Knowledge in Action
AP Physics I Syllabus

Course Driving Question

How can we use physics to creatively solve problems and understand the world?

Course Introduction

This AP Physics I class is intended to meet the same objectives as a first-year college course. However, when compared to other AP Physics I classes, this course is unique in its project-based learning (PBL) approach. While PBL takes many forms, our approach involves student investigations and simulations that require students to *think* like scientists, science advisors, accident investigators, and real-world professionals. Teachers engage students in collaborative problem-solving, argumentation, and deep exploration of the concepts and principles of the discipline. The aim of the PBL approach to the course is to promote deep understanding and meaningful learning through action-based experiences.

Students work collaboratively and individually on tasks and products that are designed to help them succeed at solving complex, authentic challenges. They alternate between two types of projects in this course: 1) investigation projects; and 2) design projects. Investigation projects engage students in investigative work. For example, students investigate whether selected movie scenes are accurate by investigating the physics of motion. On the other hand, design projects engage students in design work that might have them building an ancient Roman arch and detailing the physics of procuring, moving, and building the arch.

Textbook

This course was designed using the OpenStax College Physics textbook. This text is produced by OpenStax and licensed under a Creative Commons Attribution License 4.0 license. As a result, this textbook can be accessed for free. Use the information below to access the textbook.

OpenStax, College Physics. OpenStax CNX. Jan 13, 2017 http://cnx.org/contents/031da8d3-b525-429c-80cf-6c8ed997733a@9.58.

Assessments

Over the course of each project, students will have periodic checks by completing project logs. In addition, there is a summative test at the end of each project that includes both free-response and multiple-choice questions. Each project cycle also contains a performance task that may take the form reports and presentation of authentic products.

Course Outline

The projects have been sequenced to build and deepen students' understanding of these concepts over the school year. For example, kinematics is a focal concept in the course that is taught in both the Reel Physics and Sticks and Stones projects. Students learn about one-dimensional motion as they analyze movie scenes in Reel Physics (the first project), and expand their understanding of kinematics in Sticks and Stones (the fourth project) to include two-dimensional motion through the exploration of the motion of ancient tools (i.e., the atlatl, bow and arrow and slingshot). This process of introducing a core concept in an earlier project (e.g., one-dimensional motion), and re-visiting and expanding the concept in later projects is known as “looping”.

Project 1: Reel Physics	
Project Description	In this project, students are in role as Hollywood Science Advisors who are tasked to answer the driving question, "*How real are Hollywood stunts?*" Students work in teams to evaluate clips from real films for physics accuracy and then propose solutions to inaccurate representations of motion. They learn about the principles of motion and use a software program to discern whether the scenes are, in fact, inaccurate. In the process, students learn how to both read and present data on graphs, and justify their suggestions using equations.
Driving Question	How real are Hollywood stunts?
Performance Task	Pitch to Screenwriters
Student Role	Hollywood Science Advisor
Duration	3.5 weeks
Content Covered	• One-Dimensional Motion • Kinematic Equations • Descriptions of Motion • Motion Graphs
Investigations	**Investigation 1 – Basics of Motion** Objectives: Students collect their position/time data and construct a graph. Explanation: Using video analysis software students analyze their selected scenes and collect position time data. While collecting the data students investigate the difference between position, displacement, and distance. **Investigation 2 – Descriptions of Motion** Objectives: Descriptions of motion: strobe, vector, written, graph (x/t) Explanation: Students simulate ticker-tape data for speeding up, slowing down, and constant speed. They then use varying representations to describe the motion. **Investigation 3 – Average vs. Instantaneous Speed** Objectives: Average Speed, Instantaneous Speed and Velocity. Calculate average speed. Draw velocity time graphs. Explanation: Using ticker-tape data and motion graphs, students investigate the difference between average vs. instantaneous speed. **Investigation 4 – Motion Graphs and Acceleration** Objectives: Calculate average acceleration, and draw acceleration/time graphs. Explanation: Students use a motion detector and roll a cart up and down a track. They then analyze a velocity/time graph and determine the carts acceleration. **Investigation 5 – Free Fall Motion** Objectives: Understand the basics of free fall motion in one-dimension, including motion graphs. Explanation: Students are given a sample of a free-fall motion scene. Students use Vernier software to analyze the scene and determine the value of g and investigate various free-fall motion graphs.

