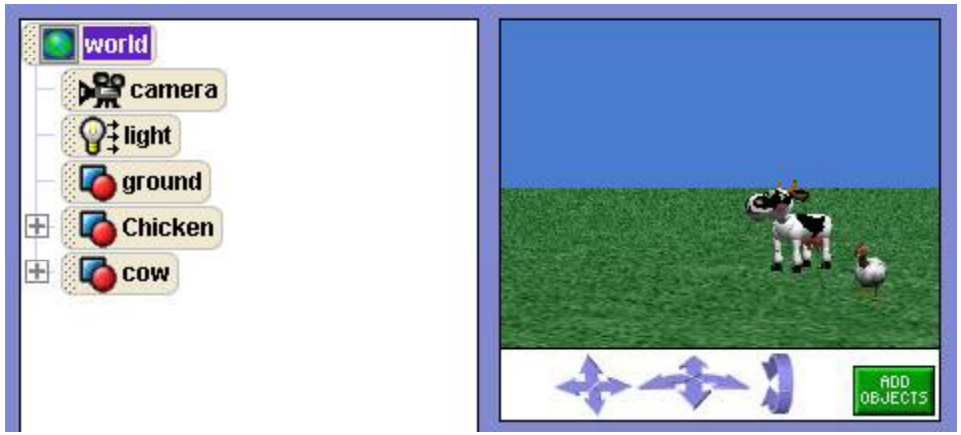
- Create interactive stories or games
- Learn programming in an easy way, drag-and-drop your code
- Learn computer science concepts:
  - Loops, classes, methods, functions, arrays

- Developed at Carnegie Mellon University
  - Professor Randy Pausch
- Alice is free: **www.alice.org**

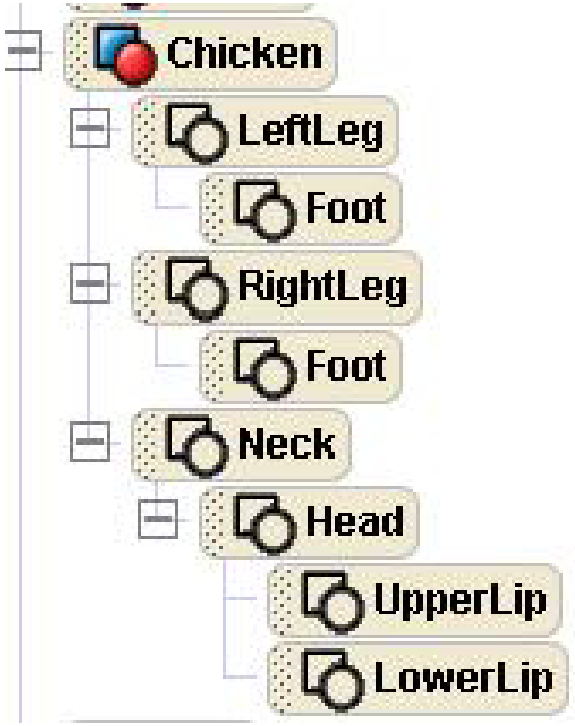
Alice Programming Language

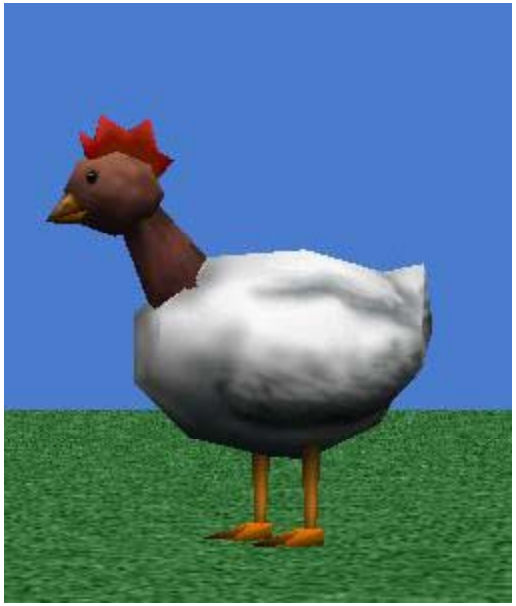
- Has libraries of 3D objects

- Keeps Track of objects you select



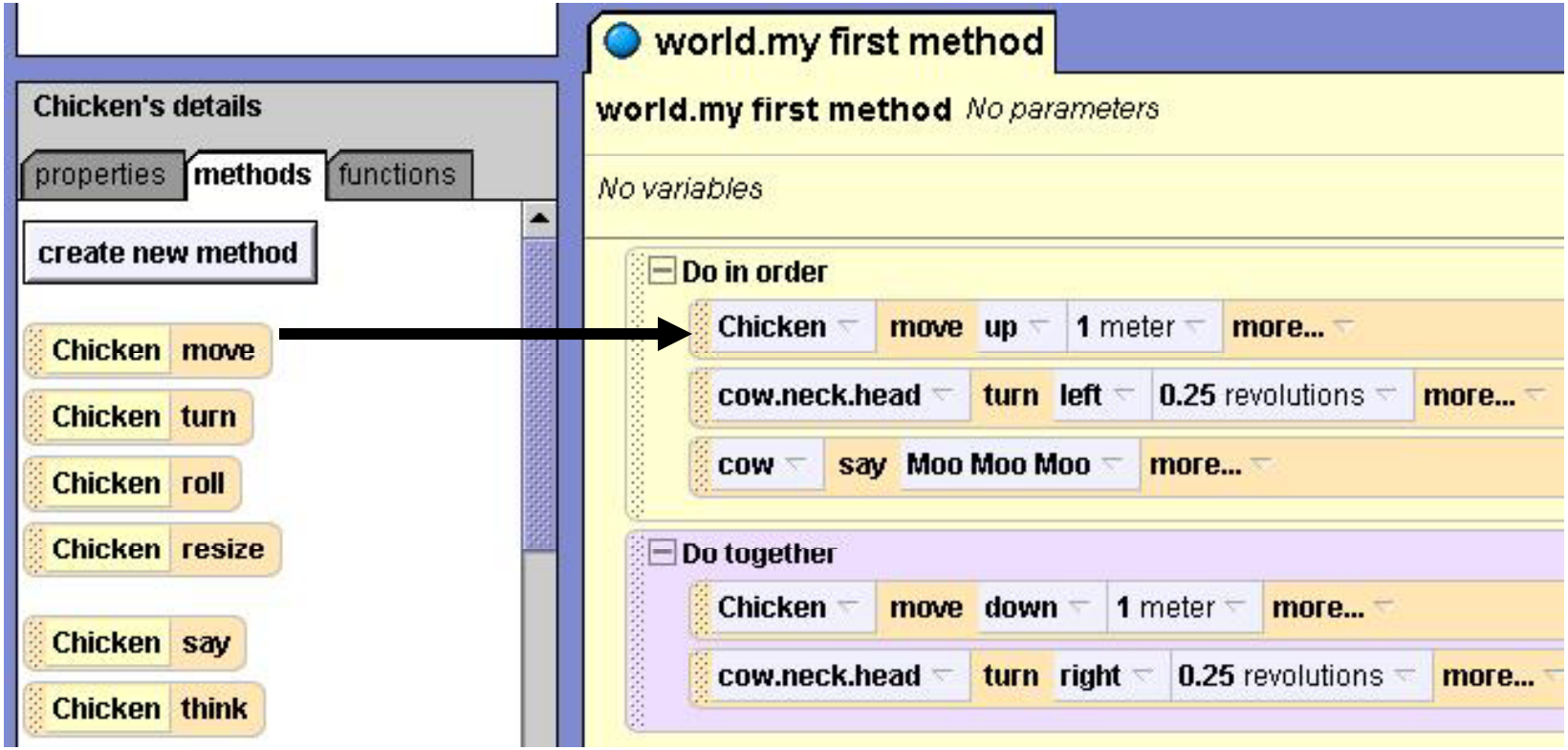
Objects Have Multiple Parts that are moveable





