

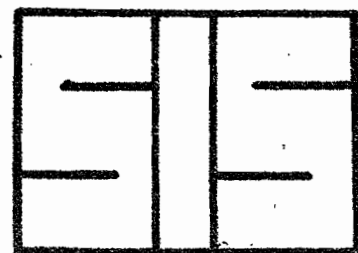
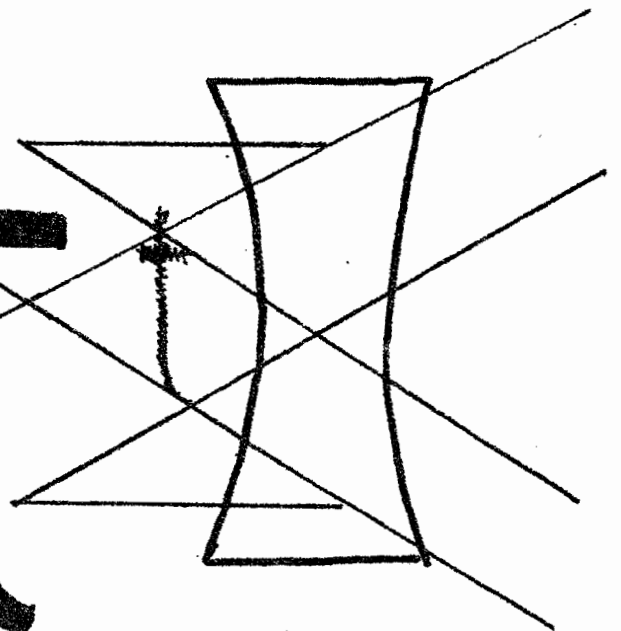
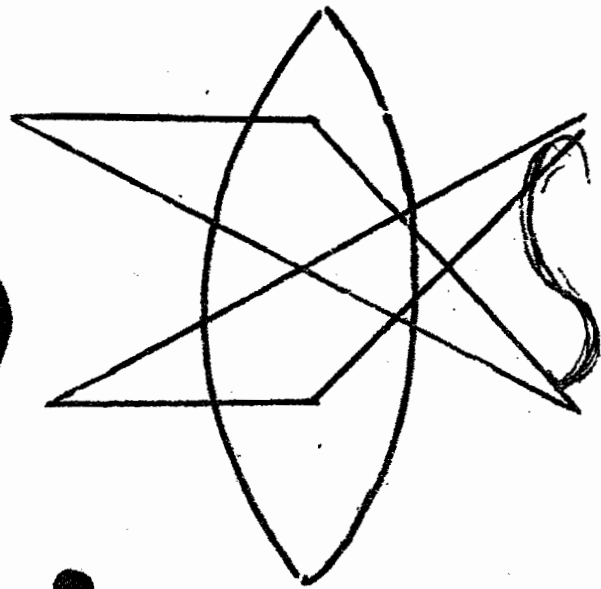
# lenses

and the

# refraction

of

# light



Science  
In  
Schools

By

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Gregory Granbo

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# Lenses and the refraction of light

This is a hands on science unit on lenses and how they bend light and otherwise affect light. Lenses are used in projectors, cameras and so many other things that you use. Through the ten experiments and two quizzes, the children will find out what lenses are and how they can be useful. There is also a bingo game included in this unit.

affect light. In this unit children will learn why submarines use periscopes and how kaleidoscopes work. There are ten experiments and two quizzes in this unit. There is also a bingo game included in this unit.

Experiments in this unit should be copied and placed in marked, or numbered, folders in a box. Allow students to get new sheets as needed. Students should be put into groups of 2, 3, 4, 5, or 6 students. By doing this the children can question each other, and can offer each other advice and help. Each group of students should receive a box of equipment with a materials list with a materials list in it. Attached to the back of the materials list should be the group clean up sheet. Each day one child, in any group, should be in charge of the box for his/her group, making sure that everything is there and that the box is neat and clean. He/she then should sign the clean up sheet. In this manner

you can keep track of which students made a mess and which were clean. You may also wish to have your students make and use a log book. The log book is a place where your young scientists can write down what they are doing and what happened in their experiments that day. Many discoveries, in science, happened by accident. If scientists did not record what they were doing, their discoveries might have been lost forever.

Students work should be graded and returned to the student as soon as possible; this insures that students will not keep making the same mistakes sheet after sheet. You can hang up a copy of the grading sheet and use it as a check off sheet or as an incentive chart. Students can then check off experiments they have done.

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SIS 502

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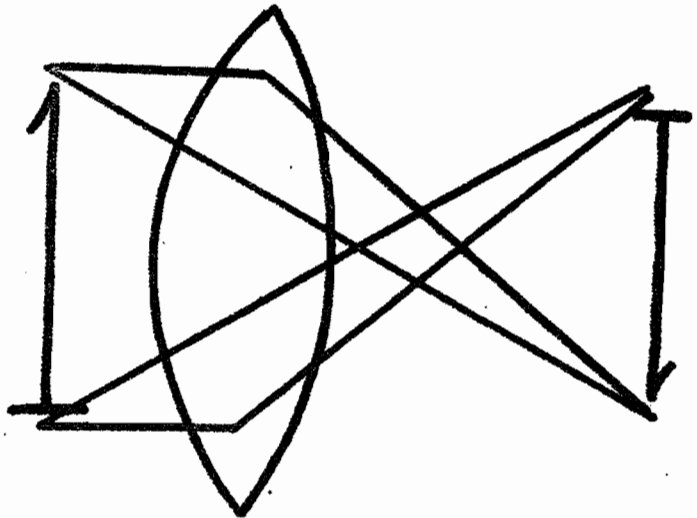
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# Chapter One

experiments

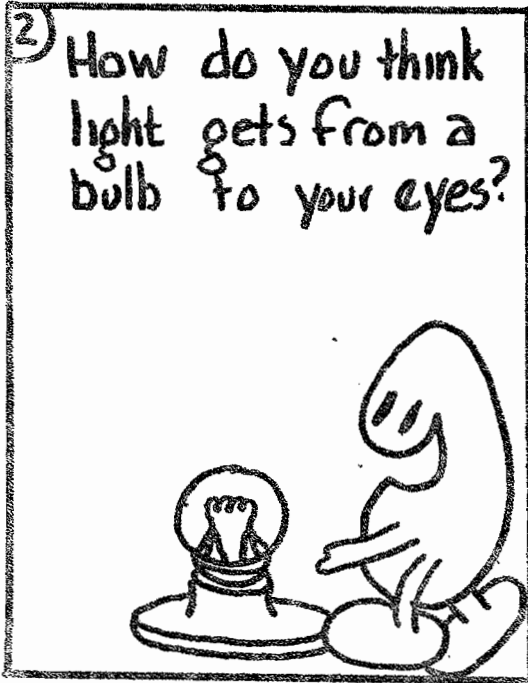
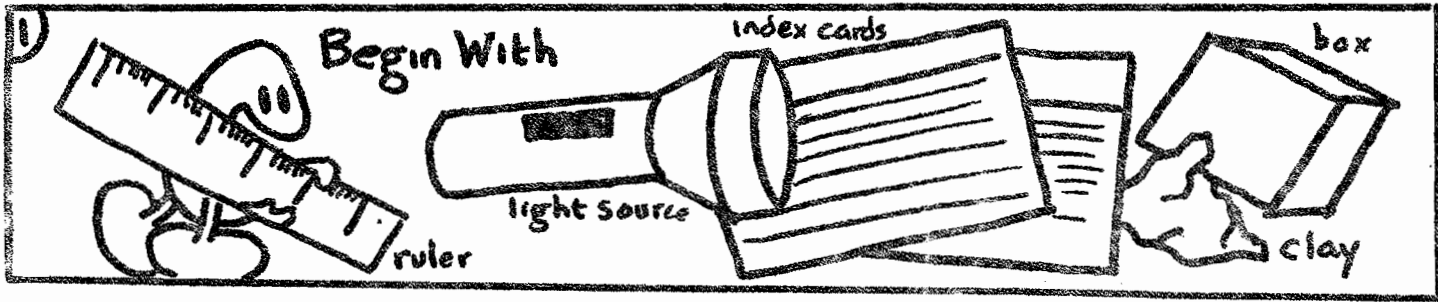


# Lenses and the refraction of light

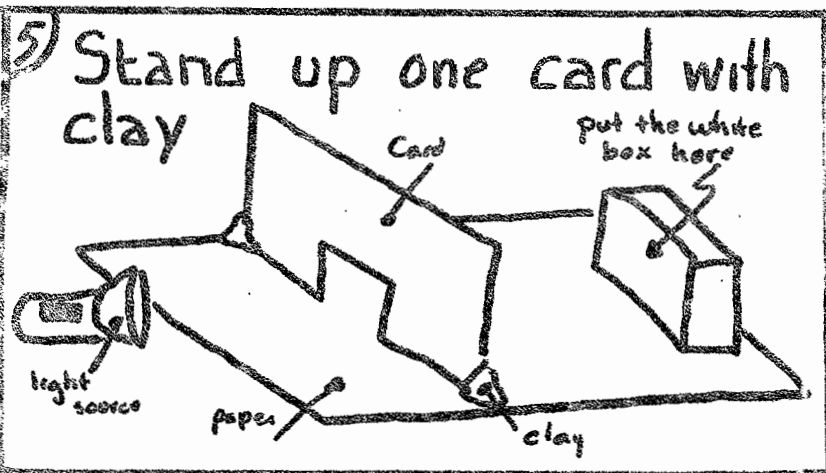
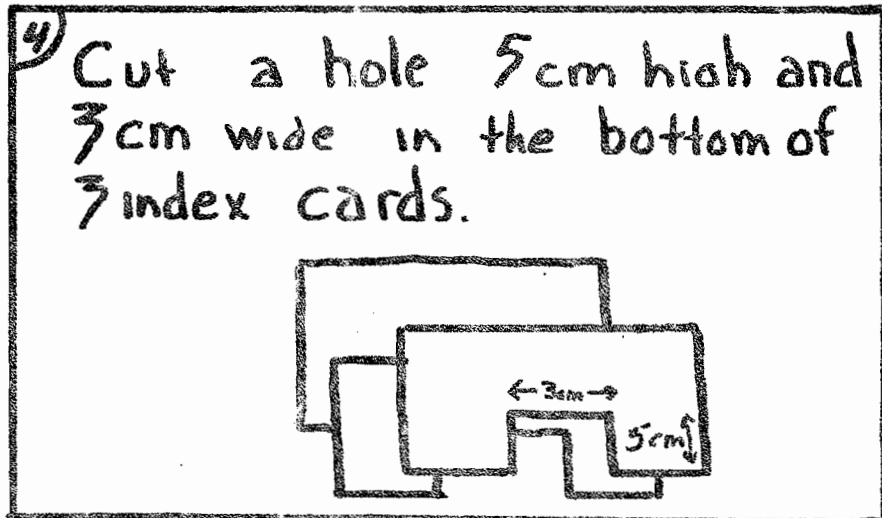
Name \_\_\_\_\_  
Class \_\_\_\_\_ Group No. \_\_\_\_\_