	Investigation 6 – Kinematic Equations Objectives: Understand and be able to use the basic motion equations. Explanation: Students work through an investigation that helps them derive the kinematic equations. This is followed up by formal instruction and problem solving practice.
Materials	LoggerPro (Vernier) Video Analysis software Vernier Motion Detector Computers Timers Meter sticks Dynamic carts Low friction tracks Vacuum Chamber (if available) Poster and/or chart paper Post-it notes

Project 2: When in Rome	
Project Description	In this project, students are in role as Ancient Roman architects (civil engineers) who have been tasked with designing original triumphal arches for Emperor Augustus, answering the question, "How can you design an arch that best pleases the Emperor?" As students learn about the physics concepts of force, friction, and torque, they make decisions about how to move their stones out of quarries, to the build site, and into place in the arch.
Driving Question	How can you design an arch that best pleases the Emperor?
Performance Task	Pitch to Emperor Augustus and his Science Advisor
Student Role	Ancient Roman Architect
Duration	5 weeks
Content Covered	• Forces • Newton's Laws of Motion • Vector Calculations • Friction • Pulleys and Ramps • Torque
Investigations	**Investigation 1 – Types of Forces** Objective: Understand the basic concept of a force and investigate different types of forces. Explanation: Students perform a series of small investigations to help categorize different types of forces. Students should understand that forces are an interaction between two objects (like a handshake). The interaction results in a push or pull. They should be familiar with the different types of forces that they will encounter in this project: normal force, friction, tension, gravity, and air resistance. **Investigation 2 – Mass Weight** Objective: Understand the difference between mass and weight. Explanation: Students should understand the weight of an object is just the gravitational force exerted on it. An objects mass, on the other hand, is a property

	of the object that is analogous to inertia. The property of mass does not change no matter where you are in the universe. **Investigation 3 – Second Law** Objective: Understand the concept of Newton's Second Law, including how the mass, net force, and acceleration are related to one another. Explanation: Using a spring scale and cart, students derive Newton's second law equation. Students should be able to use a force/acceleration graph to interpret the slope as the mass of the object. They should recognize the formal for Newton's second law, and be able to apply it to solve for the acceleration of an object. **Investigation 4 – Friction** Objective: Understand the force of friction and what factors affect it. Explanation: Students investigate friction using a computer simulation. Students should recognize that the static force of friction is variable and is often dependent on the applied force. The force of friction is affected by the normal force and the surfaces in contact. **Investigation 5 – Coefficient of Friction** Objective: To be able to calculate the coefficient of friction. Explanation: Using a brick-and-spring scale, students determine the coefficient of friction. Students should be able to calculate the coefficient of friction for both static and kinetic objects. Students should also recognize that the static coefficient is greater than the kinetic. Conceptually, students should understand that the coefficient is based on the surfaces in contact. **Investigation 6 – Pulley** Objective: Understand the Attwood machine and how it relates to forces and pulleys. Explanation: Students set up a basic Atwood machine. Students should understand how to draw free-body diagrams for masses attached to an Attwood machine. Using the free-body diagram they should be able to write a net force equation for the system and solve for the acceleration. **Investigation 7 – Inclined Plane** Objective: Understand the concept of an incline plane and how it relates to forces and motion. Explanation: Using a ramp, brick, and spring scale, students investigate incline planes. Students should be able to draw the free body diagram for an object sitting on an inclined plane. Additionally, they should be able to use trigonometry to solve for various components of forces. This includes objects traveling at a constant speed, and accelerating. **Investigation 8 – Torque** Objective: Understand how center of mass and torque are related to the stability of an arch. Explanation: Students use blocks to test and build a Roman arch. Students should be able to determine the general rule for when an object is rotationally stable.

