How Scientific Inquiry Emerges from Game Design

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National Science Foundation: Innovative Technology Experiences for Students and Teachers (ITEST)

- Project: Game Design through Mentoring and Collaboration

3 year project, Fall 2007-Spring 2010

Game Design through Mentoring and Collaboration

McKinley Technology High School
Washington DC public school

George Mason University
Northern VA public university

Project Summary

- **Informal Education**

  Saturday/summer program that provides about 140 instructional hours in game design and 3-D modeling and simulation a year. We've worked with over 200 students from throughout the metro-DC area.

- **Traditionally underserved population:** Students are mainly DCPS students, about 85% African-American, majority male, aged 8-19 with average age of about 13 years.

- **Flexible:** Some students stay with the program for several years, others for just a session.

Project Summary (cont.)

- **Mentorship**

  We work closely with 25-30 high school students who serve as instructional assistants/mentors.

- **Studio atmosphere**

  Students spend most of the time working rather than listening to an instructor. Mentorship model allows students to work on variations of projects and still receive individualized guidance. There’s a collegial, open feeling to the classroom

- **Connections to STEM Careers and Higher Education**

  Students attend summits, go on field trips and have visits from STEM experts to connect what they do in class to “real world” opportunities.

Software we use to teach modeling and game design

- Maya Autodesk 8.5

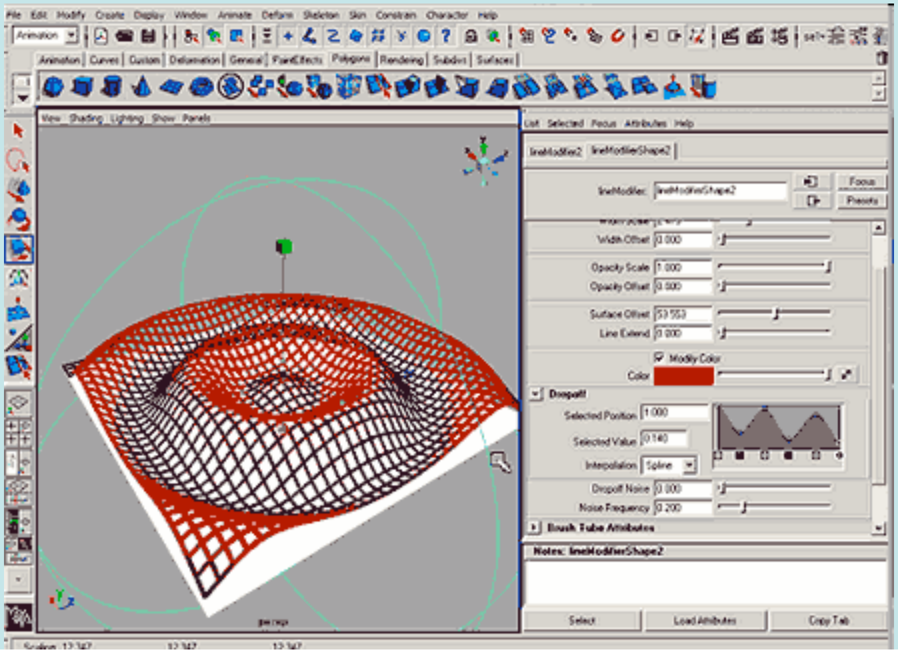
- Game Maker

Also bring in other resources (e.g. Flash, GarageBand, Alice, MissionMaker, Virtools)

Games and Learning

- **Playing games**

- **Designing games**



3-D Modeling & Simulation in Maya and Scientific Inquiry

Qualitative study

– Intensive **field observations** of students (based on field notes from over 100 hours of instruction/studio work time)

