

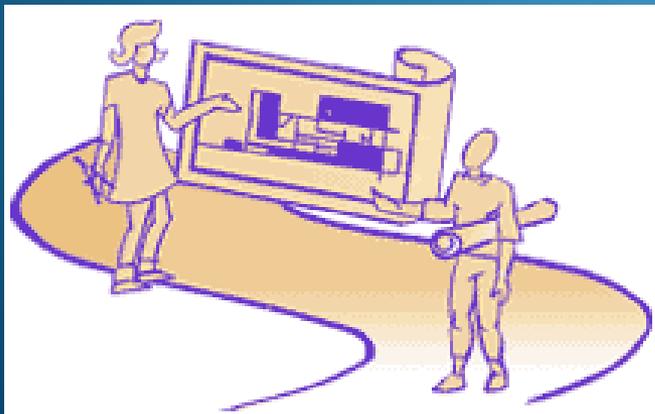
Interdisciplinary Learning: Using Educational Software in the Classroom

LA-SiGMA RET

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Classroom Technology

- For several years researchers have gathered information on factors affecting student retention and concluded that student determination requires a strong academic background, achievement of good grades and academic motivation.
- Using audio-visual materials in the classroom is nothing new and educators have recognized the power of audio-visual materials to capture the attention of learners, increase their motivation and enhance their learning experience.

Classroom Technology

- The use of educational video and television in classrooms has risen steadily over the past 20 to 30 years, according to a series of studies conducted by the Corporation for Public Broadcasting.
- Perhaps the most significant survey finding that supports the value of these multimedia tools, is the direct relationship between frequency of use and perceived student achievement and motivation.
- Among teachers who use video for two or more hours per week, two-thirds find that students learn more when video is used, and close to 70% find that student motivation increases.

Classroom Technology

- Mayer (2001) defined a media instructional message as a communication using words (printed or spoken text) and pictures (graphics, animation or video) that are intended to promote learning.
- Hoey and Manning (2005) indicated that “this generation (the Millennial-born 1982-2002)” has used some type of technology such as educational software and computer games.
- In general, instructors use media in the teaching process and plan to organize instructional procedures and generate authentic assessments of student learning.

Technology Learning at BRCC

- Traditional learning methods typically focus on one learning style at a time, but the integration of multimedia in the classroom addresses the issues of learning differences and styles.
- **In this project** “effective use of media instruction” that all authors pointed out along with **specialized software** will be applied to physics and engineering topics.
- Physics and engineering at BRCC often suffers from the perception that it is boring and in some cases unconnected to real life situations.

Benefits of Technology Learning at BRCC

- By using graphics, audio, and interactive activities, utilizing specialized software with multimedia instruction can fit a range of interests and learning styles, including the visual, the auditory and the experimental.
- Specialized software opens the horizon for students to communicate and discuss science with classmates and relate more to subjects.
- The main idea is to develop dynamic real-life examples related to science subjects, where students can relate to, and at the same time understand the physics behind each concept from mathematical representation.

Specialized Software

(Video/Graph + Equation + Real-Life Example)

- In the beginning of the project, software such as *Excel* and *Matlab* were utilized to plot curves and do some basic computations ...etc. but the representation was not in real time.
- *Mathematica* software offers a new form of truly interactive presentation with its unique integration of documents, graphics and computations to modify or generate in real time, so that a presenter can adjust parameters or controls on the fly and the audience can immediately see the result.
- It was decided at the end to use *Mathematica*, and its dynamic capabilities, makes it reachable to generate compelling visual material for any subject with some knowledge of the coding language.