## Does light travel in straight or curved paths?

## Experiment 1



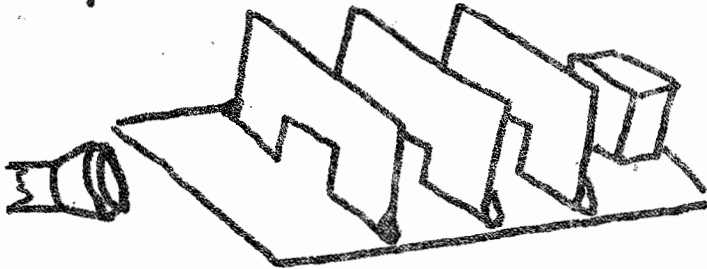
3) **Lets Find Out**



6) Shine the light through the hole. Why does light hit the box?

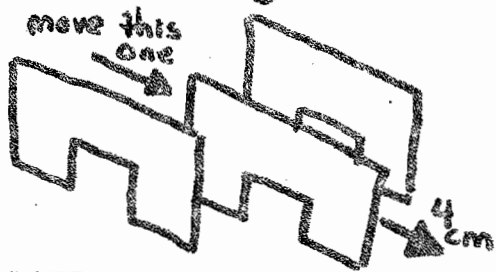


7) Stand up all three cards so that the holes line up.



8) Shine the light through the hole again. How is the box affected?

9) Move the middle card 4 cm to the right.



10) Shine the light through the hole again. Describe what happens.

11) Does light travel in a straight or curved line? How do you know?

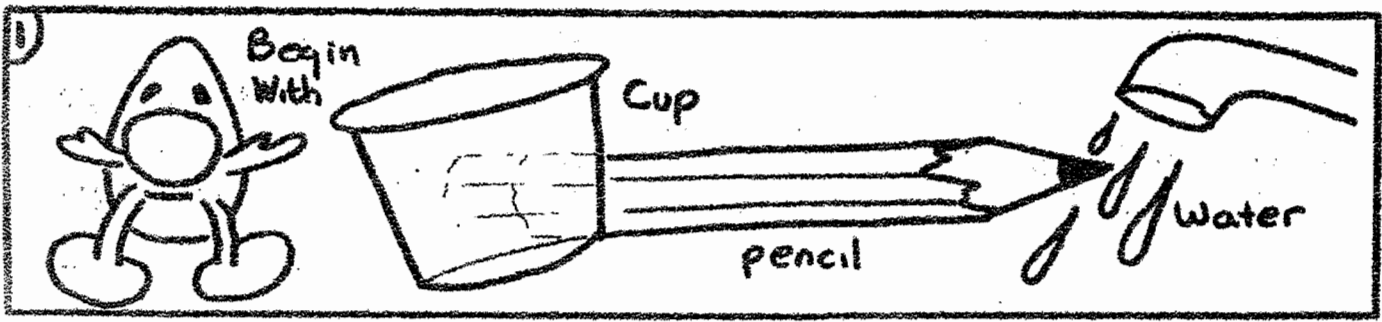
## Homework-

1- Define Path-

2- Prove light travels in a straight path?

Why do objects look bent when you put them in water?

# Experiment 2

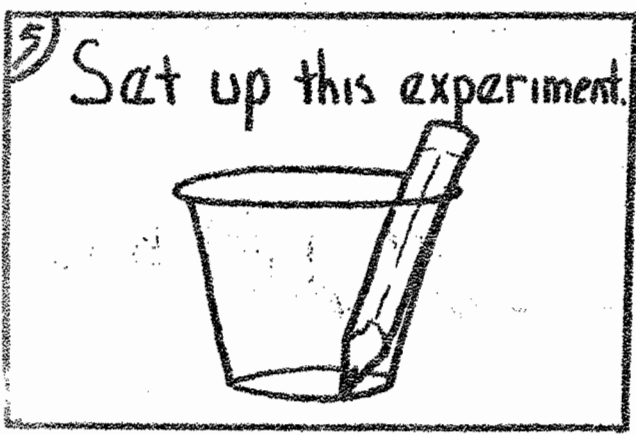


2) Have you ever reached for something in water?

Were you surprised when it was not where you thought it was?

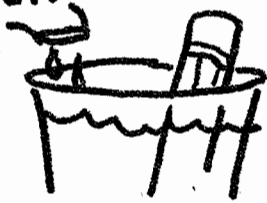
3) Why did this happen?

4) Lets Find Out!



6) Examine the set up in box 5. Describe how the pencil looks.

7) Add water to the cup until it is  $\frac{2}{3}$  full of water.



8) Draw how your setup looks.

9) How does the pencil look now?

How has it changed?

10) Define -  
Matter -

As light moves from one kind of matter into another its speed changes. It might go faster or slower. Light usually travels in a straight line, but as its speed changes it appears to bend (or change direction).

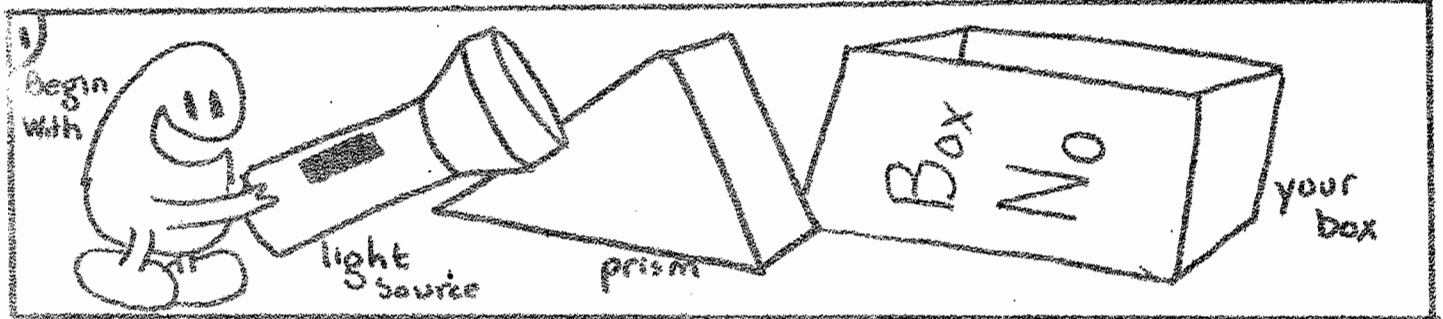
11) When light bends, we call it refraction (rih-FRAK-shuhn)

Homework -


1- Would a thicker liquid make the light bend differently? (How could you find out?)

# What makes up white light?

## Experiment 3



2) When you put a pencil into water, why does it look bent?



3) How can you bend light?

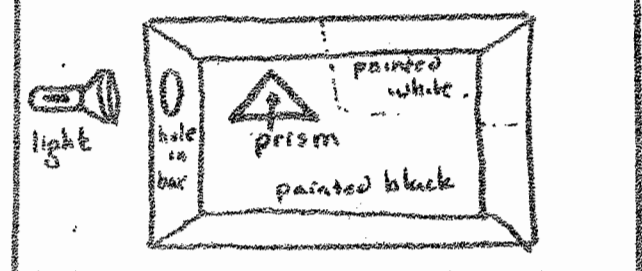
4) Why do you say this?



5) Let's find out what happens when you bend light as far as you can.

6) Empty your box. You will need it for this experiment.

Set this up



7) Turn the prism while the light is hitting it.

8) How does the prism affect the white light?

9) Where do the colors come from?  
  
What direction does the colored light go?

10) Draw the colors you see. (In order)

11) This is like a rainbow. The white light bends so much it breaks up into a spectrum of colored light

12) In nature light hits water drops. The drops act like prisms bending light to create a colored rainbow.

## Homework-

1- What is a spectrum? What is a prism?

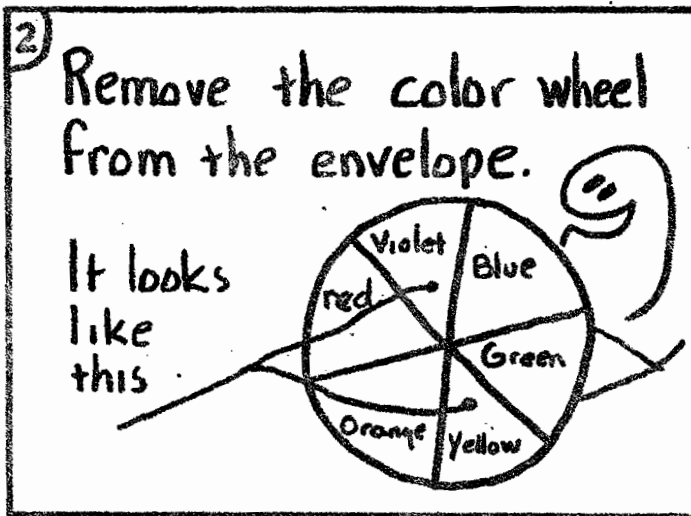
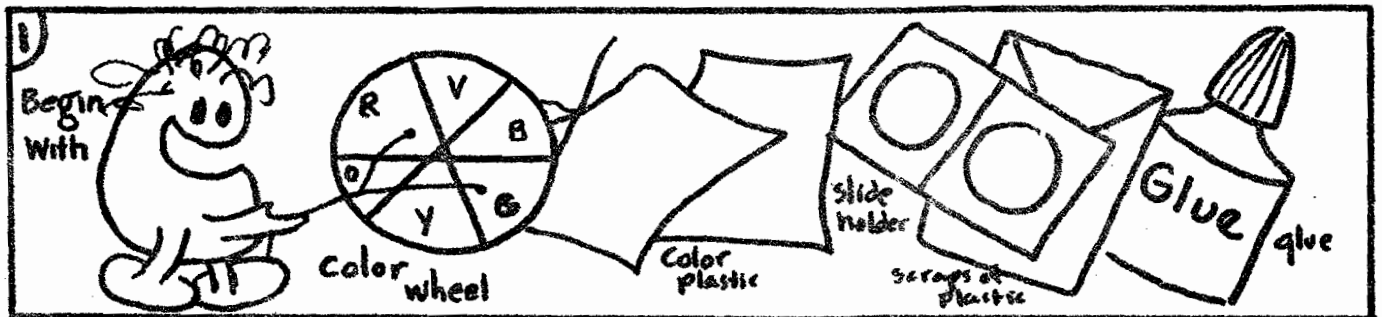
2- How is a rainbow made?