– **Interviews** with students about their learning

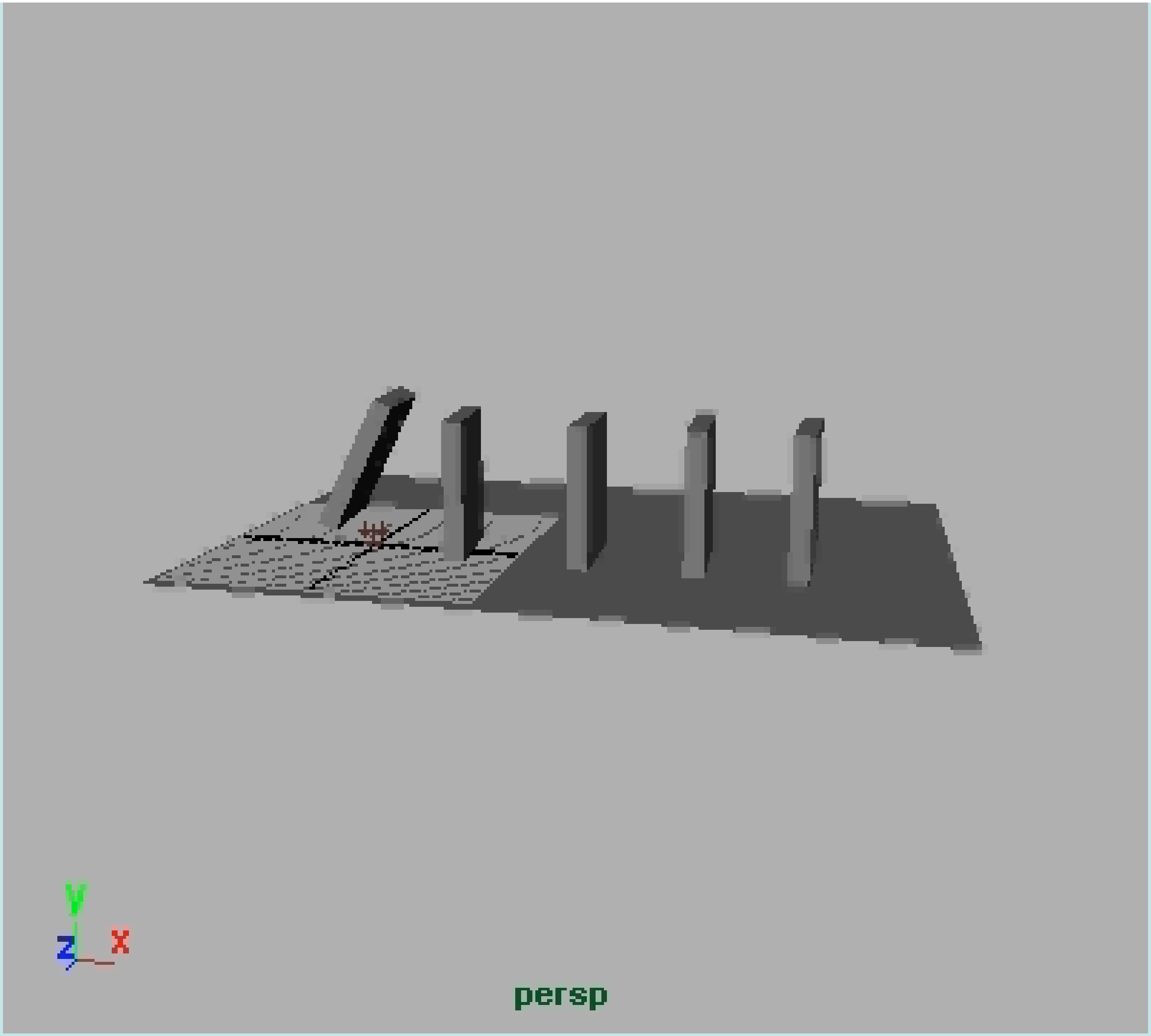
– Examination of **student work**

3-D Modeling & Simulation in Maya and Scientific Inquiry

- Dominoes example

- Catapult Example

Student extension: “Rube Goldberg” component