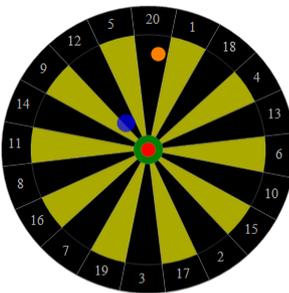
Sample Activity: Projectile Motion

Dart Practice

distance
velocity
angle

jitters

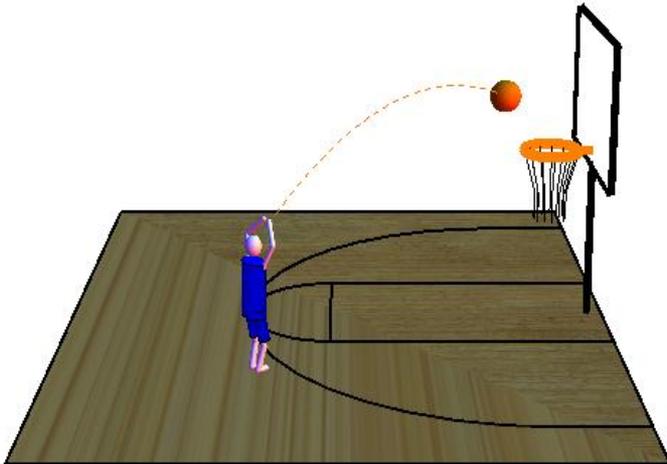
dart 



throw

speed (feet/sec)
angle (degrees)

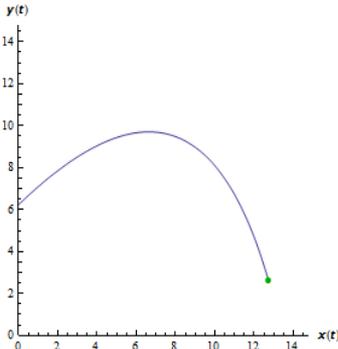
shoot



Animated Projectile Motion

initial velocity
initial angle
initial height
gravity
drag coefficient

animate



Animated Projectile Motion
Wolfram Demonstrations Project

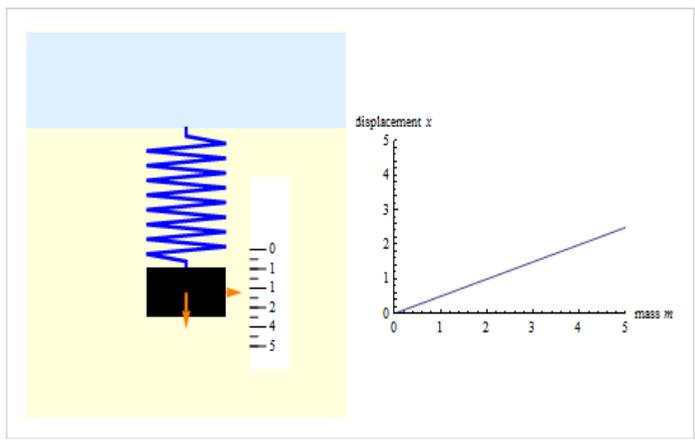
Sample Activity: Hooke's Law

Hooke's Law

Wolfram Demonstrations Project demonstrations.wolfram.com »

Hooke's Law

mass m 4.45
constant k 2.01



The diagram shows a blue spring attached to a black mass, which is suspended from a light blue ceiling. A vertical ruler is positioned to the right of the mass, with markings from 0 to 5. The mass is currently at the 1 mark. To the right of the diagram is a graph with 'displacement x ' on the vertical axis (0 to 5) and 'mass m ' on the horizontal axis (0 to 5). A blue line starts at the origin (0,0) and passes through the point (5, 2.5), representing a linear relationship between mass and displacement.

Springs in Parallel and in Series

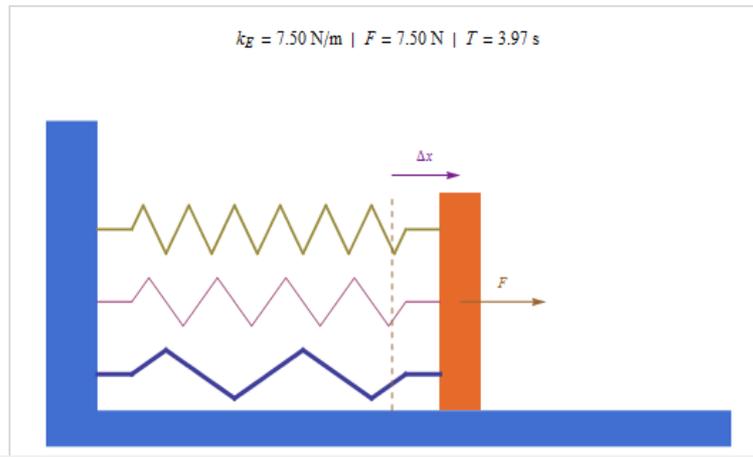
Wolfram Demonstrations Project demonstrations.wolfram.com »

