

*School as Real Life or
The Academy without Borders
Putting Physics and
Personal Integrity in Context*

Louis Bloomfield
University of Virginia



Overview

- Physics of Real Life: *How Things Work (HTW)*
- Motivation, Structure, and History of *HTW*
- Examples of objects
 - Roller Coasters
 - Bicycles
 - Clocks
 - Microwave Ovens
- Integrity: Don't Check It at the Classroom Door

What is *How Things Work*?

- Teaching physics in the context of objects
 - Objects ahead of physics concepts
 - Physics concepts ahead of formulas and calculations
- A backward course in physics

Motivation for HTW

- Difficulties with teaching physics
 - Only one intro course: *Physics-for-Physicists (PfP)*
 - To non-scientists, *PfP* is
 - Academic
 - Unfamiliar
 - Irrelevant
 - Boring
 - Frightening
 - Neglects how science developed – in context of objects
 - Active learning, hands-on work, enthusiasm can't fix

Structure of *HTW*

- A hierarchy with three levels
 - Level 1: Areas of Physics – for the instructor
 - Level 2: Objects of Everyday Life – for the students
 - Level 3: Concepts of Physics – for both

Chapter 7. Resonance and Mechanical Waves

7.1 Clocks

(time and space, natural resonance, harmonic oscillators, simple harmonic motion, frequency)

7.2 Violins and Pipe Organs

(sound, music, vibrations of a string and column of air, higher-order modes, harmonics, sympathetic vibration)

7.3 The Sea and Surfing

(tidal forces, tidal resonances, standing waves, traveling waves, wavelength, wave velocity)

History of *HTW*

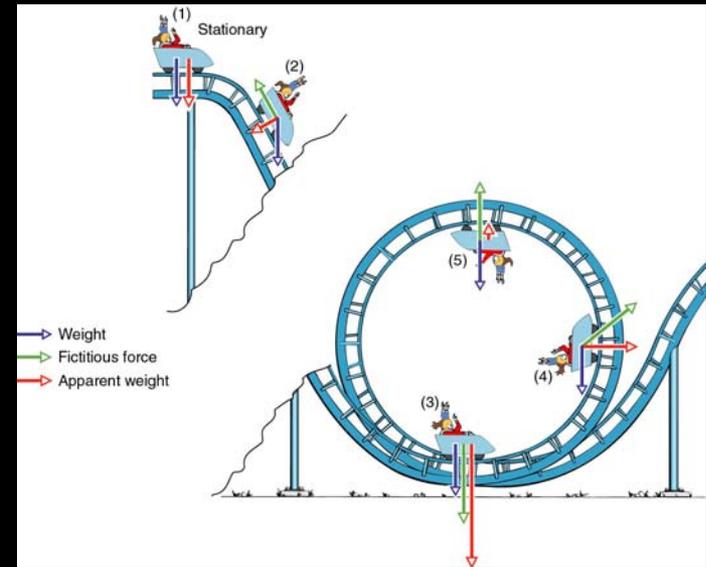
- **Design and start-up (1991-1992)**
 - Course built around everyday objects—case study
 - Custom fit for non-scientists; concepts not formula
 - Expected fall enrollment: 20-25; actual enrollment: 92
 - Spring enrollment: 262
- **Growth and development (1992-1996)**
 - Rearrangement and reduction of material
 - Enrollment grew toward 500 per semester
 - Lecture notes evolved into a book

History (con't)

- **Steady-State (1996-present)**
 - Further reduction of material to avoid a frantic pace
 - Working to stay “on message”
 - Getting students involved