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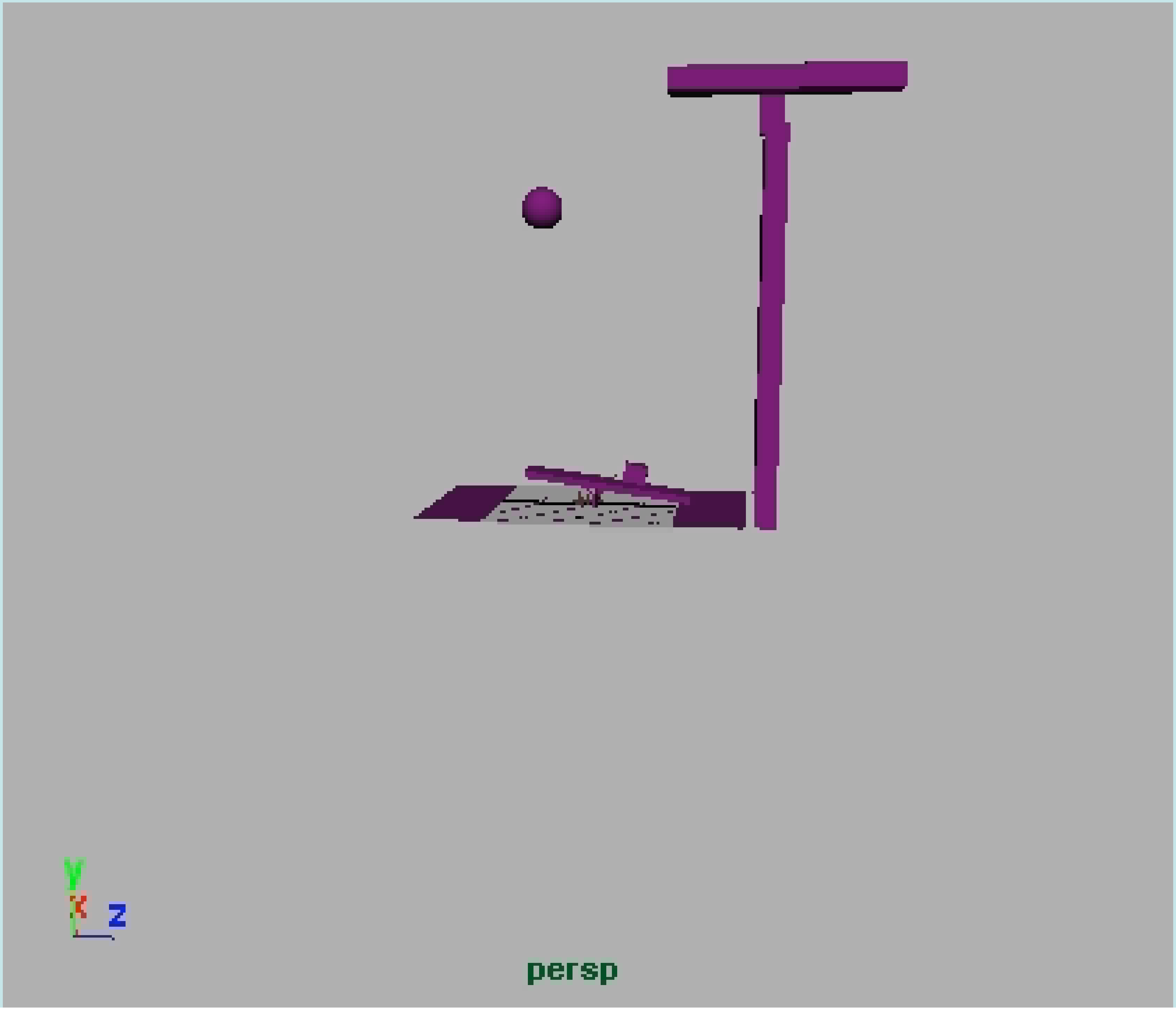
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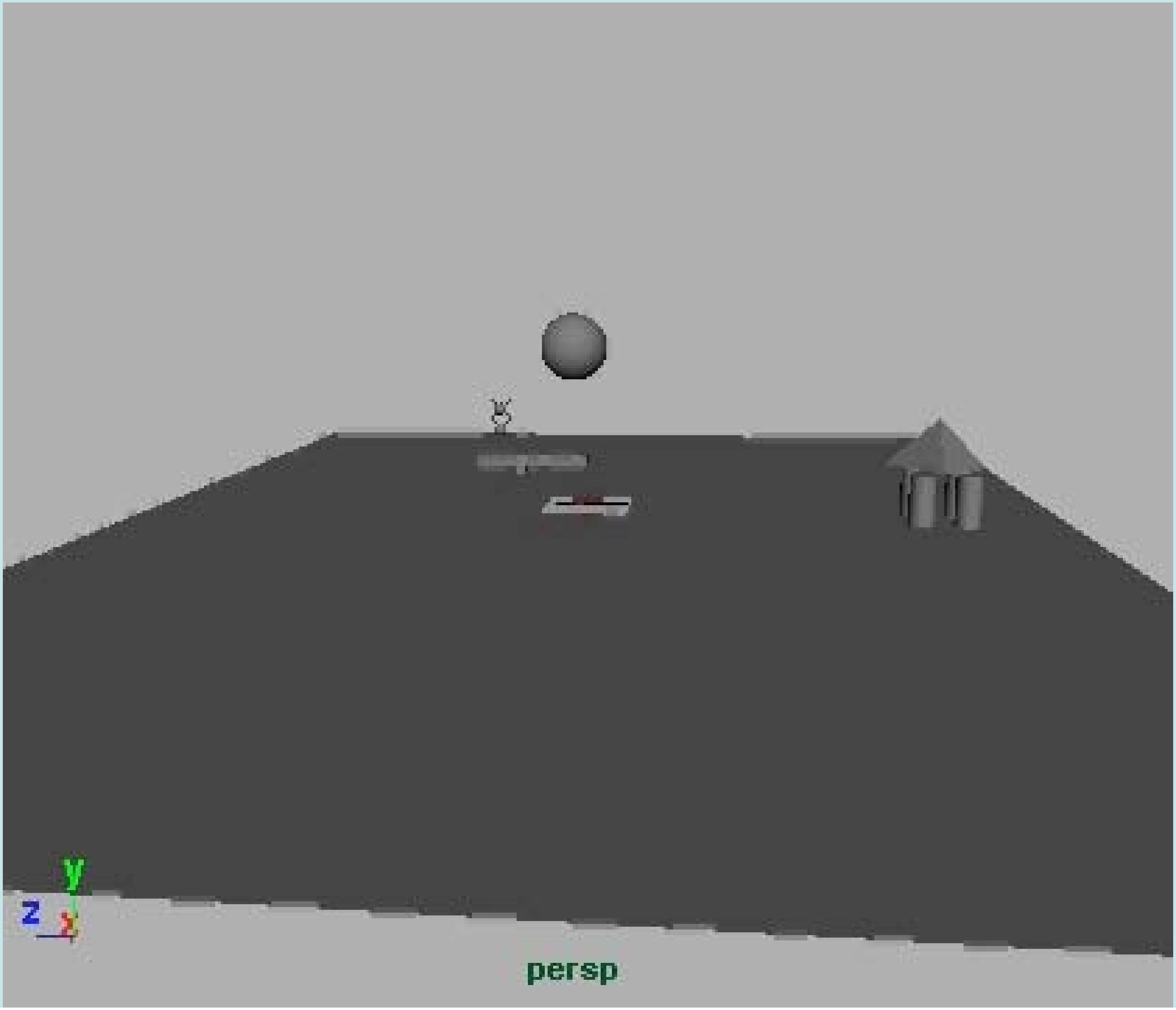
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Why we think this is powerful science learning