Springs in Parallel and in Series

connected in series parallel
number of springs 2 3

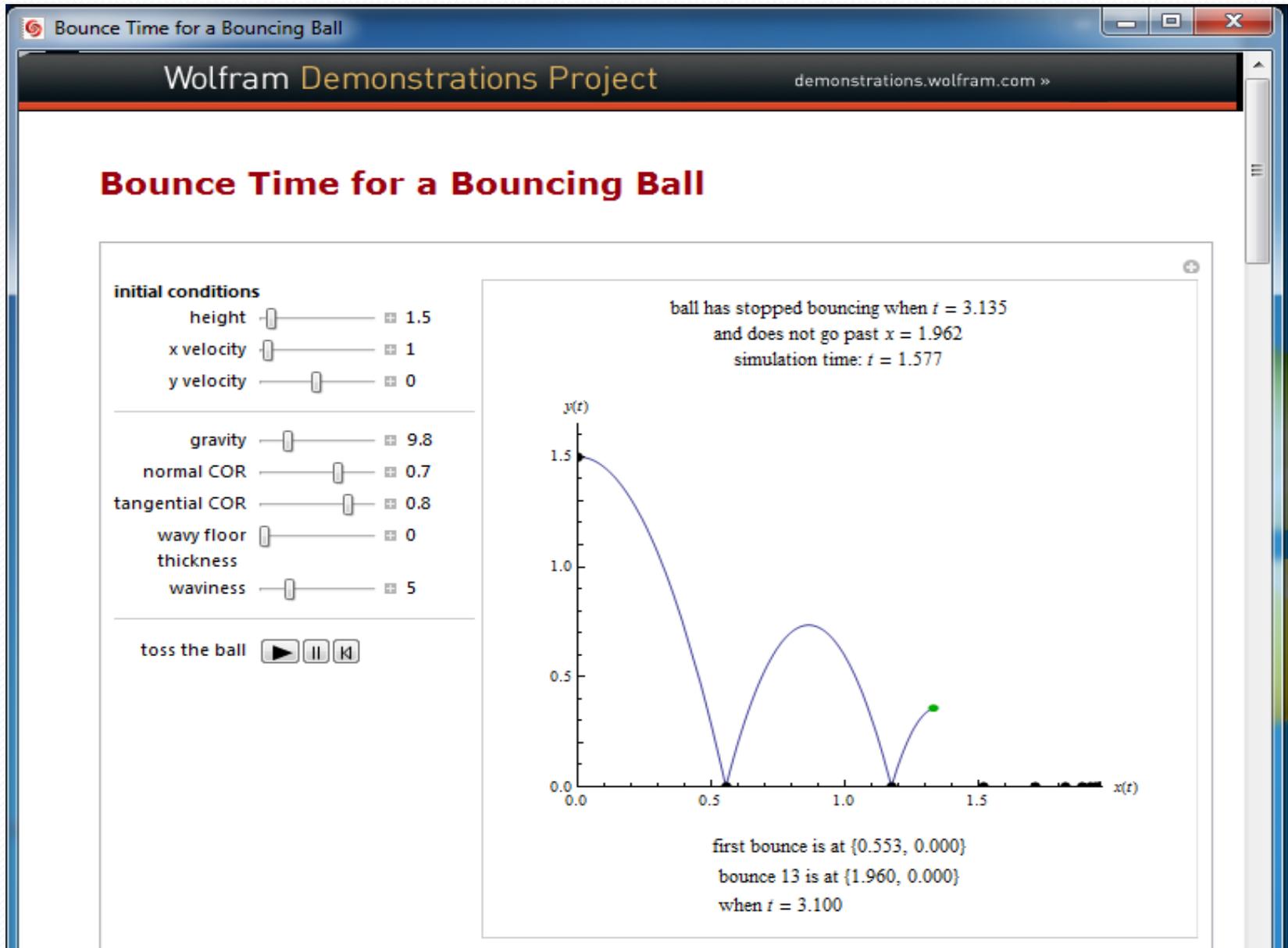
Δx 1.0
 k_1 2.0
 k_2 2.0
 k_3 3.5
 m 3.0