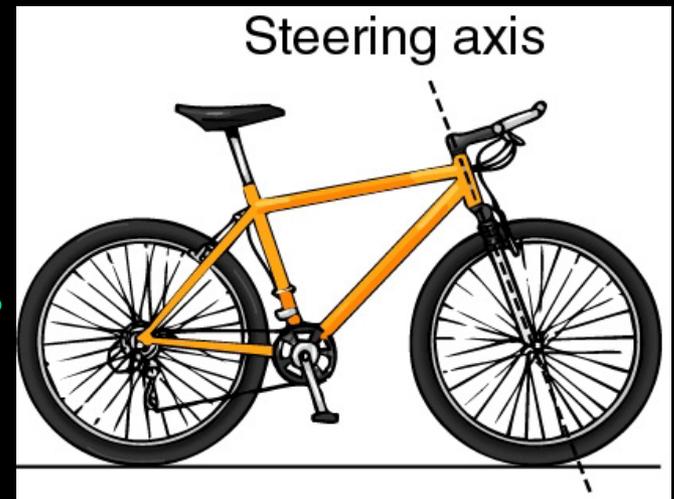
Roller Coasters

- How do loop-the-loops work?
- Physics concepts involved:
 - Inertia
 - Acceleration and forces
 - Centripetal accelerations
 - Weight and “weightlessness”



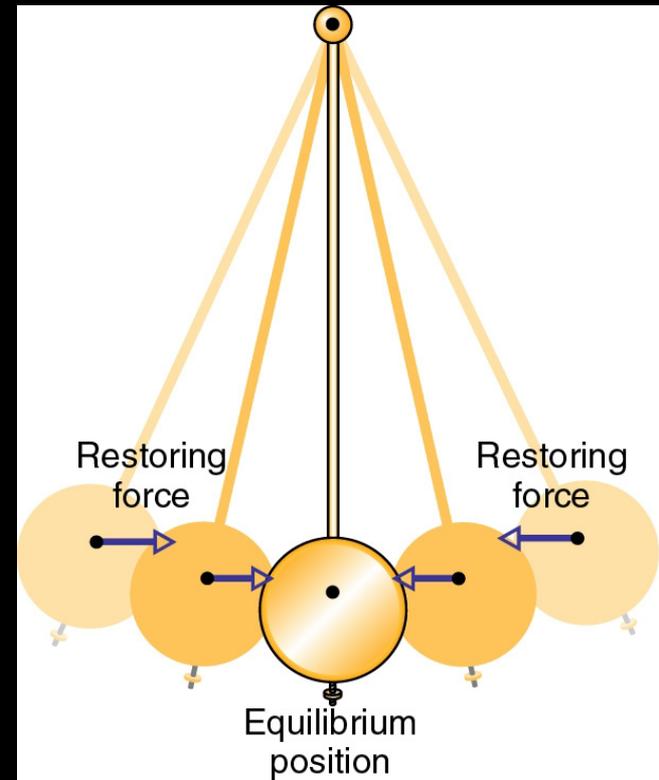
Bicycles

- Why are bicycles so stable?
- Physics concepts involved:
 - Equilibrium
 - Energy and acceleration
 - Stable and unstable equilibriums
 - Static stability
 - Gyroscopic precession
 - Dynamic stability



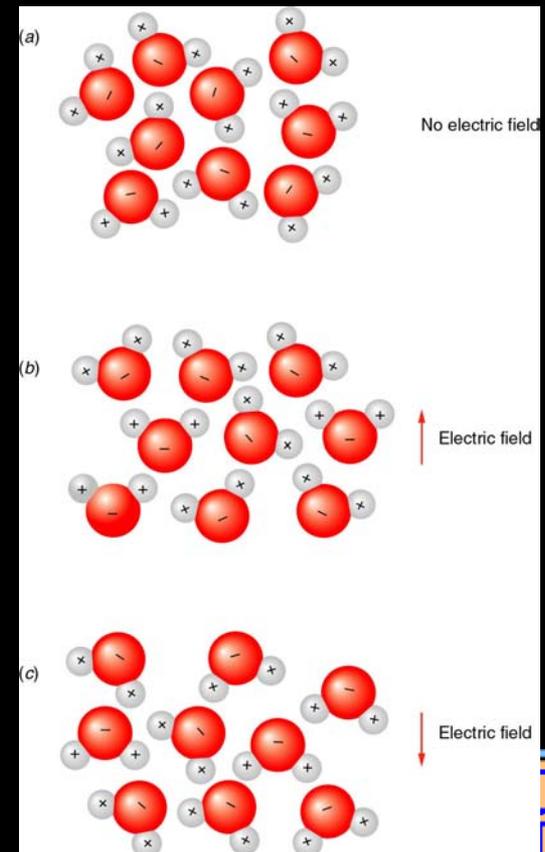
Clocks

- How do clocks keep time?
- Physics concepts involved:
 - Time and Space
 - Forces and Acceleration
 - Harmonic Oscillators



