> During the Middle Ages there were all kinds of crazy ideas, such as that a piece of rhinoceros horn would increase potency… Then a method was discovered for separating the ideas—which was to try one to see if it worked, and if it didn't work, to eliminate it. This method became organized, of course, into science.
>
> -- Richard Feynman, *The Pleasure of Finding Things Out*.

Instructor: Dr. Martin John Madsen
Office: Goodrich 309
Email: madsenm@wabash.edu

Discussion: *Goodrich 104:* MWF 10:20 –11:10 am *AND* Lab: *Goodrich 205:* Thursday 8-11 am
OR
Discussion: *Goodrich 104:* MWF 11:20-12:10 am *AND* Lab: *Goodrich 205:* Thursday 1-4 pm

Introduction

I welcome you to what, I hope, will be a new type of lab science distribution course, one which is centered on the lab experience. This new model will teach you the core principle of science as described by Feynman in the quote above: to try ideas out to see if they work. This course is loosely based on methods popularized by the TV show "Mythbusters". Their model encourages critical thinking about the physical world and can be summarized by the following steps:

1. You will be presented a variety of "myths" or stories about some physical situation.
2. You will work in teams to design, build, run, and analyze experiments that will test the physical ideas central to the myths.
3. Your team will then extend your experiments, exploring the physical limits of the experiment and applying it to real-world situations.
4. Your team will then present your findings to the class (and to the world!) and make conclusions as to whether the situation described by the myth is physically plausible or even possible.

The course will teach you the skills needed to carry out these experiments. At the end of the semester, you will be asked to implement this experimental methodology in a unique team project.

Learning Objectives

After completing this course, you should be able to:

- Design experiments that test ideas about the physical world,
- Build and safely execute a variety of experiments,
- Analyze the results of your experiments, and,
- Clearly communicate the results of your experiments.

Discussion Periods

The structure of the course will be centered on the weekly lab experience. Our discussion periods will be spent 1) preparing for lab activities and 2) practicing communicating the results of your experiments. I will periodically take some time during the discussion to explain new concepts, skills, and tools as needed during the semester.

Course Materials

There will be no official textbook for the course. Instead, you will be required to bring a video camera for use during the semester. By having each student bring a video camera, we will be able to film our experiments from many angles and perspectives simultaneously, providing a richer data set for analysis and presentation. I will not require a particular make or model of camera, though the camera must have the minimum requirements listed below:

Video: 720p, 60 frames per second (not FIELDS per second)

Storage: 8 GB Format: H.264 video encoding

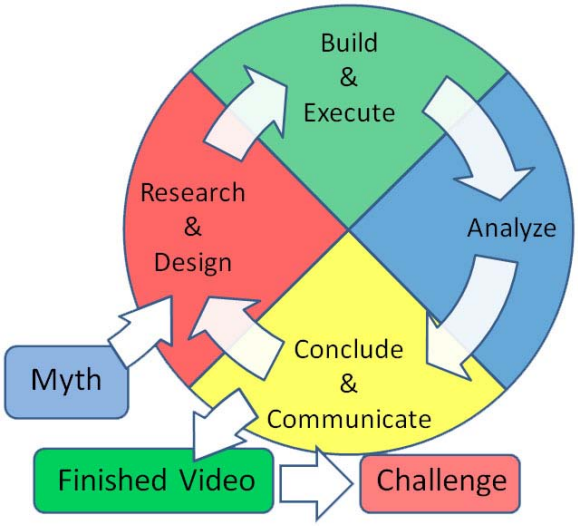
Several cameras that match these minimum requirements are listed below. If you have another camera that meets these requirements, please contact me with the make and model number so I can verify the specifications and add it to the list of possible cameras.

Kodak: Zi6 ($150) Sanyo: VPC-HD1010 ($350)

Kodak: Zx1 ($150) Samsung: HMX-R10 ($400)

Myth Structure

During the course of this semester you will be presented a series of "Myths"- activities described below that you will work through with your team. Each Myth will follow this pattern:



1. I will introduce you to the Myth.
2. Your team will work through the four stages in the Methods section described below, repeating and iterating the experiments as needed to understand and test the Myth.
3. At the end of each Myth, your team will assemble a video that clearly communicates your experiments and results.
4. Each Myth will have a "Challenge" associated with it, typically due at the end of each Myth cycle. These challenges may include a written or oral examination of the Methods, Tools, Skills, and Concepts learned during the Myth, a "commentary" voice-over for a video, a video blog entry in response to the myth, or other written or video assignment. Challenges will typically be completed individually and not in teams.
5. I will wrap up each Myth and we will watch the team videos together.