$k_G = 7.50 \text{ N/m} \mid F = 7.50 \text{ N} \mid T = 3.97 \text{ s}$



The diagram shows three springs (green, pink, and blue) connected in parallel to a blue vertical wall on the left and a blue horizontal base on the bottom. An orange vertical bar is attached to the right ends of the three springs. A purple arrow labeled Δx points to the right from the top of the orange bar, and a brown arrow labeled F points to the right from the middle of the orange bar. The springs are shown in a compressed state.

Sample Activity: Restitution



Sample Activity: Impact

Inelastic Collisions of Two Spheres

Inelastic Collisions of Two Spheres

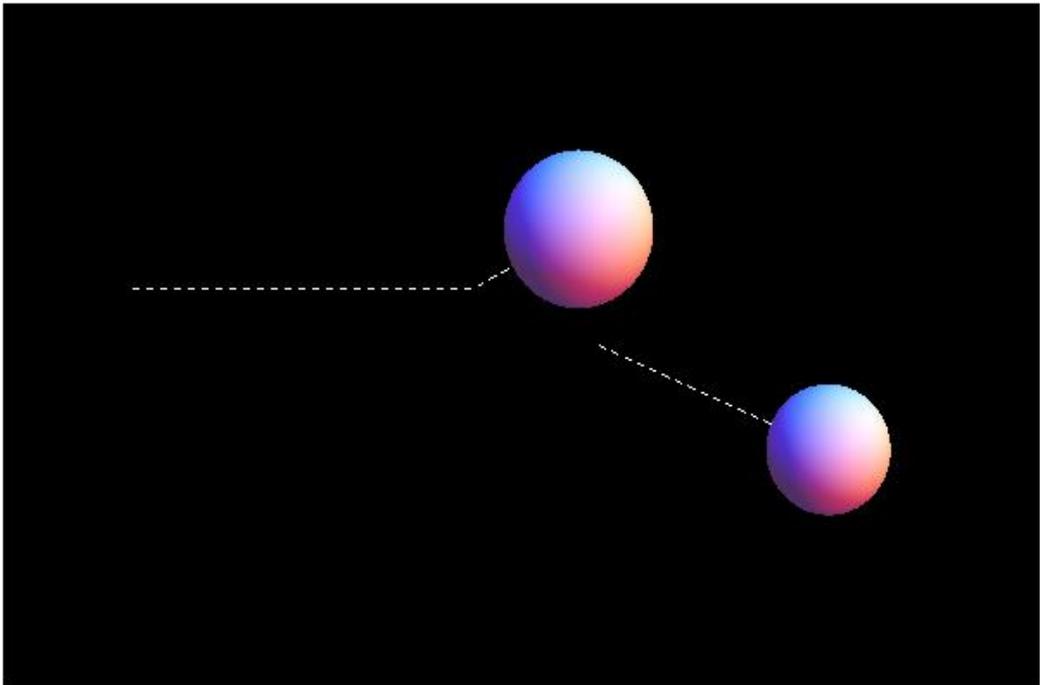
time

coefficient of restitution

relative mass

impact parameter

reference frame



The simulation displays two spheres, one larger than the other, on a black background. Dashed lines indicate the trajectories of the spheres, showing they are moving towards each other. The larger sphere is positioned higher and to the left, while the smaller sphere is lower and to the right.

