NJIT New Jersey's Science & Technology University

A Survey of Technologies that Can Be Used to Enhance Student Interest in and Understanding of STEM Disciplines

Midwest Regional Noyce Conference

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Thanks also to: C^{2}PRISM – NSF GK-12 Award 0638423 and our other supporters

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Why Use Technology in the Classroom?

Benefits:

- Adds variety
- Relevance to student lives
- Classroom management – variety
- Hands-on opportunities

Disadvantages:

- Often time consuming to learn / use; glitches during class
- Can distract rather than encourage learning
- Too many products seem to be tech for tech sake
- Lots of things out there but can take time to find

Comments on Student Motivation

Research results:

–Interest arises from grabbing the learners' attention.

–Includes humor, novelty, social interaction, and hands-on activities (Bergin, 1999).

–By offering choices students feel less external control and more intrinsic motivation (Ishee, 2005; Stone, 1995).

–More motivation → fewer discipline problems/off-task behaviors - work on topics of interest (Ediger, 2005; Mandel Morrow, 2004).

–Student sense of empowerment; Greater autonomy and self-determination (Deci, et al, 1991; Ishee, 2005; Stone, 1995).

So teacher can bring student into the loop to help choose activities, but important to keep focus on learning material not the technology.

Outline

- Background
- What we've used
  - Examples
  - Comments
  - How to get started
- Play with some of them
  - Without hands-on time difficult to get comfortable with the technology

Background

C²PRISM program

- 8 fellows and teachers in high-need district
- Bring research ideas computation and communication
- No funds for equipment
- Original plan:
  - Use (voiceover) PPT + videos to introduce fellows
  - Fellows use PPT and work with CS UGs to make flash simulations: http://web.njit.edu/c2prism/physics/Physics.swf
  - Lesson plans/products can be found at:
    http://c2prism.njit.edu or web.njit.edu/c2prism
  - Downsides: lot of work, we're not professional game designers/programmers, students well past topic by time simulations were ready

Our experience

Obtained foundation funding for equipment and workshops

–Purchased laptops for Fellows

–Purchased probes, interfaces, sensors and toolboxes

- Vernier

–Fellows & others brought other ideas to us

- Algodoo
- Pixton
- Prezi
- Geogebra
- Clickers & Mobis
- iPads

With all these there are fancy things you can do (takes more time, may cost more). We'll focus on basics – get you up to speed fast to do simple things.

Vernier (vernier.com)

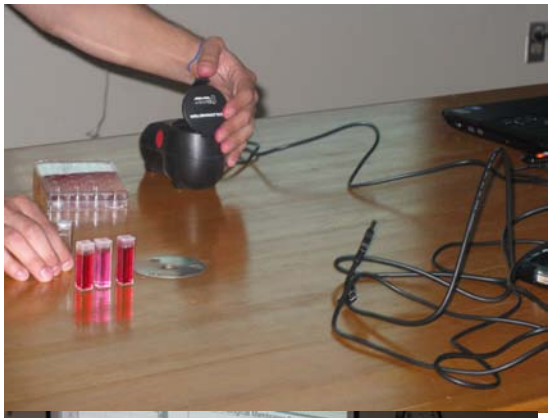
Probes, sensors and interfaces

- Perform hands-on experiments
- Obtain immediate results on computer (and certain TI-calculators)
- Can analyze results
- Can be costly, esp. if want enough for whole class
- Plenty of books, lessons available

- Accelerometers
- Anemometer
- Barometer
- Blood Pressure Sensor
- Charge Sensor
- CO_2 Gas Sensor
- Colorimeter
- Conductivity Probe
- Current Sensors
- Digital Control Unit
- Digital Radiation Monitor
- Dissolved Oxygen Probe
- Drop Counter
- EKG Sensor
- Electrode Amplifier
- Flow Rate Sensor
- Force Sensors
- Gas Pressure Sensor
- GPS Sensors
- Gas Chromatograph
- Hand Dynamometer
- Hand-Grip Heart Rate Monitor
- Instrumentation Amplifier
- Ion-Selective Electrodes
- Light Sensor
- Magnetic Field Sensor
- Microphone
- Motion Detectors
- O_2 Gas Sensor
- ORP Sensor
- pH Sensors
- Photogate
- Polarimeter (Chemical)
- Power Amplifier
- Relative Humidity Sensor
- Respiration Monitor Belt
- Rotary Motion Sensor
- Rotary Motion Sensor
- Salinity Sensor
- Sound Level Meter
- Soil Moisture Sensor
- Spectrometers
- Spirometer
- Temperature Sensors
- Turbidity Sensor
- UV Sensors
- Voltage Probes
- Wireless Dynamics Sensor System