3- Why is orange between red and yellow?

lenses and the refraction  
of light

Name \_\_\_\_\_  
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How do colored lights interact  
with each other? What happens  
when colored lights meet? Experiment 4



3) Pull on the strings so the wheel spins

4) How does turning affect the colors on the card?

5) Why does this happen?

6) The colors of light can be put back together again.

7) Remove the colored plastic from the envelope. Shine a light through them.

8) How does the plastic affect the light?

9) Why do you think this happens?

10) Try mixing a few colors

11) Tell what happens!

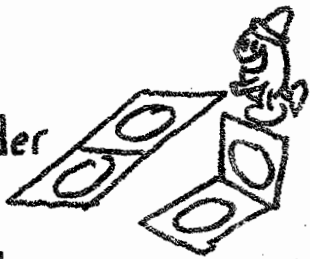
colors used	results

Lets try using alot of colors

12) Find the slide making envelope  
Remove the coin holder and bits of colored plastic.

A- Take the coin holder and bend it.

B- Place plastic bits and other thin objects inside the holder.



13) Glue the holder closed.

14) Place your slide into the viewer.

15) Describe what you see.

16) How do the colors affect each other?

### Homework -

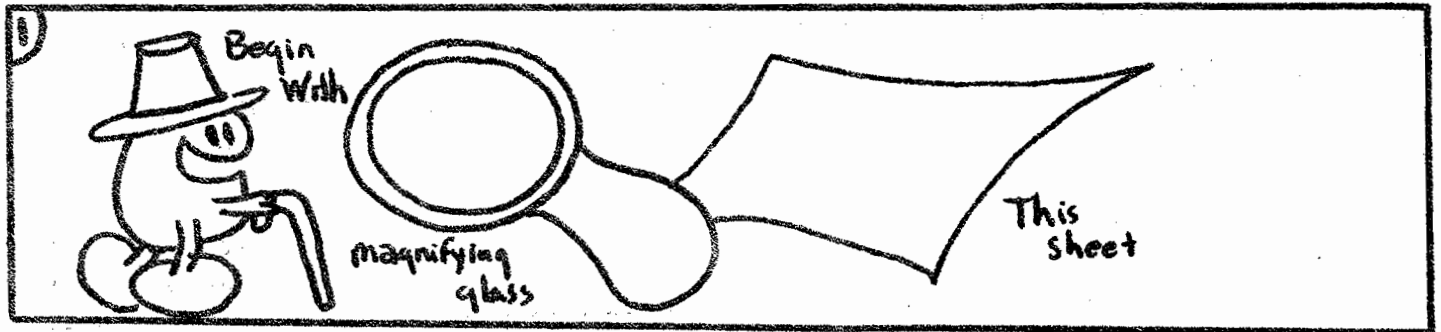
1- Why do some spots on the slide come out black?

2- Where does the orange and green come from?

17) Draw what your slide looks like.

How do you use a magnifying glass?

# Experiment 5



2) Place the magnifying glass on top of these words. How does it affect the words?



3) Begin to lift the magnifying glass while looking through it.

4) How are the words affected now?

5) What happens when you move the magnifying glass even further away?

6) Why do you think the words blur?



7) Define -  
magnify

8) Define -  
focus

9) How can you make the letters on this page look larger but clear?

large

10) Draw what your magnifying glass looks like from the side.



front  
View

Side

11) Movie and slide projectors have magnifying glasses in them. How do they help make a picture look larger?

## Homework-

1- Define Image-

2- How can you get an image in clear with a magnifying glass?

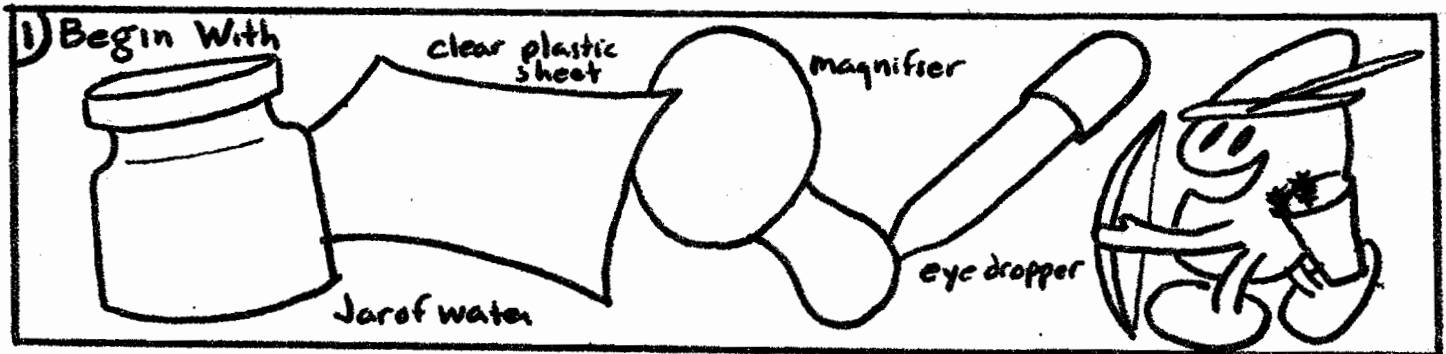
lenses and the refraction  
of light

Name \_\_\_\_\_

Class \_\_\_\_\_ Group No \_\_\_\_\_

Can a drop of water  
be a magnifier?

## Experiment 6



2) What does magnify mean?



3) How can you make  
an object look larger?



4) Cover these words  
with clear (no color)  
plastic so the paper  
does not get wet. Put  
a drop of water on  
top of these words.

5) Look at the words  
through the water.  
Describe how the  
words look.

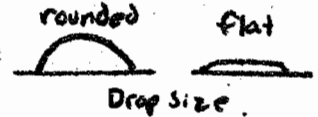
6) Does the drop of water make the letters larger or smaller?

How can you tell? (you might use the ruler)

7) Add more water to the drop on your page.

8) Does making the drop larger magnify the letters more?

9) Does a rounded drop magnify more than a flat drop? How can you find out?

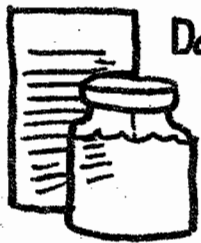


10) What happens to the magnifying power of water when the drop is flattened out?

## Homework-

1- How can water be used as a magnifying glass?

11) Look through a jar of water at this page.



Describe how the words look.