Sample Activity: Conservation of Energy

Olympic Pole Vaulting

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Olympic Pole Vaulting

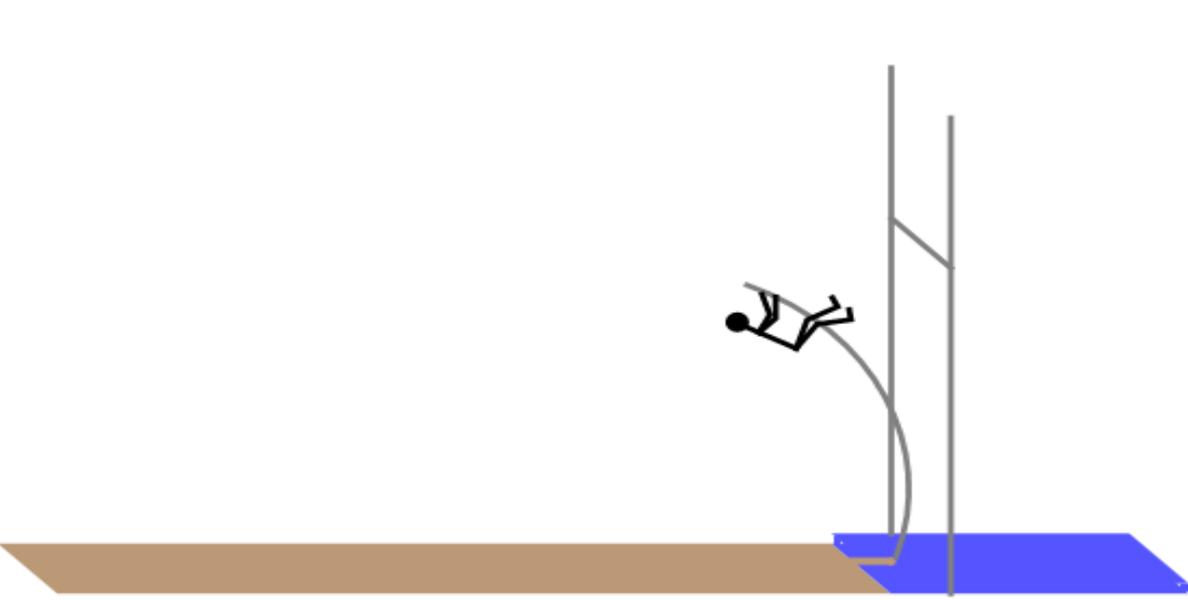
height of vaulter (m) 1.7

running speed (m/sec) 9