Vernier

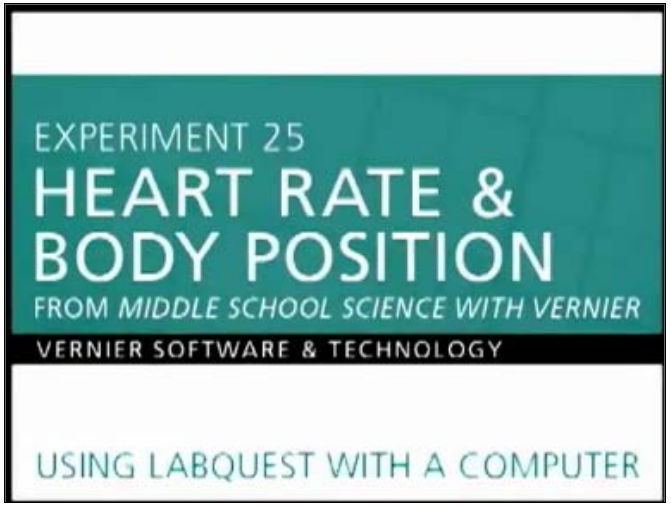
Once Vernier is set up, doing many simple experiments is relatively straightforward.

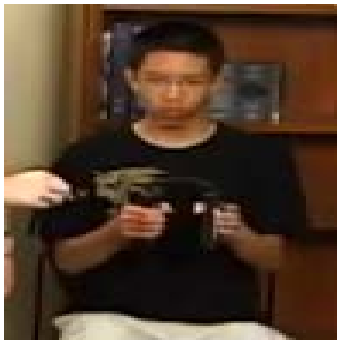


Vernier

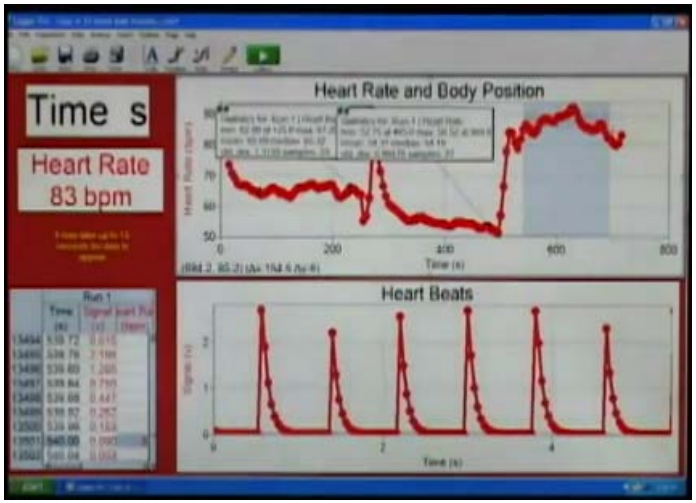
Vernier Software & Technology is an educational software and equipment company based in Portland, Oregon that produces sensors and graphing software for use in science education. Vernier utilizes sensor technology known as "probe-ware"[or "Microcomputer Based Labs (MBL)", during laboratory experiments.

Vernier Heart rate experiment using **Logger Pro** (data-collection and analysis software)
-Handgrip Heart Rate monitor





Student holding hand grip heart monitor



http://www.youtube.com/watch?v=oLbMlBZKM5E

Now can use with ipads

- Multiple students can use
- Wirelessly collect data w/one or more sensors
- Individually analyze and annotate data
- Data saved automatically on each iPad for later viewing, analysis and reporting

Getting Started with Vernier

To start: (see handout)

- Open logger-pro
- Connect sensor to labpro or labquest mini or go link, etc.
- Connect labpro or labpro mini or go link, etc.
- The relevant graph(s) should open up.
- Click collect to collect data and stop to stop (or run til end)

There are data analysis options.

There are many more advanced things one can do – e.g. combine with video.