	They should recognize that when the center of mass rotated past the pivot point, the object will fall over.
Materials	Wooden block arch kits: air-dry clay, or Styrofoam (1 per group) Scratch paper String Tablecloth and dishes Carts Spring scales Meter sticks Timers Access to computers for graphing (or graph paper) Skateboards or roller blades Rope Balloons Forces and Motion Basics PhET Simulations (https://phet.colorado.edu/en/simulation/forces-and-motion-basics) Small whiteboards Poster paper and markers

Project 3: Mission to Mars	
Project Description	In this project, students are in role as Entry, Descent, and Landing (EDL) engineers working for NASA tasked with answering the question, "How can you successfully land a rover on Mars?" To simulate what an EDL engineer does, students will design a rover frame, airbag, and multiple parachutes to safely drop a lander from a designated height. Prior to the final test, students will analyzing terminal velocity, energy conservation, and impulse.
Driving Question	How can you successfully land a rover on Mars?
Performance Task	Verification & Validation (V&V) Report
Student Role	Entry, Descent, and Landing (EDL) Systems Engineer
Duration	4 weeks
Content Covered	• Energy • Work • Power • Impulse
Investigations	**Investigation 1 – Air Resistance Terminal Velocity** Objective: Free body diagrams and motion graphs for objects falling in the presence of air resistance. Explanation: Students drop coffee filters over a motion detector. Students should be able to graph and interpret a velocity/time graph for an object falling and reaching terminal velocity. They should recognize that the graph becomes linear as it reaches terminal velocity, and that the acceleration eventually reaches zero. Students should be able to draw free body diagrams for object's falling in the presence of air resistance. This includes: objects in free fall, objects approaching the terminal velocity, objects falling at terminal velocity, and objects falling faster than the terminal velocity. **Investigation 2 – What Affects Terminal Velocity**

	Objective: Understanding of how cross sectional area and weight affect the terminal velocity of an object. Explanation: Students build and test various parachute designs. Students should understand that as cross-sectional area increases an object will have a slower terminal velocity. Students should understand that the greater the weight of an object the greater the terminal velocity. Additionally, they should be able to relate this idea to the free body diagram, demonstrating that a greater force of air resistance is required to balance out the greater weight of the object. **Investigation 3 – Impulse and Change in Velocity** Objective: Understand the concept of impulse and how it relates to an object's change in velocity. Explanation: Students will be able to understand impact force/time, and how it is related to the mass and change in velocity of an object. This includes understanding that greater force is needed in order to bring an object to rest in a short period of time. **Investigation 4 – Crumple Zone** Objective: Impulse and how it is related to impact force and time. Explanation: Using a force plate and crumple material, each student records landing impact data. Students should understand that in order to make their rover land safely, they should reduce the acceleration upon landing. **Investigation 5 – Work Kinetic Energy** Objective: Understand the relationship between work and kinetic energy. Explanation: Students should understand that mass and velocity are the only two factors that affect an object's kinetic energy. Students should understand that work changes the kinetic energy of an object. In order to change an object's energy, a force must be applied on the object over a distance. **Investigation 6 – Work Gravitational Energy** Objective: Understand the relationship between gravitational energy Explanation: Students should understand that the only factors that affect gravitational energy are mass and height. Students should also recognize that the gravitational energy only is present for a system that contains both the lander and planet. **Investigation 7 – Conservation of Energy** Objective: Understand the conservation of mechanical energy for a closed system. Explanation: Students analyze the landing of the curiosity rover. Students should understand under what conditions the mechanical energy for a system is conserved. They should recognize that external forces acting on the system changes the total mechanical energy. **Investigation 8 – Effect of Wind** Objective: Understand the relationship between work and the direction of the force. Explanation: Students should understand how the direction of the force and

	motion of the object is related to the change in energy of the object. If a force is applied perpendicular to the object's motion, the object will turn but there will be no change (no gain or loss) in kinetic energy. **Investigation 9 – Power** Objective: Understanding power and how it relates to energy. Explanation: Students should understand the definition of power. They recognize that power represents the rate of energy change. They should be able to apply this to solving problems involving energy and time.
Materials	Mars Lander Building Materials • Hot glue • Tape • Paper • Popsicle sticks • Cardboard • Scissors/X-ACTO knife • Cutting boards • Egg cartons • Foam • String • Rubber bands • Straws Coffee filters LabPro with computer or LabQuest Vernier Motion Detector Meter sticks Ring stand with ring Masking tape Balance One 200g mass or two 100g masses (per group) Video recording equipment (1 per group) Parachute material Post-it notes For Entire Class • Force Plate (suggested from Vernier, order code FP-BTA) • 4 masses (50g each) to represent the mass of eggs. 8 masses may be useful: as one group drops, another group can be loading the "eggs" into their rover. Video camera with no moving parts (such as flip camera or old cell phone) Helium balloons Kite string