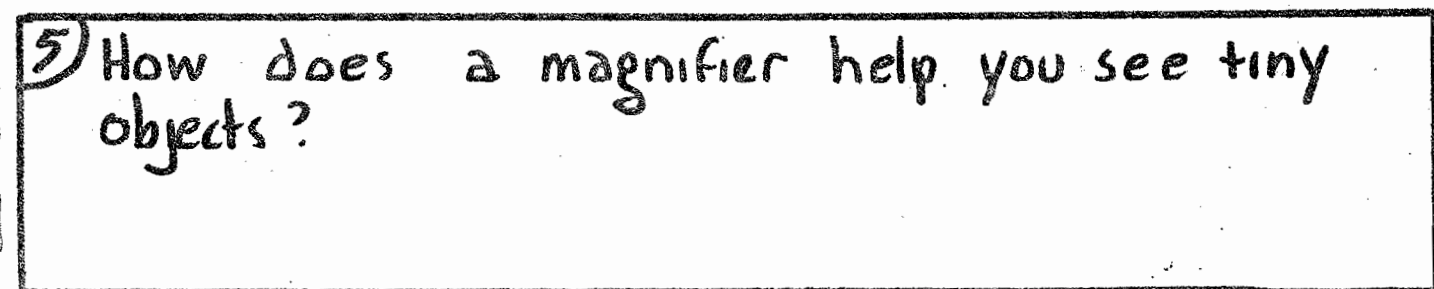
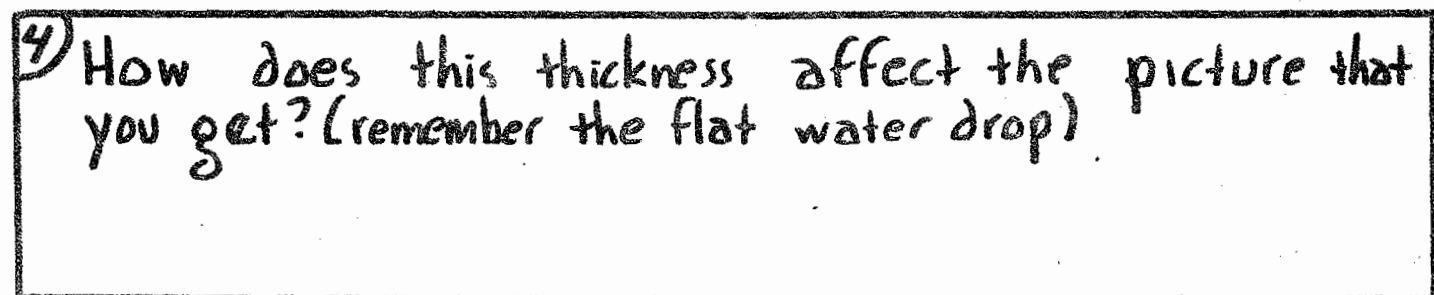
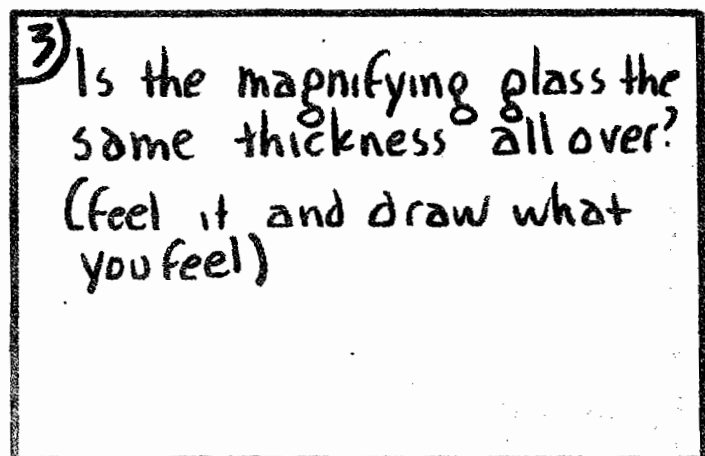
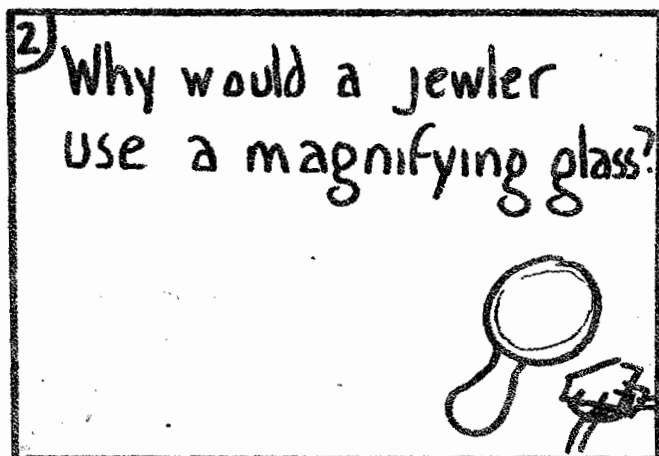
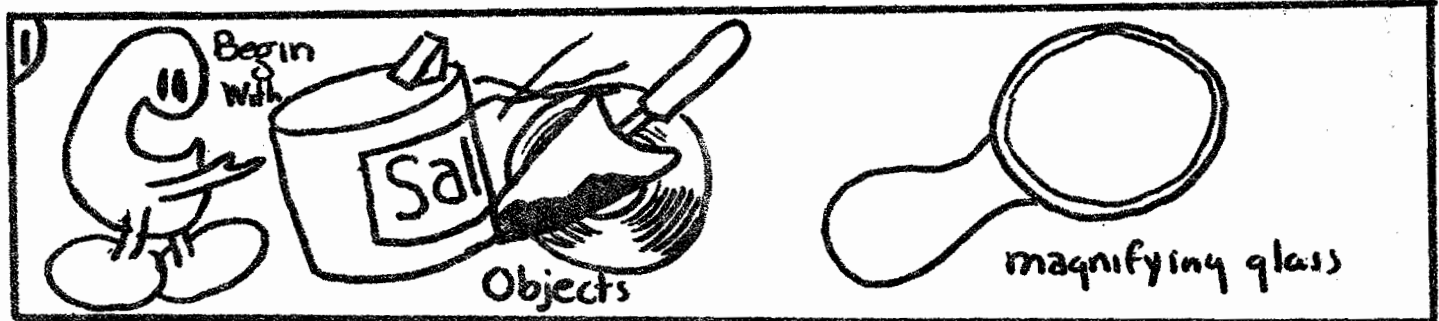


# lenses and the refraction of light

Name \_\_\_\_\_  
Class \_\_\_\_\_ Group No \_\_\_\_\_

What else can you discover with a magnifier?

## Experiment 7



6) look at the objects through the magnifying glass

Object	Drawing	What you learned
Salt		
hair		
soil		
phonograph record		

### Homework -

1- look at 5 other objects through the magnifying glass. Make a list with drawings and a description of what you learned about each

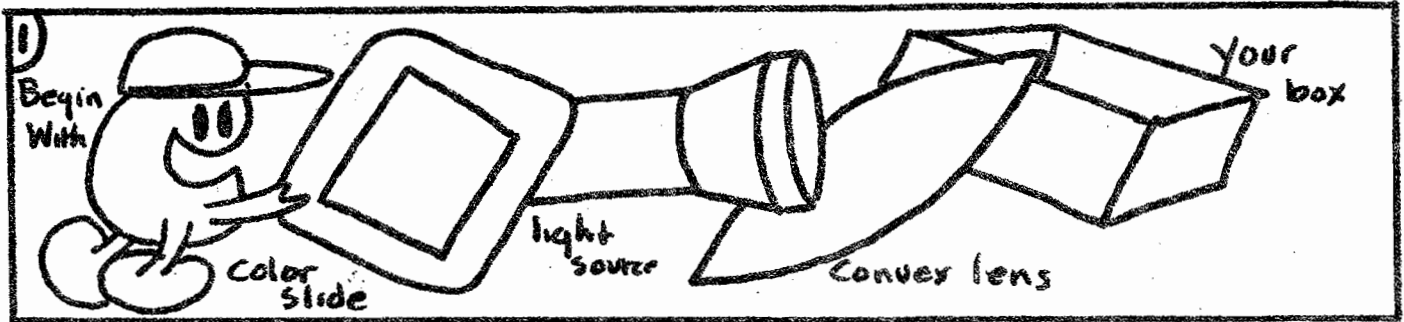
lenses and the refraction of light.

Name \_\_\_\_\_

Class \_\_\_\_\_ Group No \_\_\_\_\_

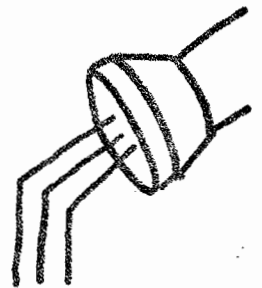
What is a Convex lens?

Experiment 8



2) Describe what happens when light moves from (or through) one object to another.

3) How can you get light to bend?

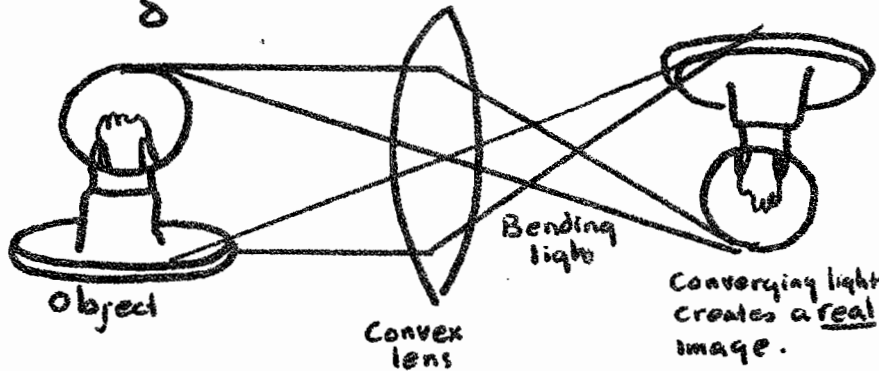


4) Describe where the thickest part of your magnifying glass is. [Draw a picture]

5) Define -  
Lens

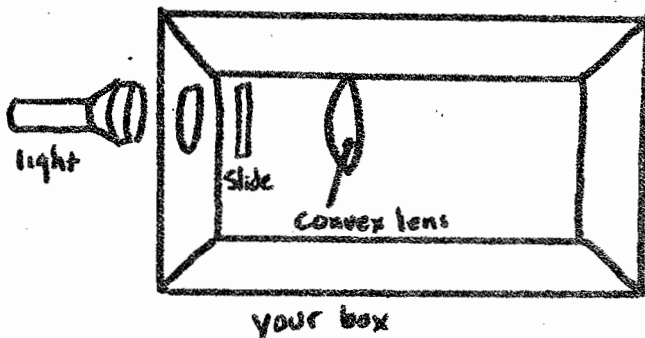
6) A magnifying glass is a lens. It is a convex lens. The thickest part of this lens is in the middle

7) As light enters the lens it is bent. The light coming out of the convex lens is bent inwards



The lens will project an upside down image on a wall.

8) Set this up



Turn on the light. Describe the image you get.

Homework -

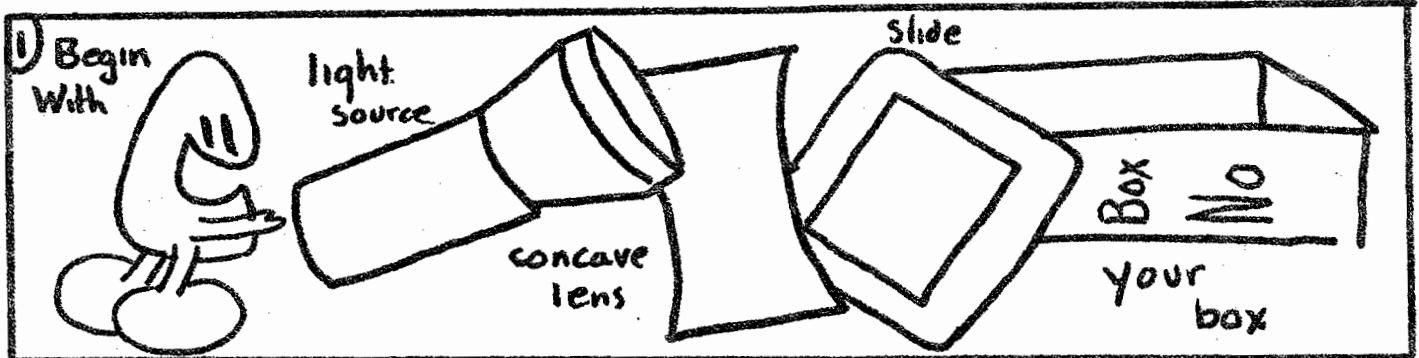
1- How does a convex lens affect light?