Rough costs:

- Books of experiments about 20 per book.
- Labquest (allows experiments in the field) $330; labquest mini $150
- Most probes run $40-$120 –
- Basic set (1 station) of probes can easily run over $1000
- Logger pro license (just one per school, $189)

Probes available today: (sorry no toolbox)

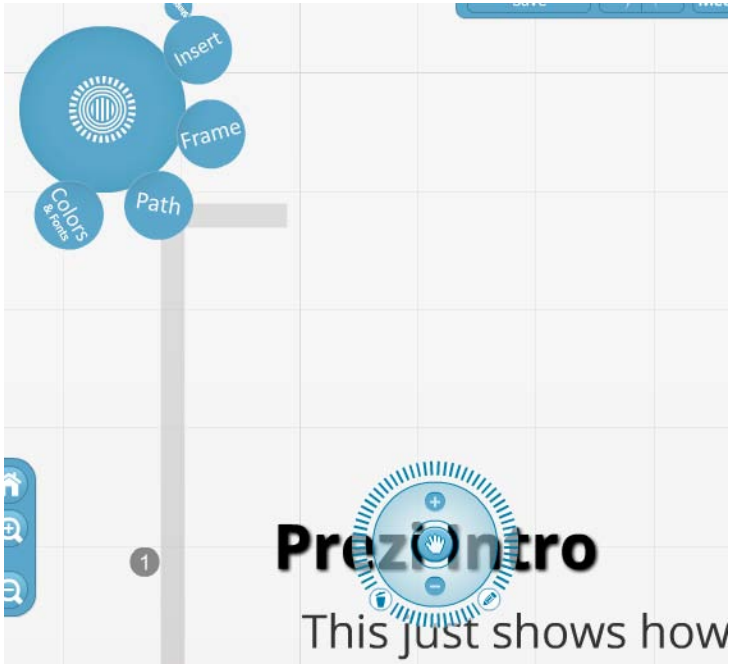
- Temperature
- Humidity Sensor
- Motion Detector

Prezi

- Very powerpoint-like
- Free but $59/year for extra utility
  - Free only allows public prezis; Saves it on their website.
  - More storage if pay
  - Can edit offline if pay.
- GK-12 samples
  - Pythagorean Theorem
  - http://prezi.com/_0qasbrcpexs/copy-of-pythagorean-theorem/?auth_key=aacfba80da4113ec46060af8e594f7ad64daf9b6
  - Complementary and Supplementary angles http://prezi.com/qm60i05waxgt/complementary-and-supplementary-angles/

Getting Started with Prezi

- (see handout) Go to www.prezi.com
- Sign up – it's free and easy and quick
- Click the learn tab to learn the basics
  - 5 minute voice over prezis to "Get Started" "Go to the Next Level" and "Share your Prezi") or
- Click on "new prezi" and jump right in.
- See very basic notes to get started on the handout.



Pixton – Comic utility

- Adds variety for students
- Provides presentation experience
- Motivates, allows students to express selves
- Visual and interactive
- Convey ideas concisely / tell story in sequence
- Can collaborate, perform project based activities
- Useful for many disciplines
- Teacher control/review/grading, etc. Aligned w standards
- Can use for free, but has quite limited utility.
- Cost is about $3/student for the whole year
- Example: Fellow introduction