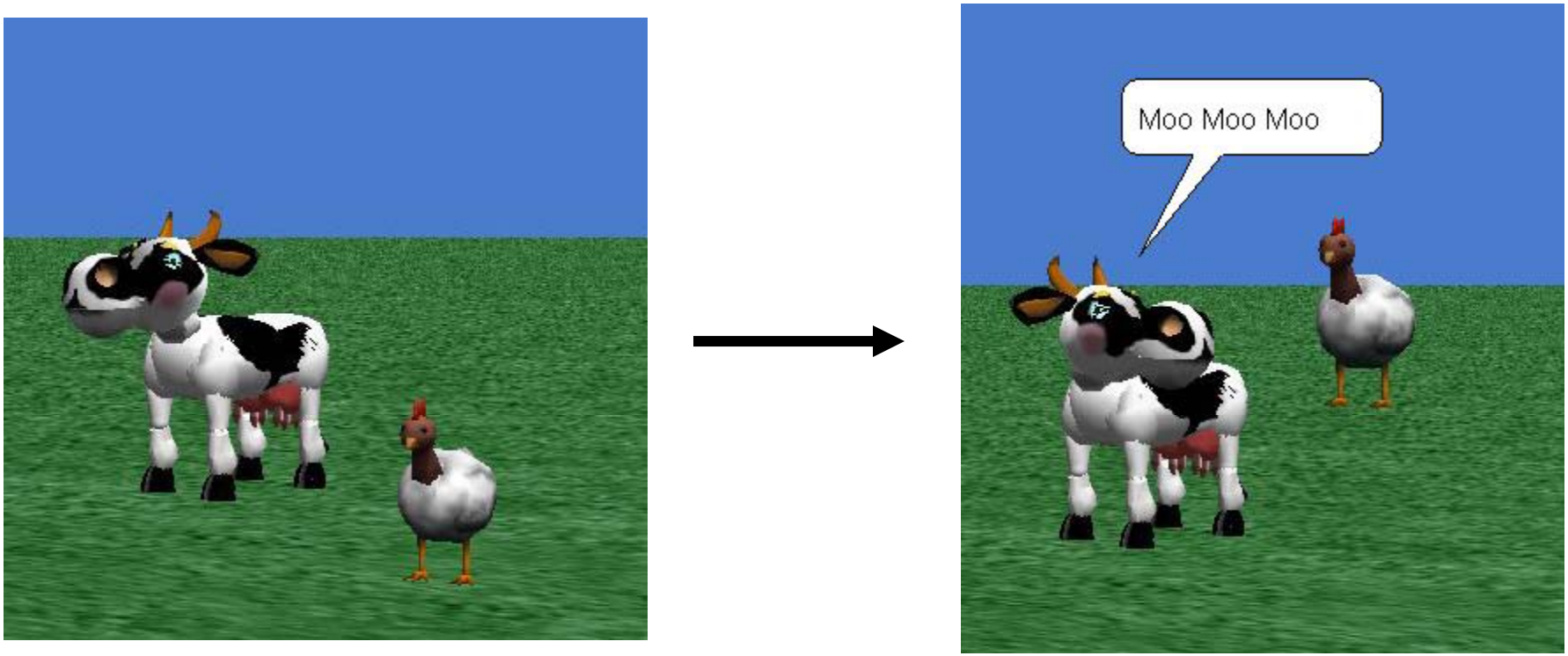
Alice Code is Easy to Learn

Select Code, Drag-and-Drop code in program



Play Alice Animation

- Chicken rises, cow turns head and talks



CompSci 4 – Alice Class at Duke

- Lecture for 10-20 minutes
- Students work on problem with computers in pairs
- Bring students back together

Success - Alice attracts diverse group

- At Duke
  - CompSci 4 Spring 2005
    - 22 preregister, 30 enroll (12 female + 3 African Amer.)
  - CompSci 4 Fall 2005
    - 20 preregister, 31 enroll (17 female – 1 African Amer.)
  - CompSci 4 Fall 2006 – 2 sections
    - 64 students, 33 female, 7 African Amer.
  - CompSci 4 Fall 2007 – 2 sections
    - 84 students - > 50% female
  - CompSci 4 Fall 2008 – 2 sections
    - 100 students - > 50% female
  - Advertised in school paper
    - picture of ice skater
    - Web site of animations