# Lenses and the refraction of light

Name \_\_\_\_\_  
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## What is a Concave lens?

## Experiment 9



2) Look at this printed page with the concave lens. Describe how it makes the words look?

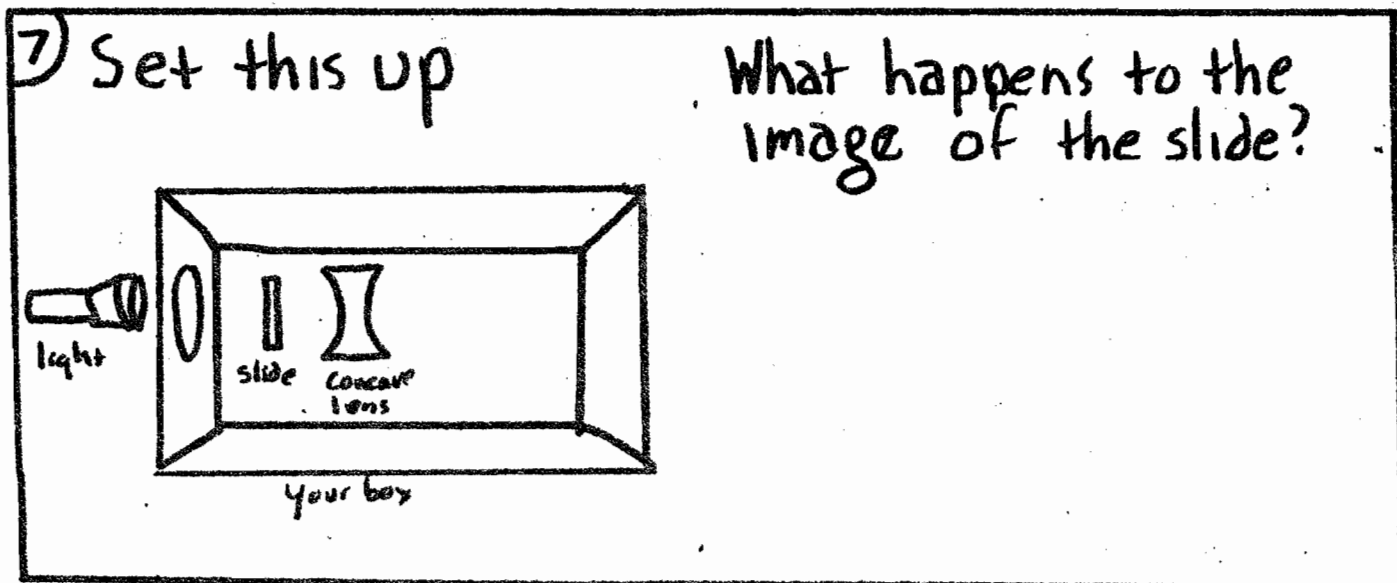
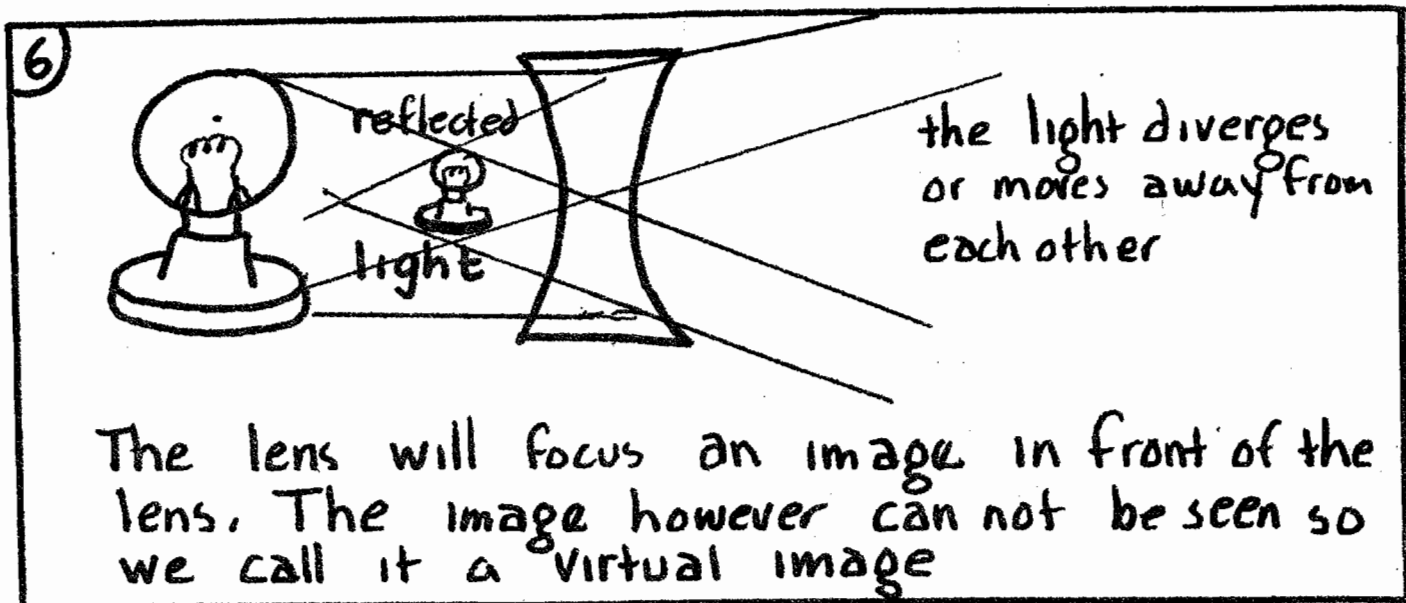


3) How can you tell the concave lens from the convex lens?

4) Define -  
Concave -  
Convex -

5) If a concave lens were put into a projector it would not make a real image on a screen.





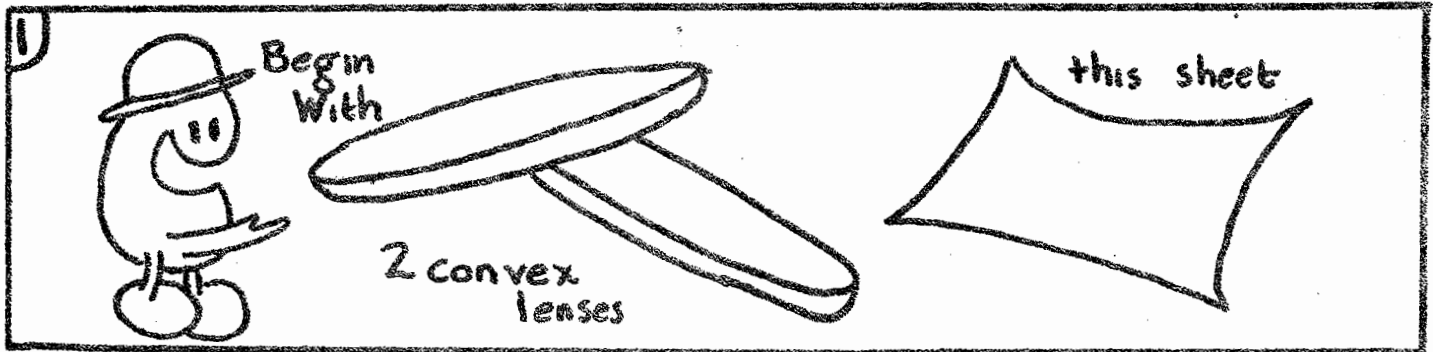
## Homework

1- What is the difference between a concave and convex lens?

2- What is the difference between a real image and a virtual image?

What happens when you put lenses together?

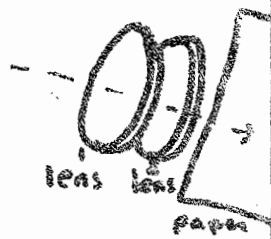
# Experiment 10



2

How do you think the words on this page would look if you viewed them through 2 convex lenses?


Try It



Detailed description: A diagram showing two convex lenses placed in front of a piece of paper. Dashed lines represent light rays passing through the lenses. The word 'lens' is written under each lens, and 'paper' is written under the paper.

3

What does focus mean?



Detailed description: A cartoon character is sitting and reading a book. The book is open, and the character is looking at the pages.

4

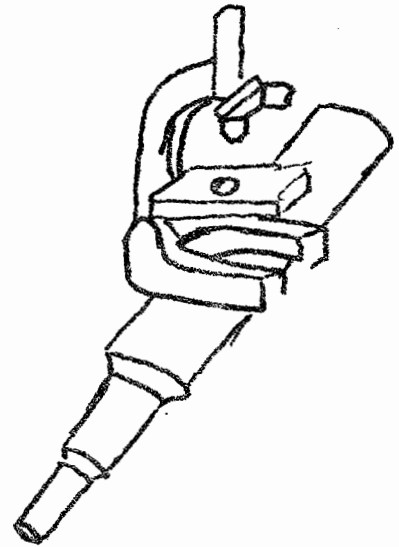
Why must you move the lenses closer together or further apart to get a clear picture?

5) How can many lenses help you see better?



6) How can lenses help scientists and police?

7) Many lenses are used in microscopes and telescopes. Explain (after looking in an encyclopedia) how a microscope or telescope works.

