

Modeling -- An Introduction

Requirements

Although you can read this section without any of the equipment below, it will be much more meaningful with this equipment.

- A flashlight or other light source
- A Postscript printer to print graph paper and finely detailed slides on transparency film
- An inexpensive laser pointer.
- A Texas Instruments CBL or similar device for recording data and two microphones.

This module is an overview of the spirit of mathematical modeling. We look at two very different kinds of “projection.”

- Ordinary slides projected on a wall or on a movie screen using an ordinary light source.
- Finally ruled “slides” “projected” using a laser pointer.

We study the first situation and discuss a model based on simple geometry using a Java applet, graph paper, pencil, and paper. This model does an excellent job of describing the results that we see.

Then we look at the second situation and discover that our model fails completely in this setting. Next we look at waves and observe that the behavior of waves suggests a way in which the second situation might be explained.

All of this illustrates the **modeling cycle**.

- **Observe the real world and collect data.**
- **Build a model based on theory, analogy, and observation.**
- **Test the model by comparing its predictions to data.**
- **If necessary, modify the model.**

The last two steps are often repeated several times.

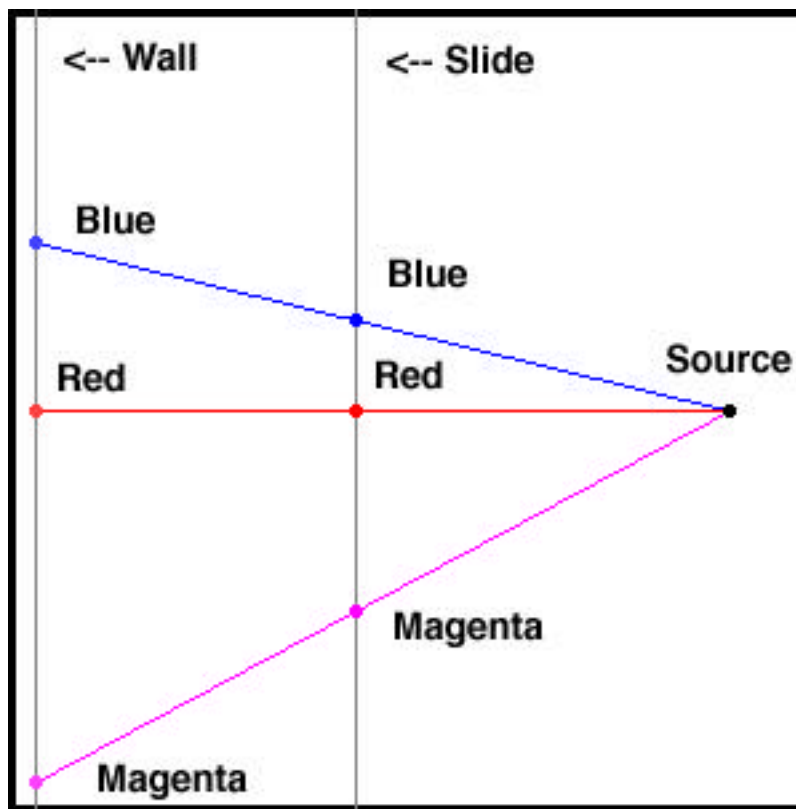
For each module your group will be expected to submit your homework to the **HW Bin** on the **MSULink** site. Although you will normally submit homework as a group, for this first module you should submit it individually. Most of these questions are unanswered questions from the module. Your email message **must follow the format below**.

- Name of module. (**Modeling -- An Introduction**)
- Names of participants in your group.

- (•) Any questions that your group has for your instructor.
- (•) Answers to the questions in this guide.

There is a list of these questions below. Normally you will receive an answer within a day or two. There is no need to wait for an answer before going on to the next module.

Questions



In the figure above

1. Measure the distance between the blue dot and the red dot on the slide.
2. Measure the distance between the blue dot and the red dot on the wall.
3. Find the ratio of the distance you measured on the slide to the distance you measured on the wall
4. Measure the distance between the magenta dot and the red dot on the slide.
5. Measure the distance between the magenta dot and the red dot on the wall.
6. Find the ratio of the distance you measured on the slide to the distance you measured on the wall.
7. Do you notice anything?
8. Measure the distance from the light source to the red dot on the slide.

9. Measure the distance from the light source to the red dot on the wall.
10. Find the ratio of the distance from the light to the red dot on the slide to the distance from the light to the red dot on the wall.
11. Do you notice anything?

Answer the following questions about your experiments with the laser pointer and finely ruled slide.

12. Keeping the slide fixed, move the laser closer to the slide and then further away. What do you see?
13. Do a second experiment side-by-side with the experiment above. For the second experiment use the pattern of large dots on the slide and an ordinary flashlight. Move the flashlight closer to the slide and then further away. What do you see?
14. Compare the results.
15. Notice that the pattern shown below on your slide has some lines that are thinner and more closely spaced than others. What would you expect to see when you shine the laser through the thinner and more closely spaced lines as compared to the thicker and more widely spaced lines? Try it. What do you actually see?
16. Describe what you see when you experiment with the ripple tank applet.
17. Compare your observations with the ripple tank applet to your observations with the laser pointer and finely ruled slide.
18. If you experimented with a CBL and two microphones, describe the experiments that you did and your observations.