Prince William Counties Math and Science Departments Present:

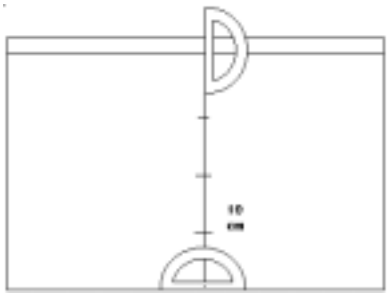
LAW OF ANGLES LAB

Lasers can be used for a variety of different utilities in modern society. They are used in everything from supermarkets to radio stations, police radar guns to classrooms. In one simple activity we can touch on fundamental mathematical principles that the mere mention of which sends many people (students and teachers alike) into cardiac arrest. We can break advanced Physics and Math into ratios, or comparisons. From there we can see how they relate to other objects.

In this activity you will "discover" a theory already known and easily understood. I could just tell you now that the angle of incidence equals the angle of reflection but that would take the fun out of what we're about to do.

TABLE SETUP:

1. Tape a piece of display paper to the edge of the table.



2. Estimate the center of the edge of your paper and place the protractor there.

3. Draw a line at the center "cross hairs" and the 90 degree mark.

4. Use your meter stick to draw the perpendicular line to the edge of your table that divides your paper in two.

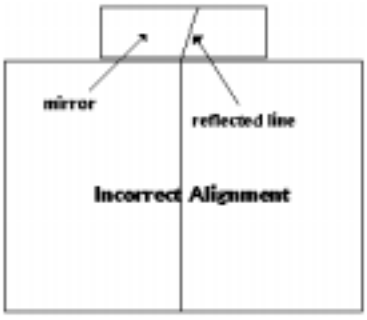
5. From the edge of the paper measure up the line you have drawn every 10 centimeters and place a small mark on the line at each point.

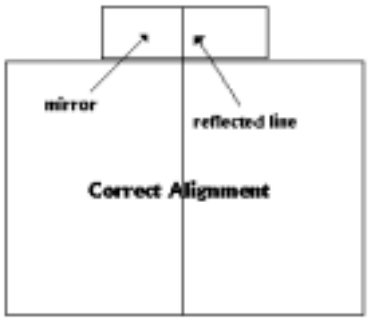
6. Align the protractor to each mark and now draw perpendicular lines every 10 cm.

MIRROR SETUP:

1. Tape the mirror horizontally to edge of the table so that the 1st line you drew is in the middle of the mirror.

2. Align the mirror having one partner look straight down the line into the mirror and one partner adjust the mirror accordingly. (The line should go straight into the mirror...this makes sense when you do it)





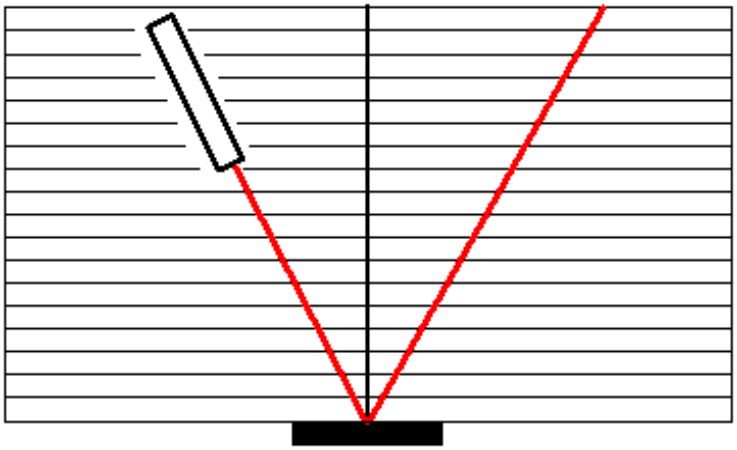
LASERS!