Learning Areas

There are four major "learning areas", **Methods (M)**, **Tools (T)**, **Skills (S)**, and **Concepts (C)**. You will be evaluated in your proficiency in each of these areas over the course of the semester, particularly in the Challenges.

Methods (M):

1. R&D = Research and Design, initial brainstorming session talking through what you think is happening, what the key points might be, the kinds of things you will need to measure and how you are going to approach measuring them
2. B&E = Build and Execute the experiment, starting with small scale results, then adapting your R&D based on the findings from the small-scale, then safely executing large-scale experiments
3. A = Analysis of the data, continues through both the B&E section and revisiting the R&D as results come in and experiments are run
4. C&C = Conclude and Communicate the experiment, make inductive statements based on the results of the experiment and communicate the experiment to a general audience (boss, co-workers, friends, family, etc)

Tools (T):

- Mass scale
- Force probe
- Accelerometer
- Video Capture

Skills (S):

- Graphical data analysis
- Find the slope of a line- what does it mean?
- Find the area under a curve- what does it mean?
- Sensor testing/checking
- Setting the data collection rate
- Video analysis
- Statistics
- Measurement uncertainty and significant figures

Concepts (C):

- Mass
- Velocity
- Acceleration
- Force
- Momentum Flow
- Energy Flow
- Newton's Laws

Myths

The following is a tentative schedule of Myths for the semester. This list is subject to change and modification based on how the course flows and what we are able to accomplish.

Training Myth 1: Crumple zones are designed to maximize the cost of damage to a car, not to protect the passengers.

Training Myth 2: A clay ball smacks harder than a rubber ball.

Myth 3: A skateboarder can jump over a horizontal pole while moving and land on his skateboard.

Build-off: Drop an egg from 4 stories up and have it land (standstill) in the fastest time without breaking.

Myth 5: A de-coupled grain car can speed up by suddenly dumping its load of grain and thus catch up with the train.

Myth 6: In a hard hit, a small running back feels more force than the large linebacker that hit him.

Myth 7: Independent team myths.

Video Editing

Although we will be covering the basics of video editing in class and lab, you are encouraged to visit the Media Center for more specialized training in how to produce a quality video. The quality of your video production will be one way in which I will determine the difference between "average" and "outstanding" students.

Grading

I will maintain a running evaluation of your performance in the class based on the following criteria:

1. Participation in class discussions
2. Work with your student team
3. Performance on the Challenges.

I plan on providing you with a status update at least three intervals during the semester: on September 25 (the last drop date), around October 19 (mid-semester), and around November 11 (before the final myth).

··· Note: Average work in the class will be graded as a "C" ···

Students demonstrating above average work and effort will earn a "B" and a few outstanding students might earn an "A".

Academic Support Services

Students with disabilities, whether physical, learning, or psychological, who believe they may need accommodations in this class, are encouraged to contact Academic Support Services as soon as possible to ensure that such accommodations are implemented in a timely fashion. Please meet with Julia

Rosenberg (ext. 6024) to verify your eligibility for any classroom accommodations and for academic assistance related to your disability. You may also discuss your disability with the professor if you wish. All discussions will remain confidential. If you have a hidden or visible disability which may require classroom or test accommodations, please see me as soon as possible during a scheduled office hour. If you have not already done so, please visit Academic Support Services (Armory 101) which is responsible for coordinating accommodations and services for students with disabilities.

Emergency Procedures

In case of a fire, we are to proceed from the classroom out the nearest exit and toward the Chapel. This holds for both class discussion and lab. You should join the instructor and the class at the Chapel to make sure that everyone got out of the building ok. In the event of a severe weather storm, we are to proceed to the basement and shelter in the basement hallway.

Acknowledgements

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