Project 4: Sticks and Stones	
Project Description	In this project, students are in role as cast members on a survival show set in the Paleolithic era, answering the driving question: "Would you have been able to survive in the Paleolithic era?" As part of this project, students will design, build and test three ancient hunting tools. As students build their hunting tools, they

	explore the concepts of projectile motion, uniform circular motion, energy, and torque.
Driving Question	Would you have been able to survive in the Paleolithic Era?
Performance Task	Survival Challenges with Tools
Student Role	Survival Show Cast Member
Duration	4 weeks
Content Covered	• Projectile Motion • Elastic Energy • Uniform Circular Motion • Rotational Dynamics • Torque
Investigations	**Investigation 1 – Elastic Energy** Objective: Understand elastic potential energy and Hooke's law. Explanation: Students build a bow, determine the elastic energy, and derive Hooke's law. Students should be able to calculate the elastic potential energy of a spring and use Hooke's Law to determine the spring constant. This includes understanding the force/displacement graph of a spring. **Investigation 2 – Projectile Motion** Objective: Understand motion graphs for projectile motion. Explanation: Using video analysis software, students analyze projectile motion scenes. Students should be able to separate projectile motion into its x and y-components. This includes understanding the motion graphs for the x and y-directions. Additionally, students should understand that one-dimensional motion from the Reel Physics project can be applied to the separate components of the projectile motion. **Investigation 3 – Bow Range** Objective: Understand how to calculate the range for projectile motion. Explanation: Using information about their bow, students determine the theoretical range. Students should be able to use the kinematic equations to solve for variables in both the x and y-direction of projectile motion. This includes being able to solve for the time in the y-direction, and solve for the range in the x-direction. **Investigation – 4 UCM** Objective: Understand the basics of uniform circular motion. Explanation: Students look at a simulation to analyze circular motion. Students should understand basic properties of uniform circular motion including: tangential velocity, centripetal acceleration, angular velocity, and centripetal force. Students should understand the center-seeking net force requirement for an object moving in a circular path. **Investigation 5 – Sling** Objective: Understand centripetal force and be able to complete basic uniform motion calculations. Explanation: Students build and test a sling and ball. Students should be able to

	draw a free body diagram for an object moving in a horizontal circular. Additionally, students should be able to calculate the centripetal acceleration, centripetal force, angular velocity, and linear velocity. **Investigation 6 – Sling Range** Objective: Understand free body diagrams for objects moving in a vertical loop. Explanation: Using the sling data, students determine the theoretical range of their sling. Students should understand how to draw free body diagrams for an object moving in a vertical circle. This includes how the net force equation changes for the top and bottom of the objects motion. **Investigation 7 – Atlatl Design** Objective: Understand torque and moment of inertia. Explanation: Students build and design an atlatl. Students should understand how torque is related to the angular acceleration of an object. Additionally, students should understand how the moment of inertia is related to the angular acceleration, and net torque. **Investigation 8 – Atlatl Range** Objective: Be able to complete rotational dynamics, and rotational kinetic energy calculations. Explanation: Using the atlatl data, students determine the theoretical range. Students should be able to use the rotational kinematic formulas to calculate and make predictions about objects undergoing constant angular acceleration. Additionally, students should understand the concept of rotational kinetic energy and how it relates to rotational dynamics.
Materials	Materials for bow: • PVC pipe • Paracord • Duct tape Materials for arrow: • Bamboo • Duct tape • Padding/foam for arrow tip Materials for sling: • Leather or other pouch material • Cord • Duct tape • Scissors Materials for atlatl: • PVC pipe • PVC L-joint • Duct tape • String • Cardboard Bathroom scale or strong spring scale Measuring tape/meter sticks

	Vernier Logger Pro software Long measuring tape for range distances Ladybug Revolution PhET Simulation (https://phet.colorado.edu/en/simulation/rotation)