Games Created by Duke CompSci 4 Students

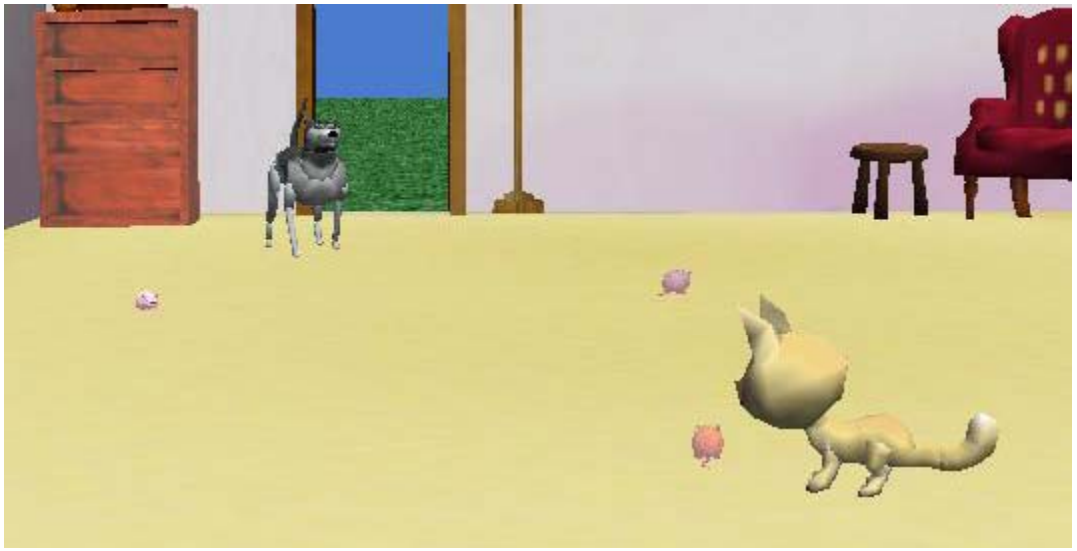
- Non-majors
- Most never programmed before
- Final projects after 10 weeks of Alice
- 50% of students are women
- Spring 05, Fall 05, Fall 06, Fall 07, Fall 08

Game: Candyland

Select girl and boy to play

Click on red and green buttons to move them.