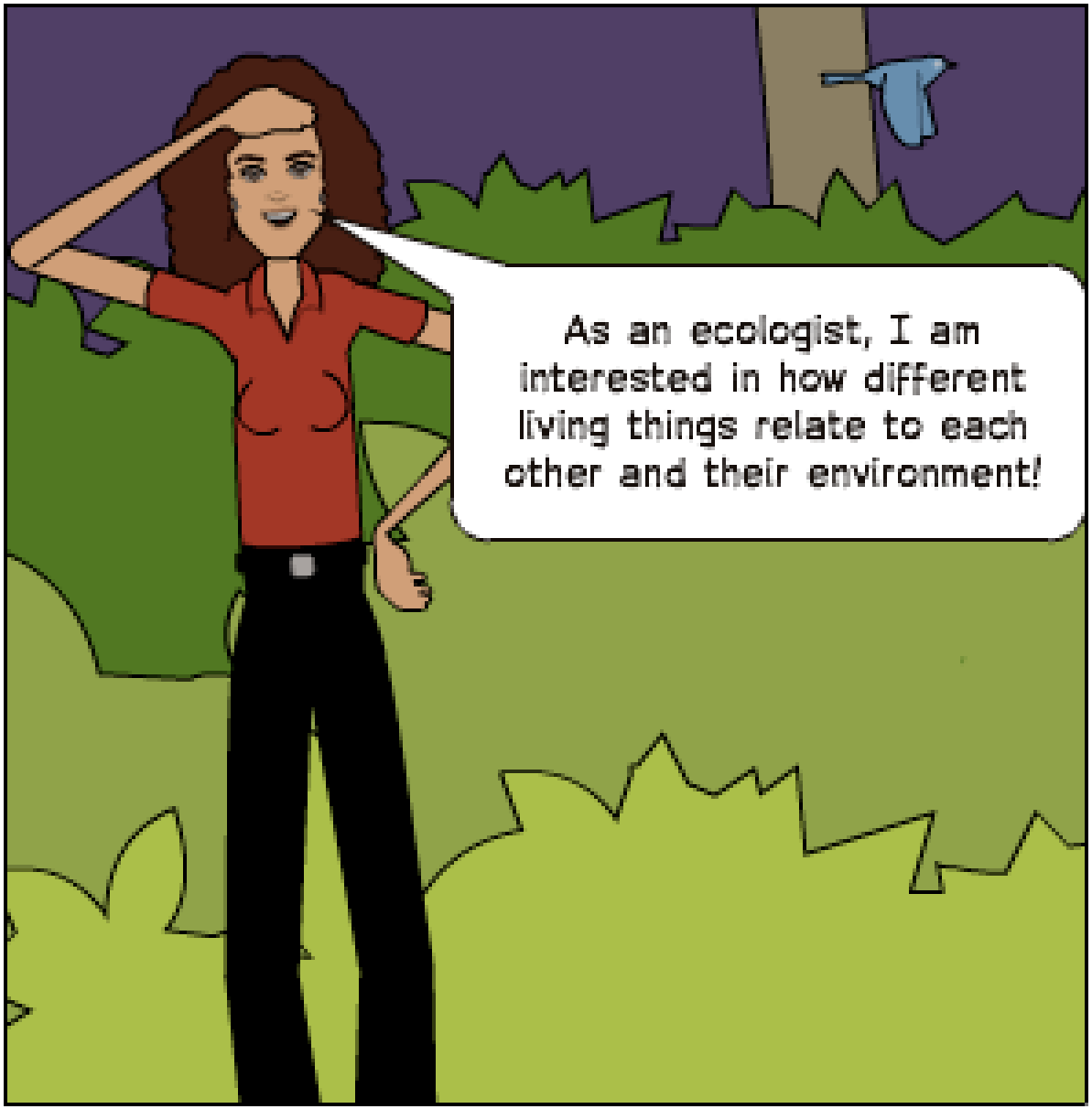

Hi there! My name is Caroline DeVan.

What images come to mind when you think of a scientist?


Definitely scientists....