Project 5: Crash Scene Investigation	
Project Description	In this project, students are in role as Accident Investigators answering the question, "How can we accurately determine what happened in a car crash?" They "loop" back to what they have learned about one-dimensional kinematics and extend that knowledge to figure out the post-collision velocity of the cars. They learn about Conservation of Momentum to determine pre-collision velocity and the force upon impact.
Driving Question	How can we accurately determine what happened in a car crash?
Performance Task	Final Accident Report & Cross Examination
Student Role	Accident Investigator
Duration	3 weeks
Content Covered	• Momentum
Investigations	**Investigation 1 – Momentum** Objective: Understand the concept of momentum, conservation of momentum, and Newton's Third law. Explanation: This is a collision investigation using carts and tracks. By the end of the investigation, students should understand the concept of momentum, including the conservation of momentum. Students should also recognize that kinetic energy is not always preserved in collisions. This investigation also covers Newton's Third Law. Students should recognize the forces during the collision are equal on both carts including cats with different masses. **Investigation 2 – Two-Dimensional Momentum** Objective: Understand the conservation of momentum for collisions in two-dimensions. Explanation: This collision investigation uses a simulation for a two-dimensional collision. This is a qualitative investigation that compares the magnitudes of the momentum separately in the x and y-directions. Students should recognize that the conservation of momentum can only be accounted for if the momentum is split into components.
Materials	Two dynamics carts and a track Timers Masses Scale Matchbox cars Butcher paper Cellphone/Digital camera

Project 6: Planet Hunters	
Project Description	In this project, students are in role as Planetary Astrophysicists who are tasked with answering the driving question, "How extreme can planets get?" Students receive data (in the form of Radial Velocity and Transit Data Graphs) on known

	exoplanets. They learn about and apply a number of physics principles: conservation of angular momentum, uniform circular motion, and the Universal Law of Gravitation.
Driving Question	How extreme can planets get?
Performance Task	Solar Simulation, Exoplanet e-book page, & Extreme Exoplanet Conference
Student Role	Planetary Astrophysicist
Duration	3 weeks
Content Covered	• Newton's Universal Law of Gravitation • Conservation of Angular Momentum
Investigations	**Investigation 1 – Kepler's Second Law** Objective: Understanding how force and energy affect the orbital motion of a planet, including how these concepts are related to Kepler's Second Law. Explanation: Students should understand how the forces and energy are related to the orbital motion of a planet around a star. This includes understanding how kinetic energy increases as the planet approaches the star, and how gravitational potential energy increases as you move further away. Additionally, students should understand how the force relates to the acceleration and change and direction. **Investigation 2 – Planetary Detection Techniques** Objective: Understand how planetary detection techniques are used to find exoplanets. Specifically, this is focused on the Doppler Effect for sound and light. Explanation: Students should understand the transit, Doppler, and direct imaging techniques for exoplanet detection. Additionally, students should understand the Doppler Effect for sound (objects moving toward or away from the observer). **Investigation 3 – Gravitation** Objective: Understand Newton's Universal Law of Gravitation and be able to use it to calculate the force of gravity acting on two objects. Explanation: Students should understand what factors affect the force of gravity. This includes understanding how the inverse square law is related to the force and distance between the objects. Students should be able to use the equation for Newton's universal law of gravitation and be able to solve for the force of gravity acting on the two bodies. **Investigation 4 – Orbital Motion** Objective: Understand how orbital motion is related to uniform circular motion. Be able to combine these two concepts to solve computational problems. Explanation: Using a computer simulation, students analyze orbital motion. Students need to be able to use prior concepts of uniform circular motion in conjunction with Newton's Universal Law of Gravitation to solve problems. This includes be able to determine the period and orbital velocity of an orbiting object. **Investigation 5 – Planet Formation** Objective: Understand the conservation of angular momentum, and how the conservation of linear momentum is related to the motion of the center of mass of a system. Explanation: Students should understand how the conservation of angular

	momentum is related to a spinning object. This includes understanding what happens to the moment of inertia as an object's spinning radius is decreased. Additionally, students should understand how the conservation of linear momentum is related to the center of mass of an object. Students should recognize that the center of mass remains stationary if all of the forces are internal to the system. **Investigation 6 – E-field and g-field** Objective: Understand the concept of gravitational fields and electric fields, and recognize the key similarities and differences between them. Explanation: Students should recognize that both electric fields and gravitational fields are governed by inverse square law relationships. Additionally, the drawn field lines are similar and represent the force acting on the objects near each particle/mass. However, students should realize that the electric field points in the direction of a positive test charge, which can either point toward or away from the particle depending on the sign of the charge.
Materials	Two dynamics carts and a track Timers Masses Scale Computers Gravity and Orbits PhET Simulation (https://phet.colorado.edu/en/simulation/gravity-and-orbits) Microsoft Sway (optional)