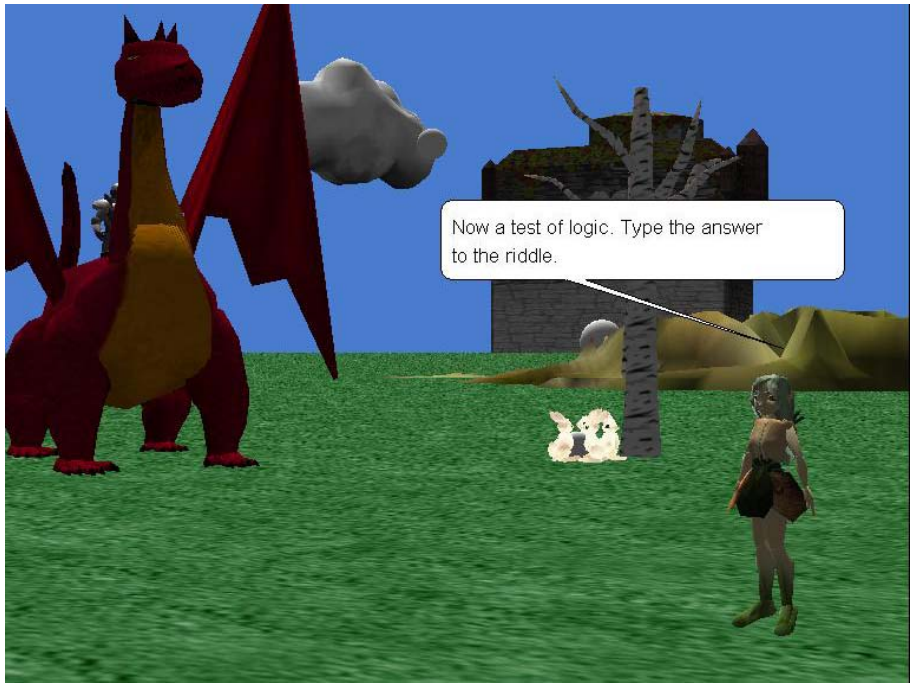
Game: Frogger – Get frog across road

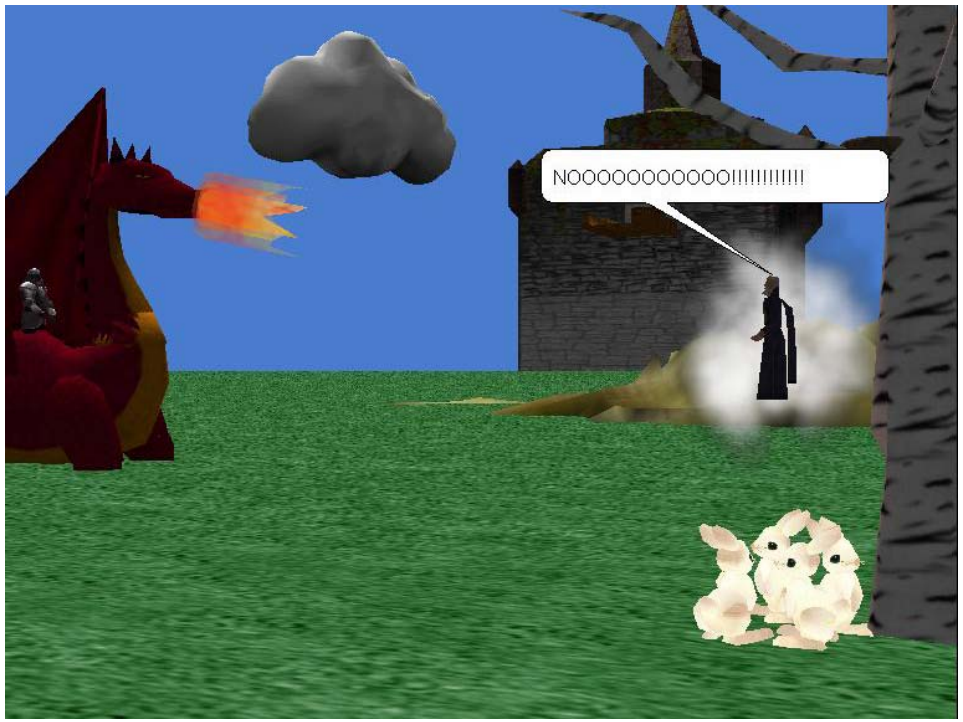


Game: Cat catch mice before dog gets cat

Game: Putt golf ball into hole

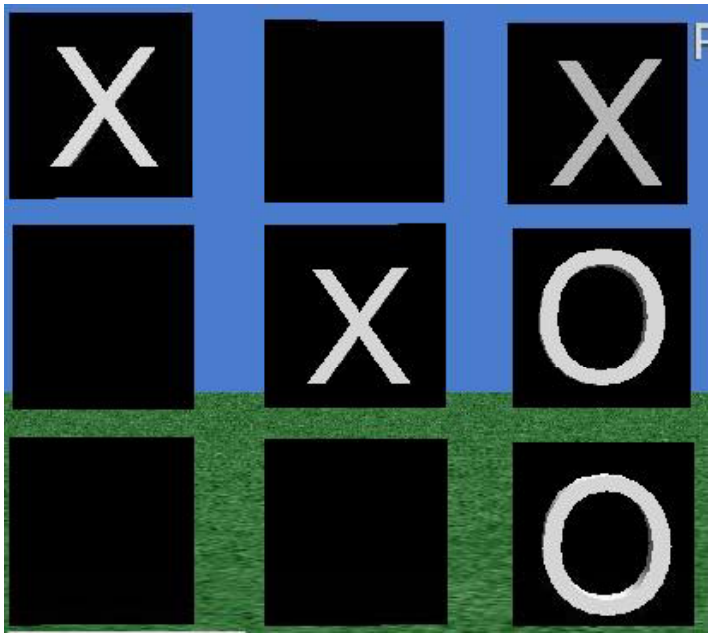
Game: Eragon

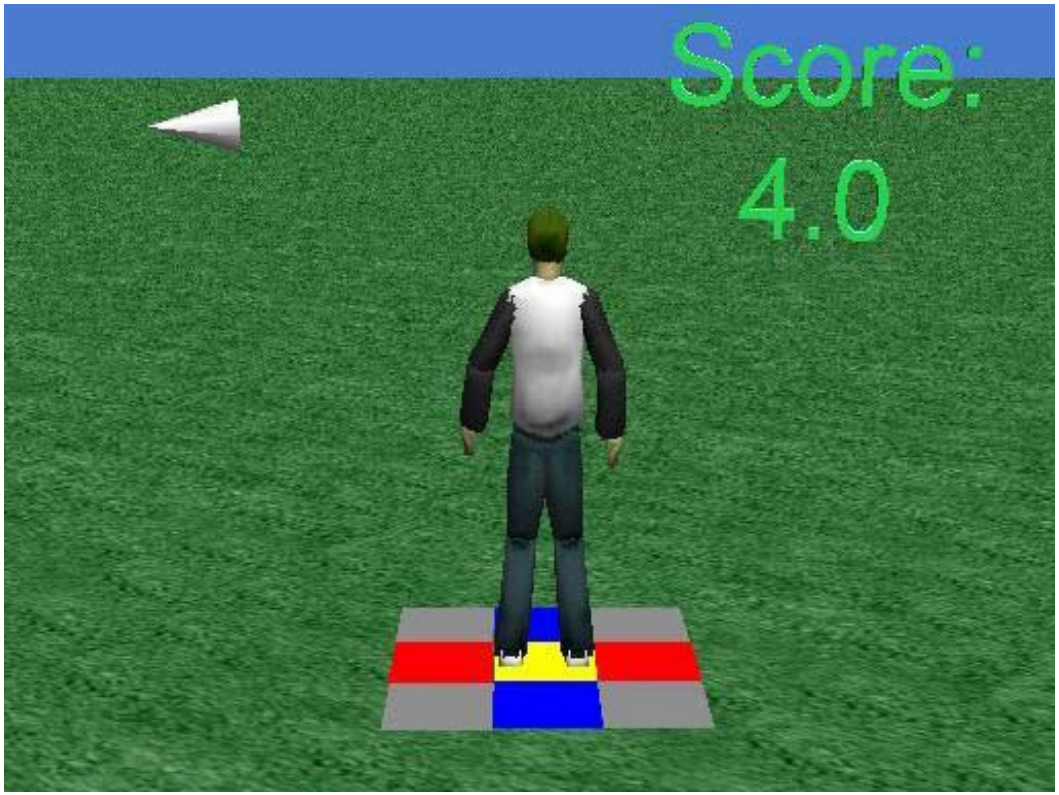




4 tasks to win the game

Game:
Tic Tac Toe

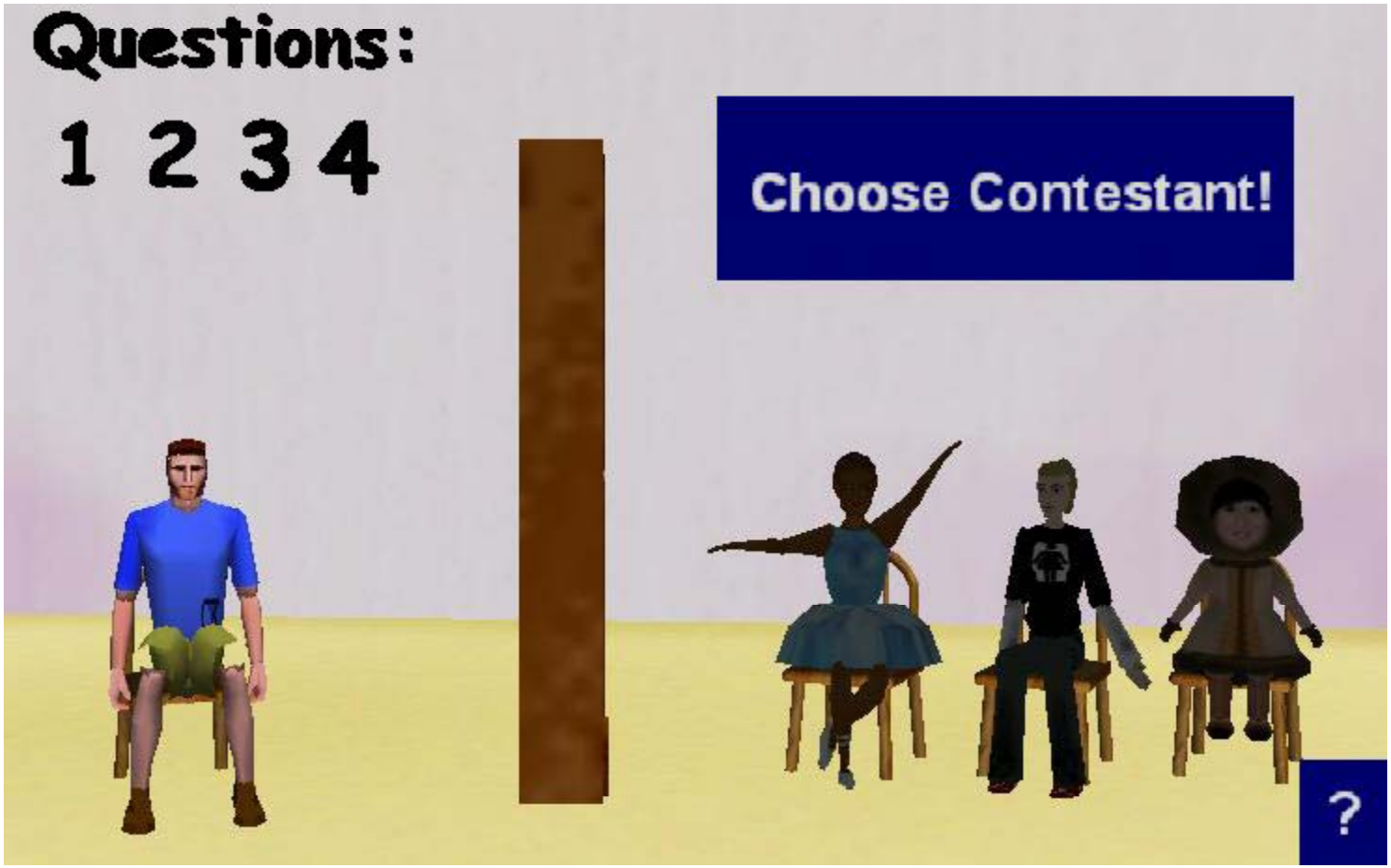




Game: DDR

Click on arrow keys,
Player moves foot to square

Game: Dating Game



Adventures in Alice Programming

- National Science Foundation ITEST Grant
- IBM Faculty Award for Durham region

Adventures in Alice Programming Grades 5-12 Outreach

www.cs.duke.edu/csed/alice/aliceInSchools

Adventures in Alice Programming

- Integrate Alice into high school and middle schools by training teachers
- Six sites:

Durham, NC	Charleston, SC	Virginia Beach, VA
Denver, CO	Oxford, MS	San Jose, CA

- Durham site focuses on Middle Schools in NC

  www.cs.duke.edu/csed/alice/aliceInSchools

Durham: Adventures in Alice site

- Summer 2008
  - 3-week Teacher workshop
    - 35 teachers, mostly middle school, some high school
    - Only a few had every programmed before
    - Subjects: english, math, science, history, art, technology
    - Taught them Alice, Developed Lesson Plans
  - Two one-week middle school camps
    - Taught Alice
    - Lots of time to build their own Alice worlds
  - Overlap between the two

CS Topics Taught

- CS Topics
  - Programming – sequential and “at the same time”
  - Methods
  - Events
  - Looping
  - Conditionals (making a choice)
  - Functions (compute and return an answer)
  - Lists
  - Variables