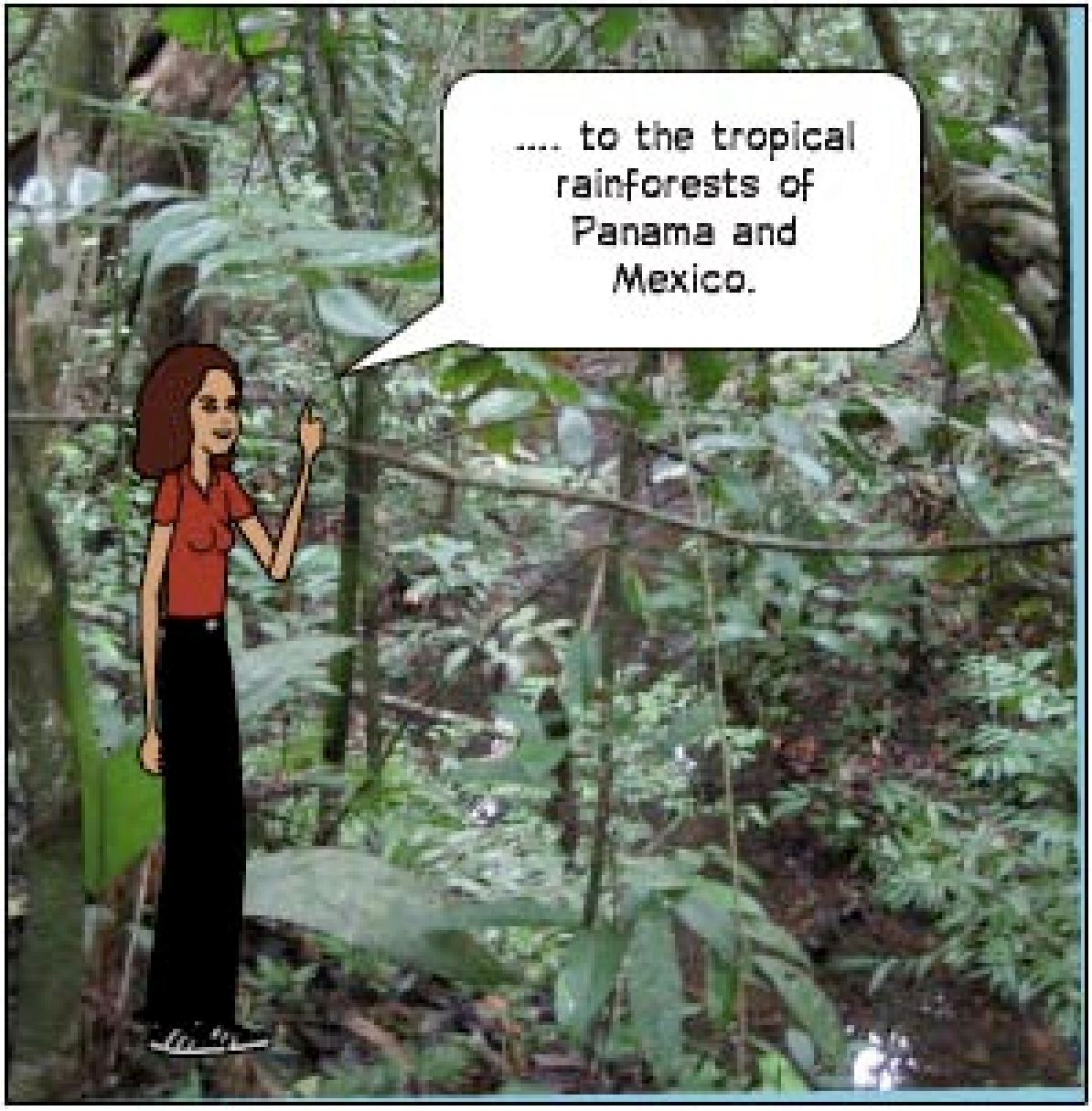

Are these scientists?