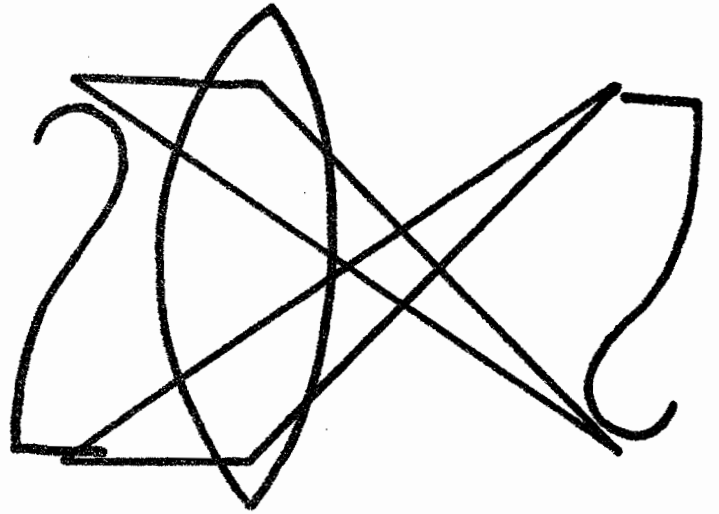


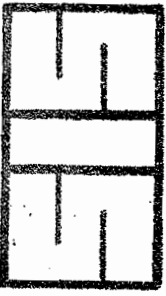
## Homework -

1- How can two lenses work better than one?

# Chapter TWO

bingo game

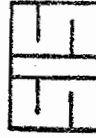
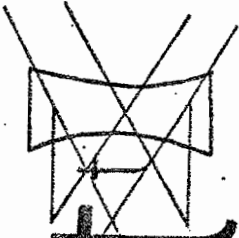




SCIENCE IN SCHOOLS

# lenses and the refraction of light

# BINGO



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# BINGO



# BINGO



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GREGORY GRAMBO



Cut glass or plastic  
2- Used in eyeglasses  
**lens**

1- focuses light behind lens  
2- Lens bends out to give a real image  
**Convex**

1- focuses light in front of the lens  
2- lens curves in. Virtual image  
**Concave**

1- Triangular piece of glass or plastic  
2- bends light into a spectrum of color  
**prism**

1- the refraction of light  
2- To make something not straight  
**bending**

1- The bending of light  
**refraction**

1- Uses a convex lens.  
2- Makes things look larger  
**magnifying glass**

1- light, other than white.  
**colored light**  
1- Contains many lenses. Used to see small plants.  
2- Instrument aims down.  
**microscope**

1- used to see the planets.  
2- Instrument has lenses and aims up.  
**telescope**

1- opposite of speeds up  
**slows down**

1- to get a clear picture.  
2- The point where rays of light meet  
**focus**

1- You can see through  
2- like a window  
**transparent**  
1- You can not see through  
2- like black paper  
**opaque**

1- light will go through.  
2- like wax paper  
**translucent**

1- a flash light is a \_\_\_\_\_  
2- Place where light comes from.  
**light source**

1- something that takes up space  
2- something that can be seen and touched.  
**Object**

1- Picture made by a lens  
2- A likeness or copy.  
**Image**  
1- Two straight lines meet at a point.  
2- The amount that light bends.  
**angle**

1- an image you can see.  
2- Image made by a convex lens  
**real**

1- opposite of slows down.  
2- light going from water to air will \_\_\_\_\_  
**speeds up**

1- to make  
2- to bring about  
**produce**

1- To send an image through the air and onto a screen.  
2- To throw or cast forward.  
**project**  
1- an image you can not see  
2- Image made by a concave lens  
**virtual**

Lenses and the refraction of light

# BINGO

opaque	microscope	lens	speed up	colored light
magnifying glass	virtual	convex	light source	light
slows down	translucent	protect	real	prism
object	angle	concave	refraction	focus
image	blending	produce	telescope	transparent

Lenses and the refraction of light

# BINGO

virtual	lens	magnifying glass	transparent	light source
opaque	project	telescope	produce	colored light
concave	translucent	refraction	slows down	angle
real	microscope	image	light	focus
prism	object	bending	speeds up	convex

Lenses and the refraction of light

# BINGO

prism	lens	speeds up	virtual	magnifying glass
real	bending	project	convex	colored light
refraction	produce	concave	focus	opaque
telescope	microscope	angle	transparent	slows down
object	telescope	translucent	image	light

Lenses and the refraction of light

# BINGO

lens	virtual	concave	opaque	project
convex	microscope	real	slows down	bending
telescope	translucent	light	light source	magnifying glass
refraction	colored light	object	prism	angle
focus	image	speeds up	project	transparent

Lenses and the refraction of light

# BINGO

5

light source	translucent	lens	virtual	slows down
light	project	telescope	speeds up	convex
magnifying glass	transparent	concave	angle	image
opaque	microscope	produce	refraction	colored light
prism	real	bending	focus	object

Lenses and the refraction of light

# BINGO

6

microscope	speeds up	virtual	magnifying glass	angle
telescope	lens	colored light	translucent	light source
slows down	prism	focus	opaque	project
refraction	real	bending	transparent	object
convex	concave	light	produce	image

Lenses and the refraction of light

# BINGO

7

light	telescope	refraction	magnifying glass	real
microscope	image	colored light	concave	prism
light source	bending	lens	slows down	object
transparent	convex	speeds up	angle	opaque
project	focus	produce	translucent	virtual

Lenses and the refraction of light

# BINGO

8

concave	magnifying glass	object	speeds up	convex
image	colored light	virtual	bending	produce
prism	real	refraction	opaque	telescope
light source	focus	microscope	translucent	angle
lens	transparent	project	slows down	light



Lenses and the refraction of light

# BINGO 9

real	slows down	project	magnifying glass	virtual
colored light	produce	prism	translucent	refraction
opaque	bending	image	speeds up	light
microscope	light source	concave	angle	transparent
telescope	focus	object	convex	lens

Lenses and the refraction of light

# BINGO 10

transparent	refraction	speeds up	object	colored light
focus	real	light source	microscope	light
opaque	project	prism	translucent	concave
telescope	slows down	virtual	convex	angle
produce	bending	image	magnifying glass	lens

Lenses and the refraction of light

# BINGO 11

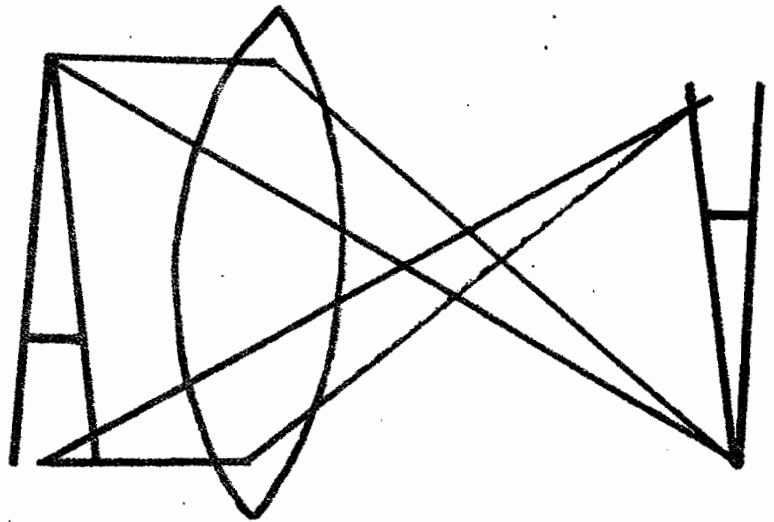
angle	lens	produce	real	prism
convex	image	concave	project	focus
object	light	microscope	refraction	transparent
colored light	telescope	virtual	opaque	magnifying glass
slows down	speeds up	bending	light source	translucent

Lenses and the refraction of light

# BINGO 12

bending	light	colored light	refraction	telescope
magnifying glass	lens	microscope	prism	slows down
translucent	convex	speeds up	focus	opaque
light source	concave	object	image	transparent
real	virtual	angle	produce	project

# appendix



# Lenses and the refraction of light

Name \_\_\_\_\_  
Class \_\_\_\_\_ Group No \_\_\_\_\_



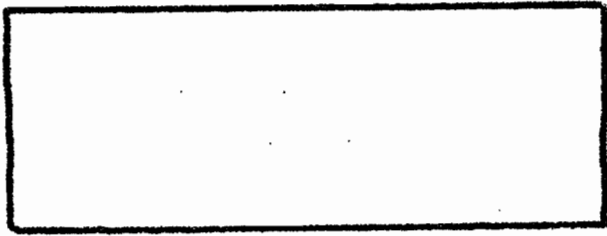
## Quiz on Experiments 1-5

- 1- Prove light travels in a straight path.
- 2- Define Refraction -
- 3- Why does a pencil look bent when you put it in water?
- 4- How does a prism affect light?
- 5- How is a rainbow formed?

# Lenses and the refraction of light

Name \_\_\_\_\_

Class \_\_\_\_\_ Group No \_\_\_\_\_

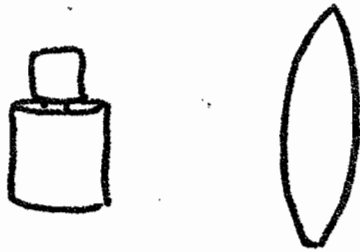


## Quiz on Experiments 6-10

1- How can you use water to magnify an object?

2- What is a convex lens?

3- Show how a convex lens works.



4- How is a convex lens different from a concave lens?

5- How does a microscope or telescope work?

# Lenses and the refraction of light

## Materials List

Your group is responsible for all the materials in your box. Keep them neat and clean. Report all missing materials to your teacher.

Index cards

Clay

light source

White box

ruler

pencil

cup

Jar (with lid)

prism

color wheel

plastic sheet

plastic bits

coin holders

glue

magnifying glass

eyedropper

clear (no color)

plastic sheet

color slide

convex lenses

concave lenses

objects

salt

soil

phonograph  
record

## grading sheet instructions-

In the teacher's marking book, this sheet can serve as a place to grade or check off the experiment sheets that the students have completed. There is a space provided for quiz grades. This chart can be mounted on construction paper and hung on a wall in your classroom. Students can mark off all sheets you have corrected and handed back to them. By seeing other students' test grades and experiment check offs, they may try to do better and work faster so the rest of the class will be proud of them.



# Group clean up sheet

One person in your group must sign this sheet after your box is cleaned up. It is that persons responsibility to make sure the box is neat and clean. Take turns with other people in your group.