1. PLEASE BE  CAREFUL WITH THE LASERS!

2. Pick a spot on the table away from the mirror and place the laser there CAREFULLY PLEASE.

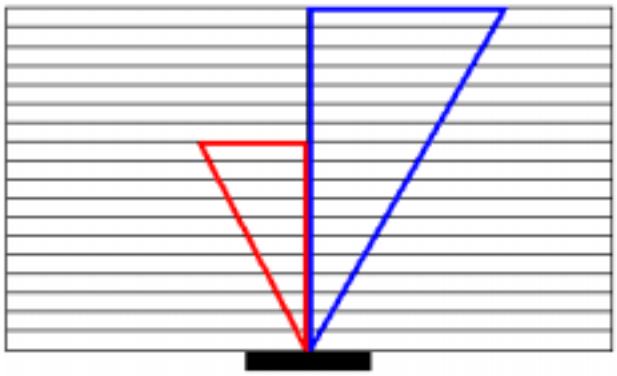
3. Turn on the laser and point it towards the mirror. Again, have one partner looking down the line on the paper that extends into the mirror, another partner gently turn the laser until the dot you see on the mirror is directly on the line in the mirror. (Again, it makes sense when you do it)

4. Now looking down in "3-D" we will check your alignment (lights out with fog or aerosol) and make any adjustments necessary.



5. Use the protractor to determine where along the lines you have drawn does the beam cross. (Have I mentioned, this makes sense once you have done it)

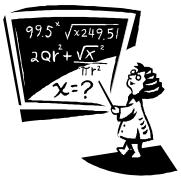
6. Using a red marker on the incident (incoming) side draw the triangle produced WITHOUT moving the laser. Do the same on the smaller triangle on the reflected side but in blue.



7. Now, in the dark again look down on the triangles produced. (I know...it's just a light. BUT it's a cool light!)

8. Turn off the lasers. (I have said carefully right?)

MATH STUFF:



1. Draw stick figures in the angles nearest to the mirror.

2. Label each side as "**O**," I use "the side **O**ver there" as the reason, "**H**" as the "**H**eck of a long side" and "**A**" as the one "**A**long side of you."

3. On the large paper where your triangles are measure and label the length of the sides in centimeters.

RATIOS: A ratio is the fundamental theme between all math and science. It refers to how one quantity (ie. Mass or distance) compares to another (Volume or time).

1. Compare number of boys to girls at your table by saying either:
   ___ to ___, or, ___:___, or, ___/___

2. For EACH triangle make these ratios (comparisons):

Red Triangle:

		In the chart under:	Estimate the Angle: (to .1*)
O= **H**=	_____ =	**Sin**	_____
A= **H**=	_____ =	**Cos**	_____
O= **A**=	_____ =	**Tan**	_____
		Ave:	_____

Blue Triangle:

		In the chart under:	Estimate the Angle: (to .1*)
O= **H**=	_____ =	**Sin**	_____
A= **H**=	_____ =	**Cos**	_____
O= **A**=	_____ =	**Tan**	_____
		Ave:	_____

SUMMARY:

SCIENCE QUESTIONS

1. Compare the two average angles. What do you notice about the incident angle compared to the reflected angle? This is known as the "Law of Reflection" in Physics.

*2. In this activity the incoming light acts as a wave. What wave behavior is this known as? (Diffraction, Refraction, Reflection)

3 How is the light from the Laser different from the light on the ceiling?

4 List 5 applications for Lasers.

5 Why might a Laser be better for sending signals (like old Morse-code) than a flashlight?

MATH QUESTIONS

1. What do you think would happen to the RATIO if I "stretched" the sides of one of the triangles to make it larger? Smaller?

6 If the two are right triangles, and one of the two remaining angles is the same in each triangle, what can be said about the whole red triangle compared to the blue triangle?

7 Without measuring it and ONLY using the angles you know from the Red triangle (90 degrees and your calculated angle), tell what the last angle in the BLUE triangle is!

*4. If the inside angles are the same in each triangle, even if the lengths of sides are different, what term can be used to describe how the sides relate to each other?

*5. If the angles in each triangle are the same, what term can be used to describe the angles?

*6. When you measure the sides of each triangle then take the ratio for each angle, will your ratios change if you measure in centimeters or meters? Why or why not?

* advanced topics/questions