Project 7: Art in Motion	
Project Description	In this project, students are in role as Science-Based Artists answering the question, "How can you use physics to build a whimsical kinetic sculpture?" This project provides students with creative license to design a sculpture that meets specific physics criteria. Students' sculptures must include pendulum and spring motion, sound, and a simple electric circuit. The final task in this project is an art installation in which students build their sculptures.
Driving Question	How can you use physics to build a whimsical kinetic sculpture?
Performance Task	Kinetic Sculpture Showcase & Online Competition
Student Role	Science-based Artist
Duration	7 weeks
Content Covered	• Simple Harmonic Motion • Mechanical Waves • Simple Circuits
Investigations	**Investigation 1 – Pendulums** Objective: Understand the simple harmonic motion of a pendulum. Explanation: Using a simulation on a copter, students analyze the motion of a pendulum. Students should understand how force and energy are related to the simple harmonic motion of a pendulum. This includes recognizing that the kinetic energy of the pendulum decreases to zero as the pendulum reaches its max amplitude. Additionally, students should understand that the force of gravity acts as a restoring force constant pulling the bob back toward equilibrium position.

	Finally, students should be able to solve for the period of the pendulum using the correct formula. **Investigation 2 – Spring Simple Harmonic Motion** Objective: Understand the simple harmonic motion of a spring and mass. Additionally, write an equation for the position of an object moving in simple harmonic motion. Explanation: Students use a simulator to analyze the motion of a spring and its mass. Students should understand how Hooke's law and elastic energy is related to the simple harmonic motion of a spring and mass. This includes understanding when the kinetic energy and elastic potential energy are at their maximum values. Additionally, students should be able to write an equation for the position of an object in simple harmonic motion. Students should recognize that the position follows basic characteristics of a periodic function. **Investigation 3 – Waves** Objective: Understand the difference between longitudinal and transverse waves, including wave interference and standing wave patterns. Explanation: Students use Slinkies to analyze the motion of waves. Students should be able to identify the difference between longitudinal and transverse waves. Additionally, they should understand the concept of super position and how it relates to wave interference patterns. Students should be able to recognize nodes and anti-nodes in standing wave patterns. **Investigation 4 – Pipe Harmonics** Objective: Understand open and close end pipe harmonics. Explanation: Students use a tuning fork and pipe to study pipe harmonics. Students should understand standing wave patterns for both open and closed end pipe harmonics. This includes understanding harmonics and how to solve for the wavelength and frequency of a wave. **Investigation 5 – Circuit Elements** Objective: Understand basic circuit characteristics including voltage, current, and resistance. Explanation: Students should understand voltage, current and resistance. Additionally, students should be able to draw basic circuit diagrams. Students will use Ohm's law and understand how its variables are related. **Investigation 6 – Parallel and Series** Objective: Understand the difference between parallel and series circuits, including combination circuits. Explanation: Students should understand how the current and resistance vary for circuit arranged in parallel or series. This includes being able to calculate the equivalent resistance for parallel and series. Students should also be able to analyze combinations of circuits. **Investigation 7 – Kirchhoff Rules** Objective: Understand Kirchhoff's loop and junction rule. Additionally, understand

	how to use the concepts within circuit analysis. Explanation: Students should understand how Kirchhoff's rules apply to circuits. This includes recognizing the relationship between the conservation of energy and the loop rule, and the relationship between the junction rule and the conservation of charge. Students should also be able to use the rules to apply them to circuit analysis solving for current and voltage. **Investigation 8 – Power and Resistance** Objective: Understand electric power and the resistance of a wire; this includes the concept of resistivity. Explanation: Students should be able to solve for the power dissipated by a circuit. Additionally, they should recognize the factors that affect the resistance of a wire. This includes understanding how resistivity is related to the material of the conductor.
Materials	PhET Simulations: • Pendulums (https://phet.colorado.edu/en/simulation/pendulum-lab) • Masses and Springs • (https://phet.colorado.edu/en/simulation/mass-spring-lab) • Wave Interference (https://phet.colorado.edu/en/simulation/wave-interference) • Circuit Construction Kit (DC Only) (https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc) Slinky Tuning forks Pipes Graduated cylinders Light bulb Battery Wire Various sculpture materials: • Old electronics • Paint/spray paint • PVC pipe • String • Duct tape • Hot glue