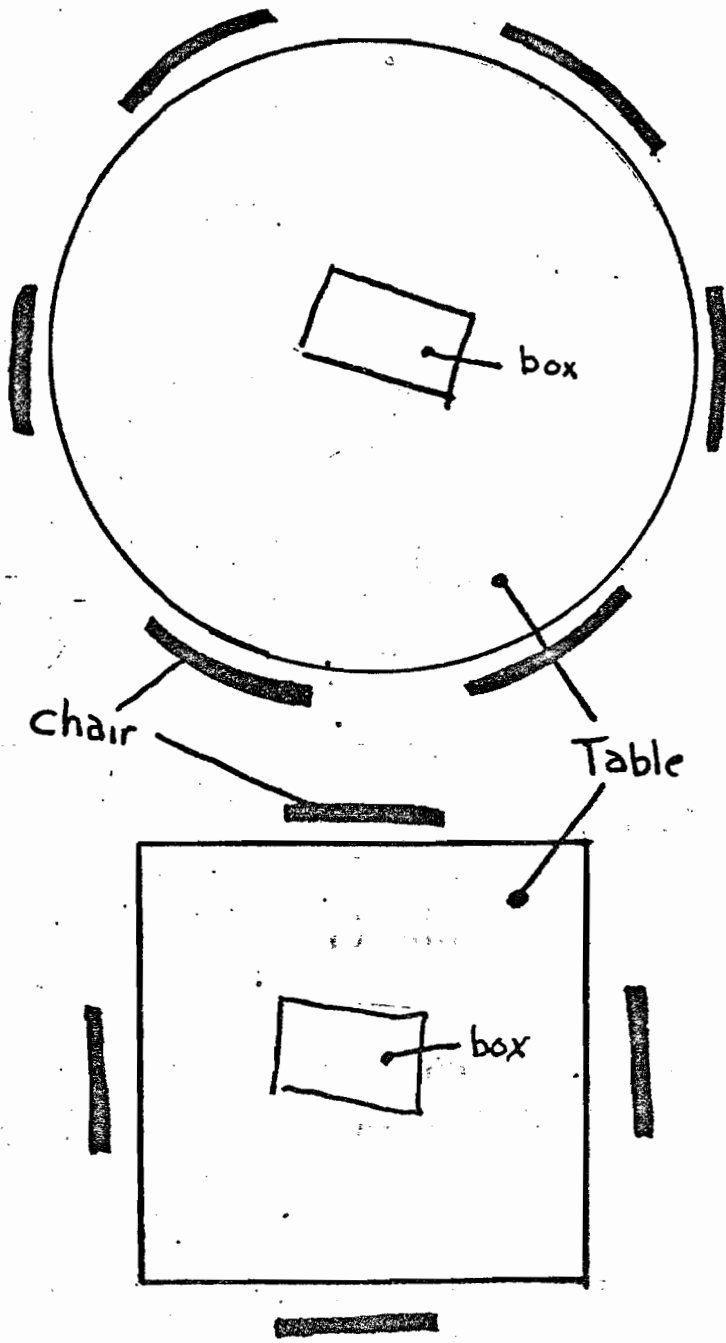
Date                      Name                      Class                      Period








# Setting up the room for group work



Place the box of materials in the center of the table. Allow students to sit around the table so they can talk and interact with each other. In this manner, children can question each other, and the work they are doing becomes more important than the front of the room or the blackboard.

If the children can face each other, they will be able to help each other.

# Log book - What is it?

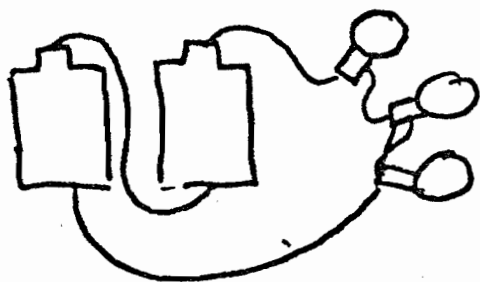
A log book is a place where a scientist writes his/her ideas, writes observations to experiments he/she is working on and draws conclusions to those experiments. Everything that happens good or bad should be reported in the log. Things not wanted should be crossed out not ripped out. Things you may not want now may become important later on. If information is torn out it may be lost forever.

log book pages should contain

Date or Week

Topic - Simple Circuits.

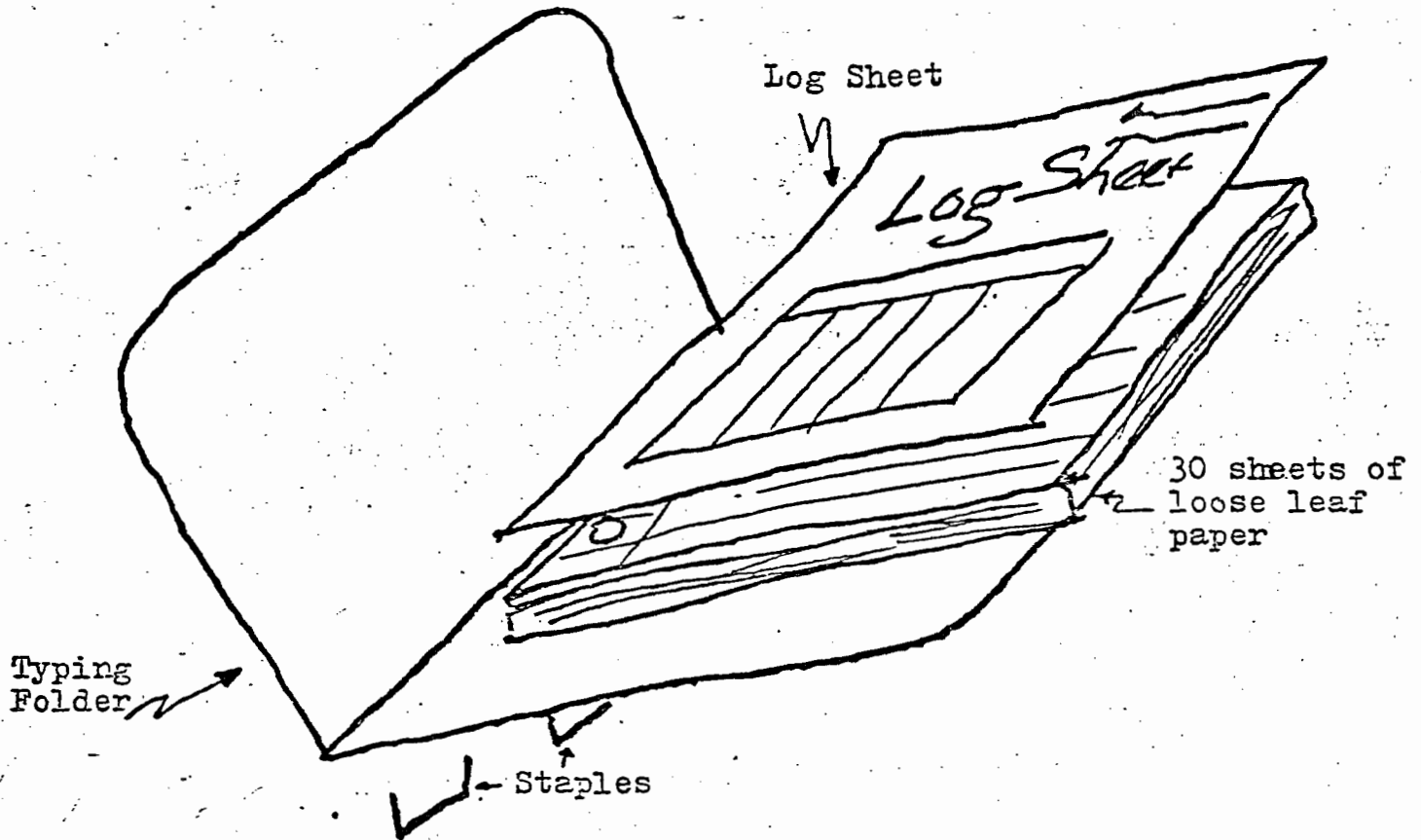
Ideas or Hypothesis - I tried to connect 3 bulbs, 2 batteries and some wire together so all bulbs go out when I remove one wire from the batteries. This is what I did.



It worked

It could have tables - Salt and liquids

## How To Set Up A Log Book



Bind 30 sheets of paper along with the log sheet into a typing folder. Staple folder closed so papers will not fall out. Place students name and class at the top of the folder. Students may wish to decorate their folders. Pass out folders at the beginning of the period, and collect them at the end. Store folders in a milk crate or in a box. Students will write a summary of each days experiment into the log book. Periodically check log books.

Name \_\_\_\_\_

Class \_\_\_\_\_

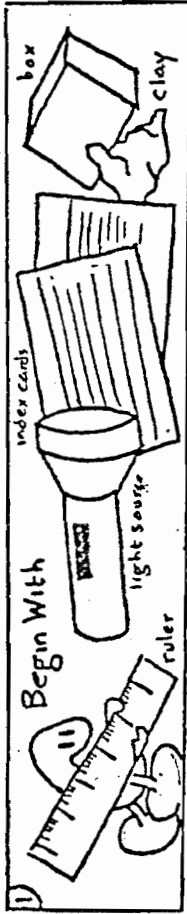
# Science Log Book

Dates From To		Pages	Teacher's Comments	Checked By

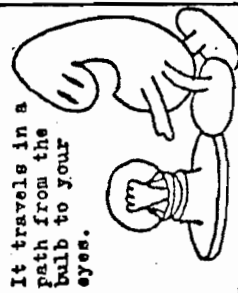
Lenses and the refraction of light

Name \_\_\_\_\_ Class \_\_\_\_\_ Group No. \_\_\_\_\_

# Does light travel in straight Experiment 1 or curved paths?

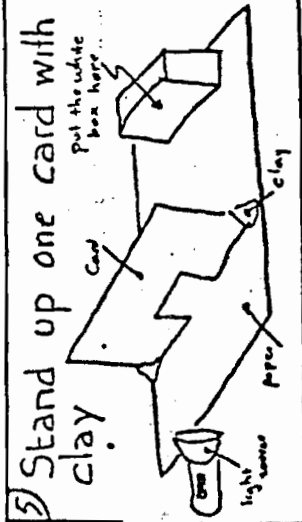
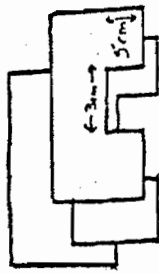


2) How do you think light gets from a bulb to your eyes?