height of bar (m) 5

sequence of action

animate



Sample Activity: Newtonian Mechanics

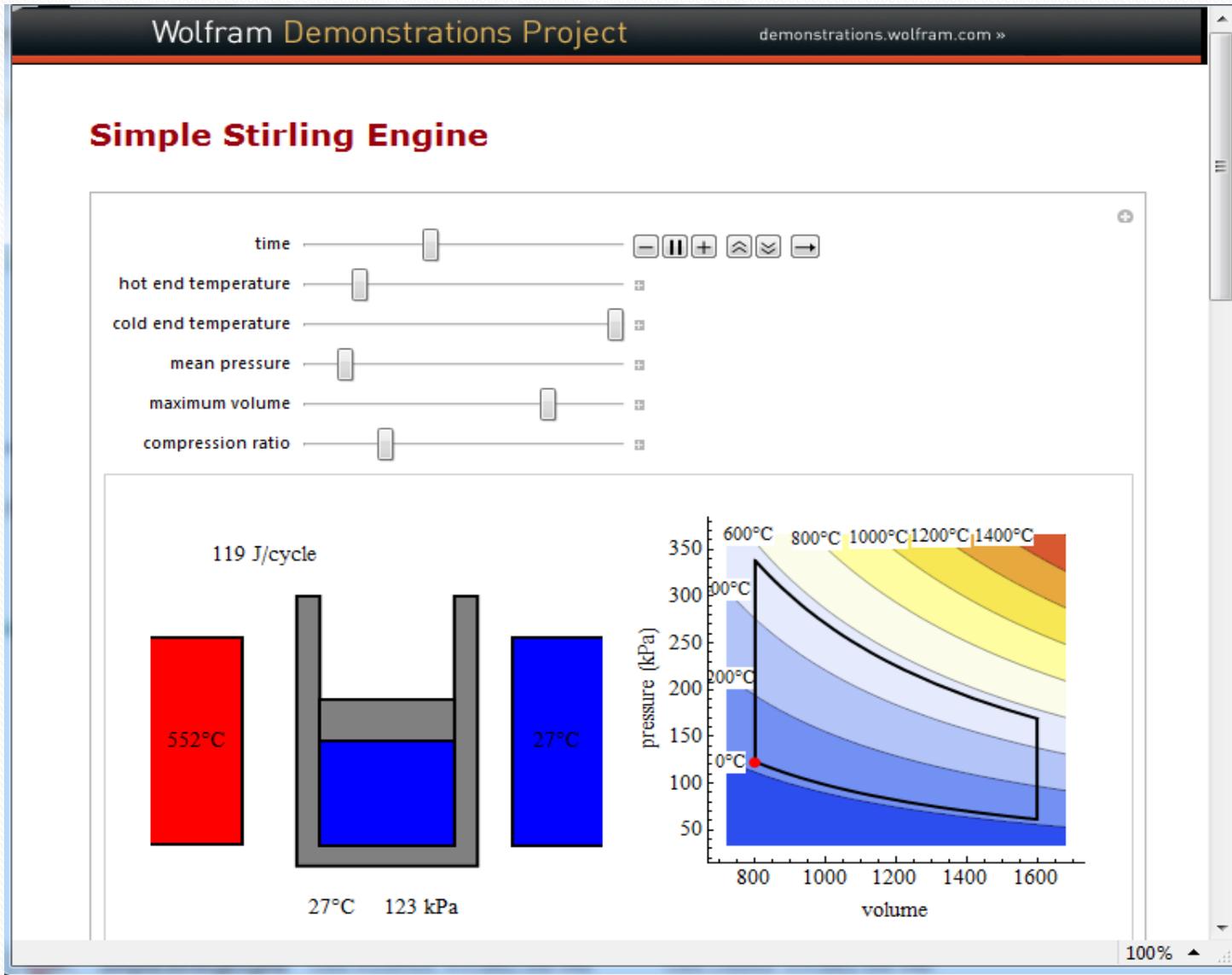
Atwood's Machine

The simulation interface includes the following controls and data:

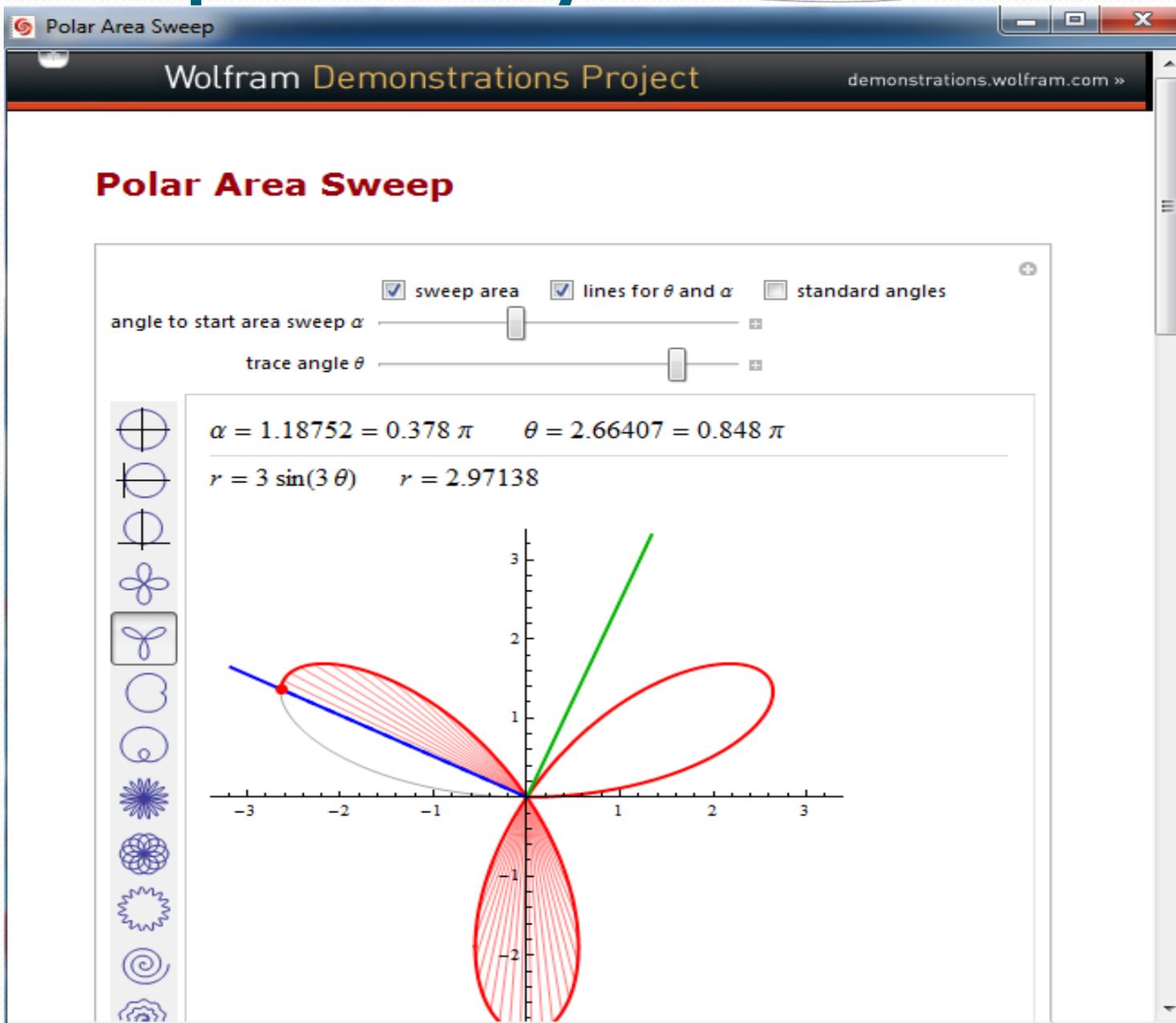
- mass on the left in kg: 0.2
- mass on the right in kg: 0.5
- time: play, pause, and stop buttons
- Reset and Play button
- acceleration: 4.2 m/s^2
- distance traveled: 0.83 m
- time to fall: 0.714 s

The diagram shows a purple pulley at the top with a black dot at its center. A red square mass labeled '0.2' is suspended on the left side of the pulley, and a larger red square mass labeled '0.5' is suspended on the right side. A green horizontal line is positioned at the bottom of the simulation area.

Sample Activity: Stirling Engine – PV diagram



Sample Activity: Mathematics



Concluding Remarks:

We have the confidence that demonstrations of some subjects in engineering and physics using *Mathematica* will:

- Aid in the development of a common base of knowledge among students.
- Enhances student understanding of certain subjects and will increase in-class discussions.
- Increases student motivation and enthusiasm and consequently the retention rate.
- Provides greater accommodation of diverse learning styles.
- Promotes teacher effectiveness and creativity.

Future Work

- In the process of implementing through the source code of each activity, dynamic equations and to display the main symbolic equation/s in order for students to visualize the change in parameters while playing the videos.
- Learning extensively the coding language in *Mathematica* will allow one to have the flexibility of creating other interesting ideas.
- Statistical analysis need to be done in the classroom to evaluate the success of this method on the understanding of students.
- Add more activities in other subject in the STEM discipline.

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