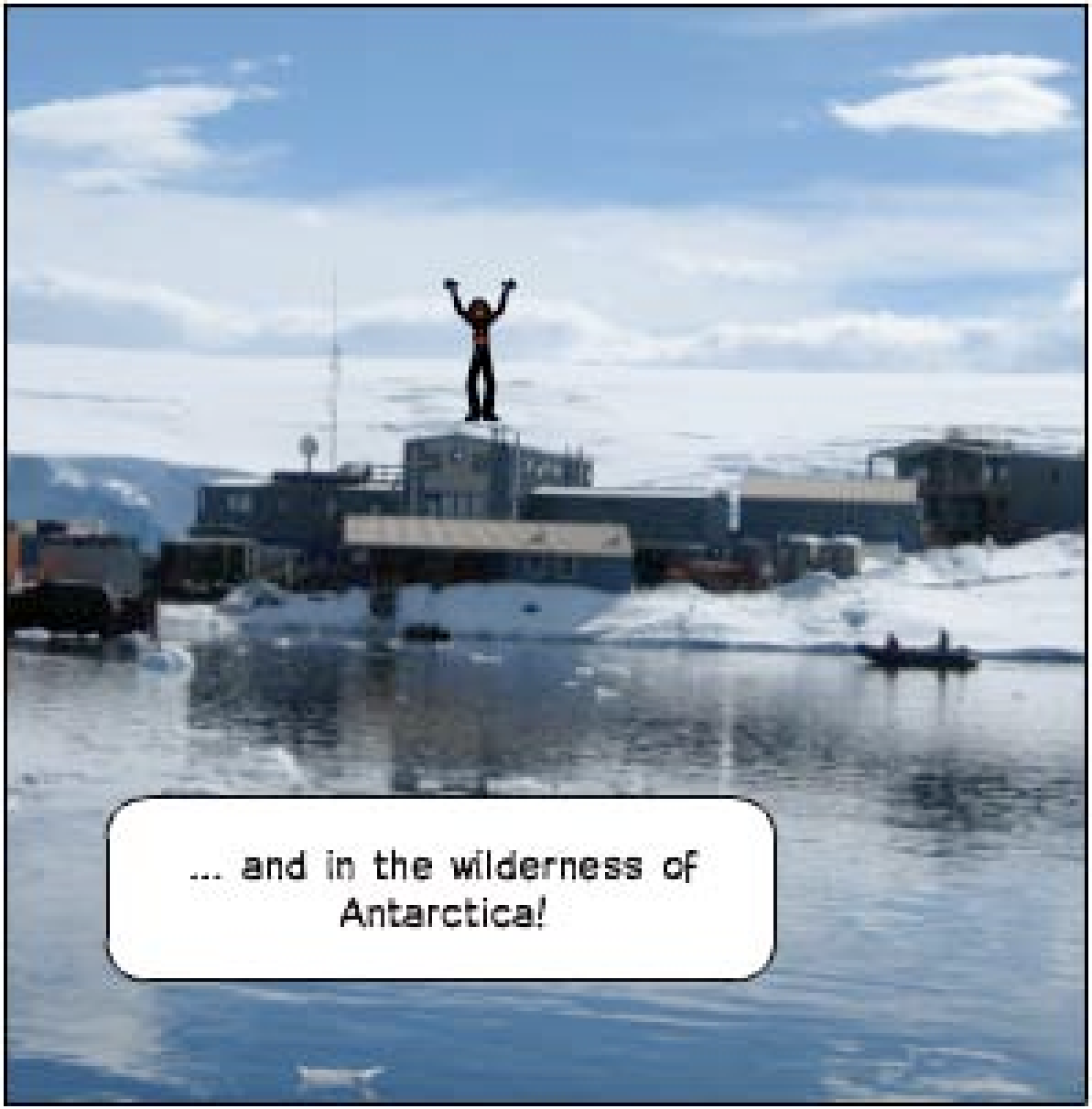

I work as a field ecologist!


As an ecologist, I am interested in how different living things relate to each other and their environment!


As an ecologist, my work has taken me around the world!


From the forests of my home state of Tennessee...


.... to the tropical rainforests of Panama and Mexico.


... and in the wilderness of Antarctica!


Now I do my research in New Jersey!

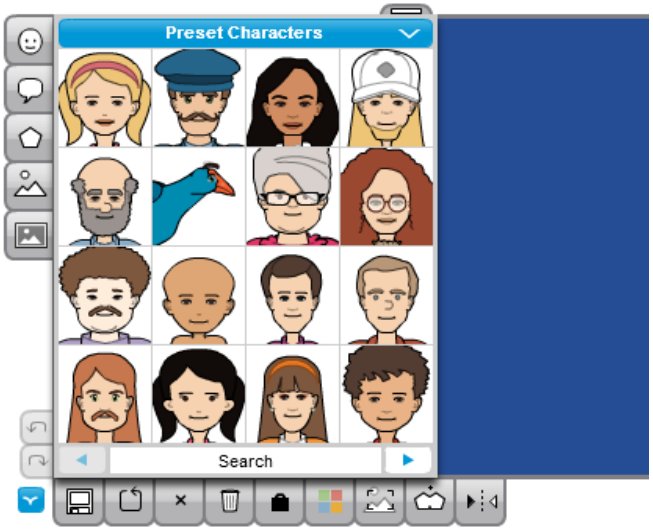

I want to know what happens to nature...

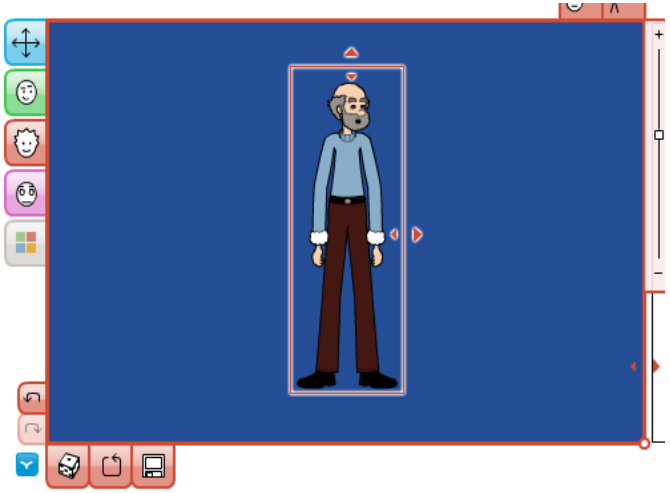

...when it ends up in the city!