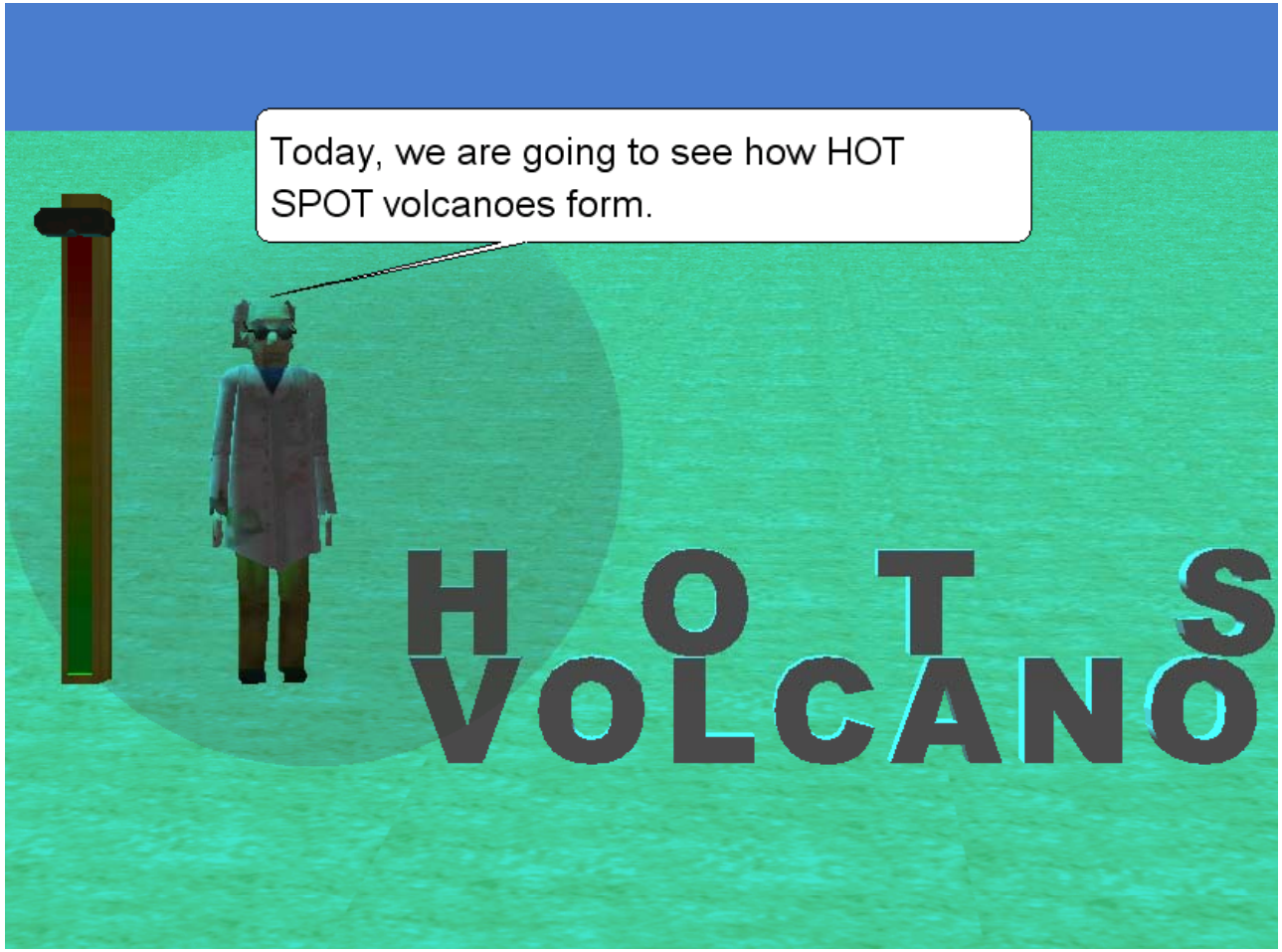
Other “Fun” Topics Blended in

- Storyboards
- Changing camera views
- Scene changes and lighting
- Making Billboards
- Making objects invisible and visible
- Sounds
- Glueing objects to others

How to Use Alice in Middle Schools

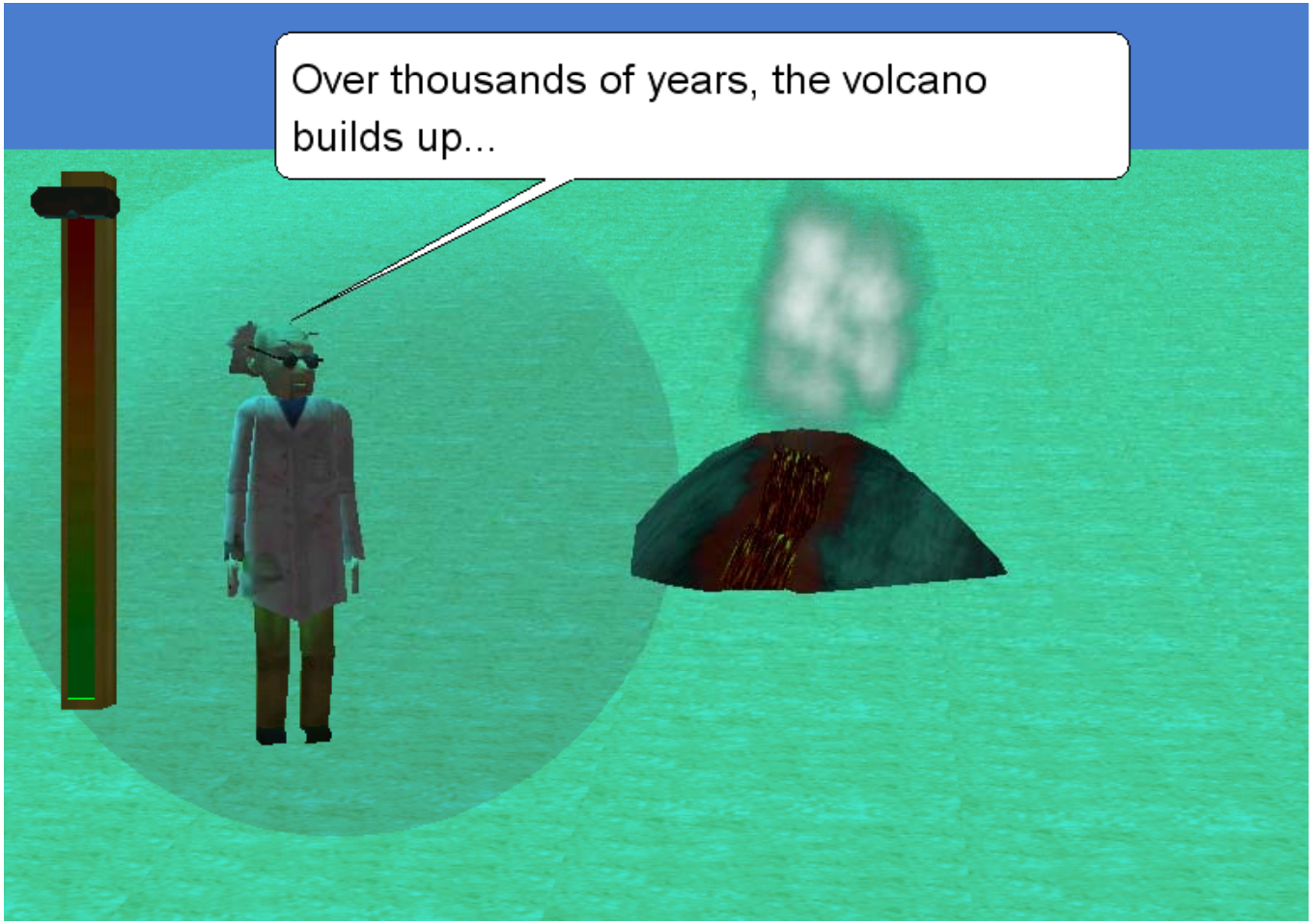
- Teachers
  - Examples in lecture
  - Make interactive quizzes
  - Make worlds on concepts for students to view
- Students
  - Projects (in place of a poster, a model)
  - To take quizzes
  - To view and answer questions about a world