Microwave Ovens

- How do microwave ovens cook?
- Physics concepts involved:
 - Electric fields
 - Polar molecules and free charges
 - Electrostatic forces and torques
 - Electromagnetic waves
 - Wavelength and frequency



Observations about *HTW*

- Many non-scientists are now learn physics
- These students find physics useful
- Much less fear of physics – a cultural change
- Physics is now a valued part of the University
- Other physics courses are flourishing

Integrity: A Way of Life

- How to Discourage Integrity
- The Cause: Content versus Credentials
- The Effect: Stolen Ideas & Language
- A Solution: Goals and Training
- The Challenge: Eliminating Recycling
- A Recipe for Academic Integrity
- What is an Honor System?

How to Discourage Integrity

- Value Grades and Other Credentials Above All Else
- Offer No Motivation for Coursework
- Do Not Teach About Academic Integrity
- Have Unclear or Absent Rules about Academic Integrity
- Have Poor Detection or Enforcement Rate for Cheating
- Punish the Wrong People
 - Instructor (redo assignment, “2nd” chances, enforcement burden)
 - Honest Students (change assignments, particularly retroactively)
 - Both (soften rules to define away cheating)

The Cause: Content versus Credentials

- **What Society Wants from Education:**
 - **A student should**
 - acquire knowledge and skills
 - learn how to think
 - develop good work and study habits
 - learn how to get along with others
 - become a good human being
- **What Society Rewards from Education:**
 - **A student should**
 - obtain good credentials: grades, scores, and resume entries

The Effect: Stolen Ideas & Language

- **Plagiarism Reflects this Confusion of Values**
 - We want original work, but reward stolen work
- **Apparent Benefits of Plagiarism:**
 - Yields credentials disproportionate to effort
- **Real Costs of Plagiarism:**
 - Recycling serves no educational purpose
 - Dilutes and devalues earned credentials
 - Demoralizes real contributors
 - Burdens the readers with meaningless work

A Solution: Goals and Training

- **Assignments should have Educational Goals**
 - Students and teachers should both understand those goals
 - Goals are often not obvious—state them
 - If an assignment has no worthwhile goals, get rid of it
- **Credentials should Reward Education**
 - Students respond to market pressures
 - Don't reward stolen ideas & language, it reinforces theft
- **Teach Intellectual Integrity**
 - Students don't understand plagiarism
 - Students don't understand why plagiarism is wrong

The Challenge: Eliminating Plagiarism

- **Benefits:**

- Original work serves educational purposes
- Makes earned recognition and credentials meaningful
- Improves morale among real contributors
- Eliminates unnecessary work by readers
- Strengthens short-term motivations in education

- **Costs:**

- Needle-in-a-Haystack problem, but technology helps
- Requires vigilance, time, and knowledge

A Recipe for Academic Integrity

- Clear, Well-Publicized Rules
- Adequate Student Training and Education
- Good Detection & Discipline Rate for Misbehavior
- Punishment Appropriate to Misbehavior
- Recognize Goal is to Keep Honest Students Honest

What is an Honor System?

- A Contract Between Students and Instructors
- Contractual Obligations for Students:
 - to be honest in all their academic endeavors
 - to identify and punish misbehavior and not to tolerate it
- Contractual Obligations for Instructors:
 - to treat students with respect
 - to give best assignments, not cheat-proof assignments
 - to expecting honesty and relax vigilance

Honor System (con't)

- **Results of Contractual Failures:**
 - Students may lose privileges and respect of instructors
 - Instructors may lose respect of students
- **Honor Systems are Not For Everyone**