Knowing the impacts of urbanization on nature can help create more environmentally friendly cities.

Getting Started with Pixton

- Go to www.pixton.com
- Click on Pixton for schools (more info) then Overview
- Click on Pixton for fun (explore now)
- Click on Create (create a comic)
- Choose a type e.g. “The Classic”
- Choose a layout; make a character, etc.





Geogebra

- Dynamic Geometry Environments:

  Cabri Geometry (France) and Geometer's Sketchpad (USA) cost $

  GeoGebra (Austria) free

- Create and explore geometric images, also has algebra, trigonometry, some calculus
  - primitive objects: points, lines, segments, vectors, circles, …
  - derived tools: midpoint, perpendicular, parallel, … transformations, reflect, rotate, translate, …
  - measurements of length, angle, and area.
- Obvious educational value
- Example: 6 squares? or do they just look like squares?

  1. Drag the vertices of each square. What do you observe?
  2. Make a conjecture about how each square was created.

Algodoo

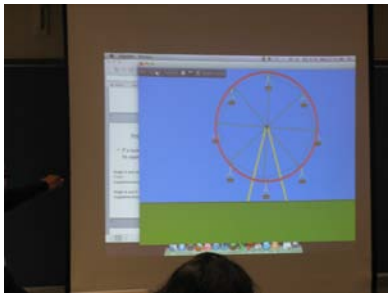
Algodoo is a 2D physics simulation environment for creating interactive scenes in a playful, cartoony manner. Algodoo is designed to encourage student creativity, and motivation to construct knowledge.

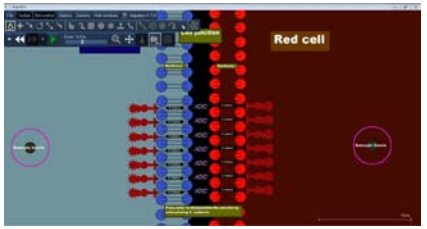
Algodoo enables experimentation without setting up and using supplies and without requiring sensors and other hardware.

Examples

Internal Combustion Engine (36 secs)

Red color in cylinder indicates combustion of gasoline in the cylinder block





Getting Started with Algodoo

- Go to www.algodoo.com
- Click on “Algodoo Play and Demo Free”
- This gives 15 hours of usage time.
- Cost: 45 euros (Algodoo for Education) or 15 euros (Algodoo Physics). Discounts for ordering multiple copies.
- Documentation is not great and some things are quite non-intuitive. Lots of advanced utilities.

Comments on Clickers and Mobis

- Teachers obtain instant feedback
- Can adjust lessons using a data-driven approach.
- Mobis enable students to have a more hands-on experience during lessons.
- Can link to exam questions
- Allows greater student participation; encourages groupwork
- Individualized or class results through semester
- Students are engaged – behavior improvement
- Costly - ~$900 for 1 teacher + 3 student mobis; $1900 for clickers

NJIT's Technology Envoy Program

NJIT New Jersey's Science & Technology University

Have an NJIT Technology Envoy visit your school to deliver a mathematics or science lesson including demonstrations using probes and sensors or computer simulations!!!

Raj Jaswal, presenting a lesson on alternative (wind) energy at East Side HS, Newark

Examples of demonstrations our students can deliver:

- **Bio-Modeling with Algodoo**
- **Understanding density using Algodoo**
- **Plant respiration**
- **Mathematics of the heart rate**
- **Calculating absolute zero**
- **Alternative energy sources – wind power**

The Technology Envoy will bring all the hardware, probes, interfaces, computer and projector to deliver a self contained lesson directly related to core curriculum standards at no expense to your school.

For more information, please contact us at:
c2prism@njit.edu, or call at 973-642-7847

Our Sponsors:

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Final Comments

- Lots of technology out there
- Some is reasonably easy to learn
- Some is even pretty easy to use to enhance education

Now let's play!!

Thank You for Coming

May the Power of Math be with You!!

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