Example Alice Project: How volcano is formed

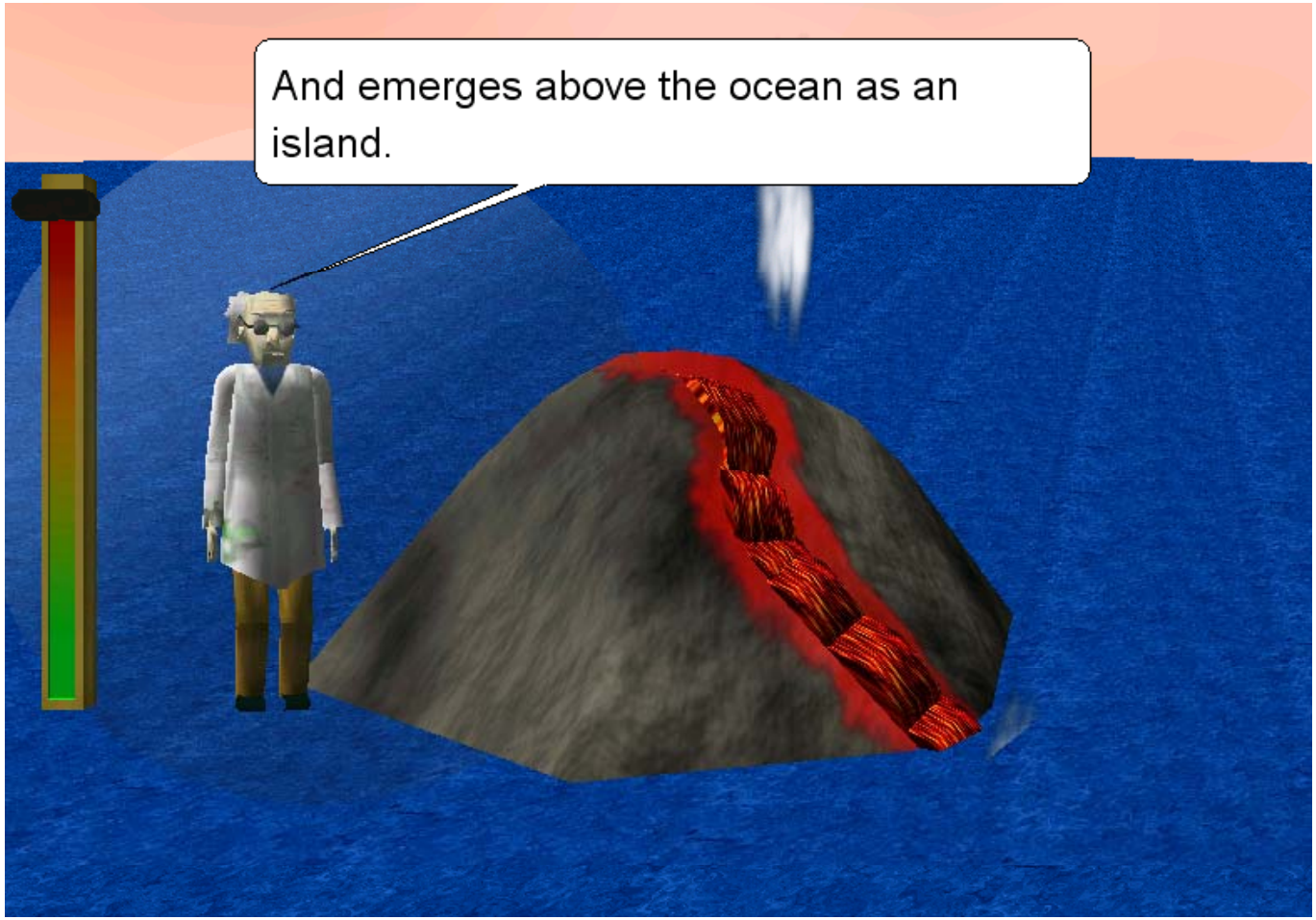


How a volcano is formed (slide 2)

How a volcano is formed (slide 3)



How a volcano is formed (slide 4)



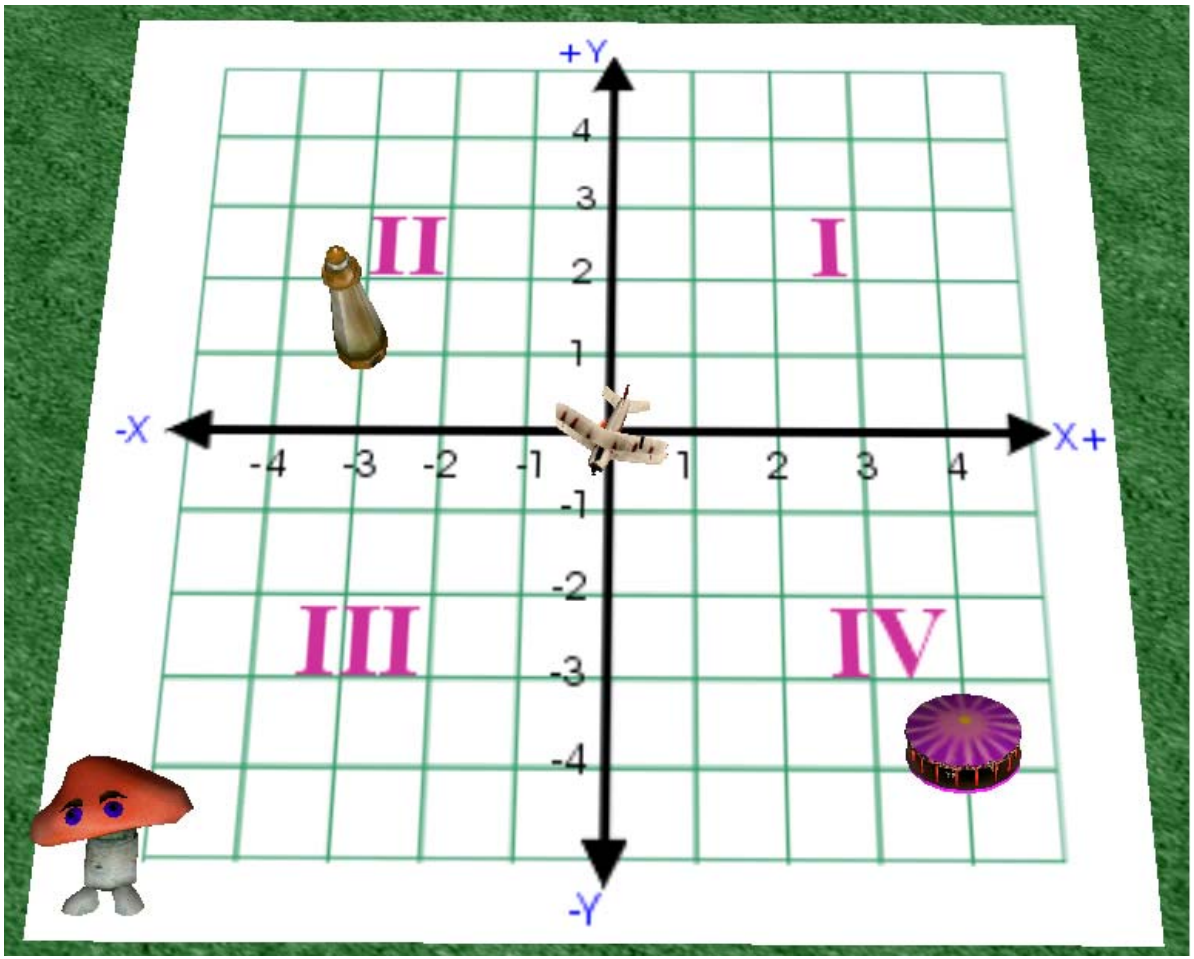
Magic Tree House Quiz
Famous Children's Book Series