- **Not "officially" science**

  Students don't think they are working in physics, they are working in making a game or animation. Makes science more relevant.

- **Open-Ended Problems**

  While operating with similar constraints, each student design own approach. Can't just get answers from anyone—they need to discover what will work in their own simulation.

Why we think this is powerful science learning

- **Collaboration**

  While you can’t “get” answers from others, you can get insight from their process. We observed a lot of collaboration and shared problem solving as students worked to see how what worked in their simulation could be applied to another’s. This mirrors the collaborative atmosphere of design studios and scientific laboratories.

Why we think this is powerful science learning

- **Immediate, vivid visual feedback**

  Students are confronted with their errors and scientific misconceptions in a vivid way.

  In the demos, inappropriate application of gravity resulted in obvious visual chaos that forced students to think about gravity.

- **Impossible, improbable and extreme**

  Fosters imaginative thought experiments: In simulated worlds, you can investigate laws of physics in places that don't exist or you couldn't observe (e.g. surface of another planet).

Limitations of pure modeling/simulation approach in promoting scientific inquiry

1. Use of trial and error rather than more systematic approaches.

2. Students may not connect implicit scientific insights to formal, explicit scientific knowledge.

Scientific Principles as "Cheat" codes in game design

- **Catapult example**

  -How models/formulas for horizontal and linear velocity can improve your accuracy in animating balls from anywhere on the plane.

  -How understanding diminishing force can make your catapult bounces look more realistic.

For further information…

- Full paper in SITE 2009 conference volume:

Sheridan, K., Clark, K. & Peters, E. (2009). How scientific inquiry emerges from game design.

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