Other Ideas for Projects

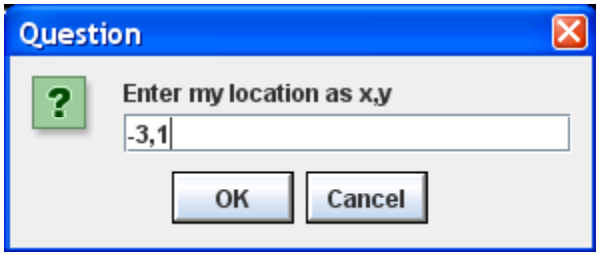
- Story from Ancient Egypt
- Spanish Quiz in which you see a word and have to click on the object the word represents
- Animate a scene from a book you have read or a poem you have written
- Create a world about school safety
- Memory game – remember a random color sequence
- Math Quiz – Answer the questions

Alice worlds for these and more are on our website.

Teacher Lesson Plan on quadrant plane

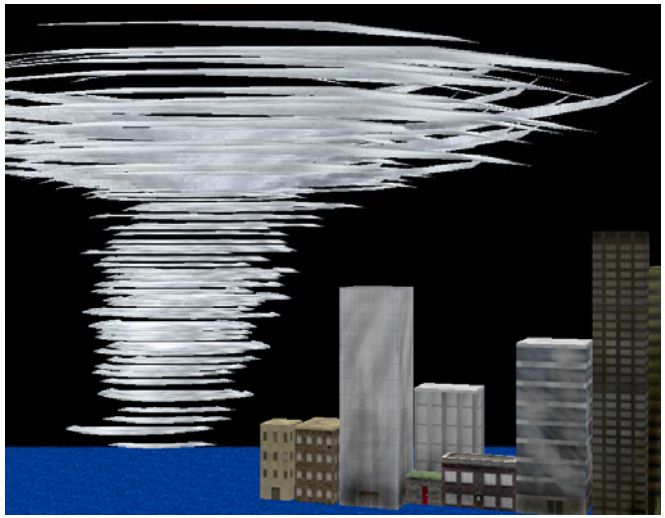


- Click on lighthouse
- Enter x,y position
- Objects randomly move



Other Teacher Lesson Plans

- Math
  - Finding surface area
  - Rate of Change and Slope
- Science
  - Create a food chain
  - Sun, Earth and Moon system
  - Tornados
  - Physics – Newton's law of gravity
  - Alternative Energy



Other Teacher Lesson Plans (cont)

- History/Social Studies
  - The continents – view world and answer questions
  - Animated overview of Japan
  - Animated overview of Egypt

- English
  - Write and animate a poem
  - Animate a poem or scene from a story
  - Write a movie trailer

How did the Students use Alice?

- Examined worlds to see which concepts they used

TOPIC	at least once	3+ times
parameters	34%	17%
loop	57%	23%
list	45%	8%
simple event	57%	34%
4 arrow event	60%	26%
if statement	43%	11%
vehicle property	88%	46%
camera controls	80%	51%

Feedback from Parents

- “[My daughter] thoroughly enjoyed her week with you. It was a great experience!”
- “I’m convinced. Kids like Alice and Alice is a good way to teach kids programming. [My son] is doing my python course and he’s not all that interested in python and never touches it between the courses. However, in the evenings when he comes home from the Alice course, he works on his Alice worlds.”

Followup

- Teachers use Alice during the school year
- Followup 2-3 day workshop in Summer 2009

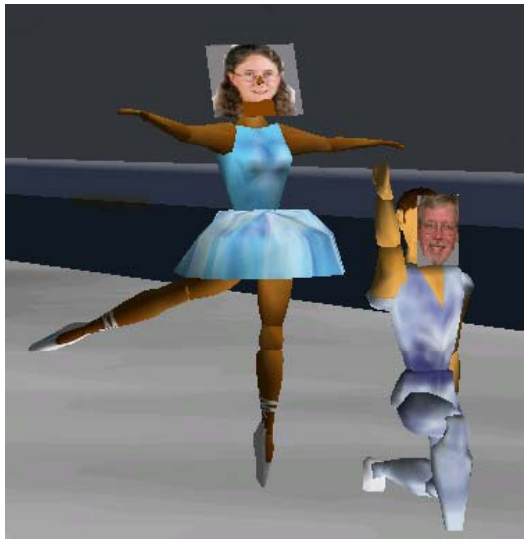
- One-week workshops in summer 2009 for additional teachers
- Possible Alice conference in summer 2009

Summarizing

- We developed
  - Tutorials
  - Examples of possible use in Middle Schools
- Teachers developed
  - Lesson Plans for history, science, math, language arts, art, and technology
  - Animation Fair
- Middle School Students
  - Were engaged, developed their own worlds
  - Animation Fair
  - Difficult to get away from the computer

All materials are on our website.

Thanks to my Alice presenters



Henry Qin, Gaetjens Lezin,
Jenna Hayes, Ruthie Tucker,
Debra Nelson and Don Slater

Web site

- Adventures in Alice Programming

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