3) Lets Find Out

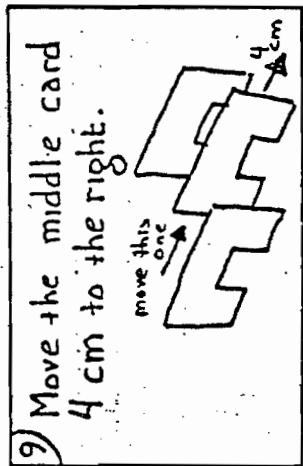
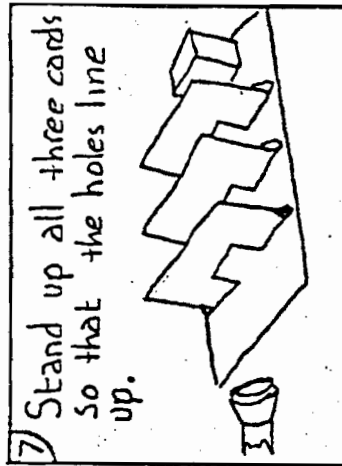
4) Cut a hole 5cm high and 3cm wide in the bottom of 7 index cards.



6) Shine the light through the hole. Why does light hit the box?

The light travels in a straight path from the light source through the hole in the card and to the box

© Grambo



11) Does light travel in a straight or curved line?

Light travels in a straight line  
How do you know?  
If it traveled in a curved path it would have curved to go through the center card.

8) Shine the light through the hole again. How is the box affected?

The light still travels in a straight path through the holes and to the box. The box gets lit up.

10) Shine the light through the hole again. Describe what happens.

The light can not go through the middle card so the light stops when it hits the card.

## Homework -

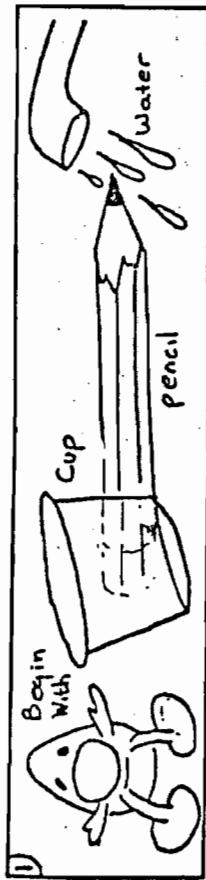
- 1- Define Path - a course along which something moves.
  - 2- Prove light travels in a straight path?
- See box 10 and 11

answer key

Lenses and the refraction of light  
Name \_\_\_\_\_  
Class \_\_\_\_\_ Group No. \_\_\_\_\_

# Why do objects look bent when you put them in water?

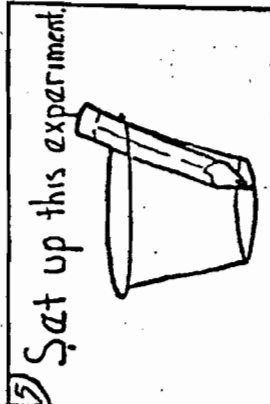
## Experiment 2



2) Have you ever reached for something in water?  
Yes I have  
Were you surprised when it was not where you thought it was?  
Yes I was

3) Why did this happen?  
The light bent making the object look like it was in a different place.

4) Lets Find Out!



5) Set up this experiment.  
6) Examine the set up in box 5. Describe how the pencil looks.  
Since there is no water in the cup yet, the pencil does not look bent.

© Grambo

7) Add water to the cup until it is 2/3 full of water.

9) How does the pencil look now?  
The pencil looks bent.  
How has it changed?  
Before the pencil looked straight, now it appears to be bent.

As light moves from one kind of matter into another its speed changes. It might go faster or slower. Light usually travels in a straight line, but as it's speed changes it appears to bend (or change direction).

11) When light bends, we call it refraction ( rih-FRAK-shuhn)

### Homework-

1- Would a thicker liquid make the light bend differently? (How could you find out?)

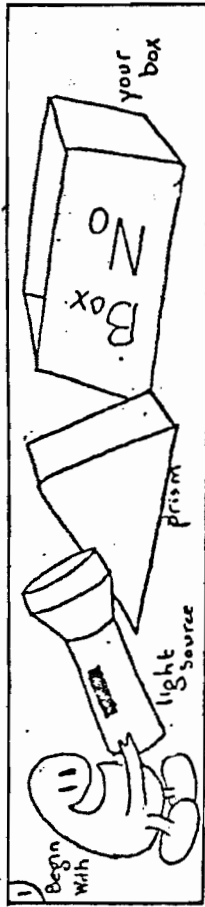
The thicker the liquid the more the light would bend. Light would go slower in a thicker liquid.

8) Draw how your set up looks.

10) Define- Matter-  
What all things are made of.  
Anything that takes up space.  
What a particular thing is made of.

# What makes up white light?

## Experiment 3



1) Begin With

2) When you put a pencil into water, why does it look bent? Light slows down when it enters the water. This makes the image of the pencil appear to be in a different place.

3) How can you bend light? You can bend light by slowing it down or speeding it up. You can do this by sending light through something other than air.

4) Why do you say this? I have tried it and it works. The thicker the substance you want the light to go through, the more light bends.

5) Lets find out what happens when you bend light as far as you can.

6) Empty your box. You will need it for this experiment. Set this up

© Grambo

7) Turn the prism while the light is hitting it.

8) Where do the colors come from? White light is made of these colors put together. Bending the white light just takes them colors apart. What direction does the colored light go? The colored light goes off in a more bent direction

9) This is like a rainbow. The white light bends so much it breaks up into a spectrum of colored light

10) How does the prism affect the white light? The prism bends the light so much that it breaks the white light up into colored light.

11) Draw the colors you see. (in order)

red  
orange  
yellow  
blue  
indigo  
violet

12) In nature light hits water drops. The water drops act like prisms bending light to create a colored rainbow.

### Homework-

1-What is a spectrum? What is a prism?

A spectrum are the colors that white light breaks up into.. A prism is a triangular piece of glass or plastic that can bend light.

2-How is a rainbow made?

See box 12.

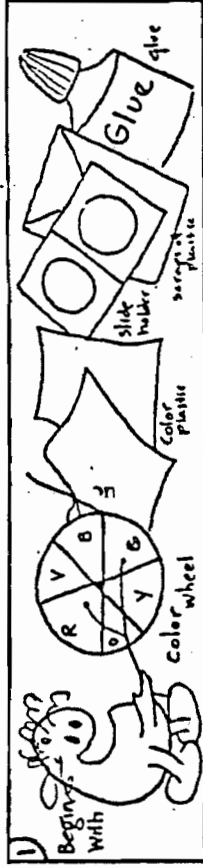
3- Why is orange between red and yellow?

answer key

lenses and the refraction of light

Name \_\_\_\_\_  
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# How do colored lights interact with each other? What happens when colored lights meet?



2) Remove the color wheel from the envelope. It looks like this

3) Pull on the strings so the wheel spins

4) How does turning affect the colors on the card? The colors seem to disappear.

5) The colors of light can be put back together again.

6) How does the plastic affect the light? It makes the light turn another color.

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9) Why do you think this happens?  
The light goes through the plastic and is absorbed by the plastic. Only red or the color of the plastic can come out.

10) Try mixing a few colors

11) Tell what happens!  
Colors Used: varied, varied  
Results: varied, varied

## Lets try using alot of colors

12) Find the slide making envelope Remove the coin holder and bits of colored plastic.  
A- Take the coin holder and bend it.  
B- Place plastic bits and other thin objects inside the holder.

13) Glue the holder closed.

14) Place your slide into the viewer.

15) Describe what you see. Colors blend together to create new colors.

16) How do the colors affect each other? Colors mix.

17) Draw what your slide looks like.  
It should be round and colorful

## Homework -

1- Why do some spots on the slide come out black?

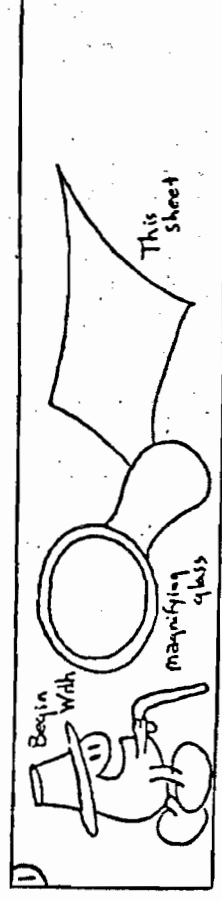
Light can not go through opaque objects.

2- Where does the orange and green come from?  
Red and yellow make orange  
Yellow and blue make green



# Experiment 5

How do you use a magnifying glass?



2) Place the magnifying glass on top of these words. How does it affect the words?

It does not affect the words at all

3) Begin to lift the magnifying glass while looking through it.

4) How are the words affected now? The words appear to get larger.

5) What happens when you move the magnifying glass even further away? After a certain point the image just gets blurry.

6) Why do you think the words blur? You are passed the focus point (called focal point) of the lens. You can not focus it any more.

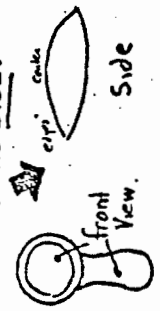
© Grambo

7) Define - magnify  
 To make larger

8) Define - focus  
 To make clear. The point where the rays of light come together to form a picture or image.

9) How can you make the letters on this page look larger but clear?  
 Use a lens and hold it at a certain distance from the paper. large

10) Draw what your magnifying glass looks like from the side.



11) Movie and slide projectors have magnifying glasses in them. How do they help make a picture look larger?  
 They take the object and enlarge it by use of lenses

## Homework -

1- Define Image - A picture, a likeness or copy of something.

2- How can you get an image in clear with a magnifying glass? Move the magnifier to get different focal distances.

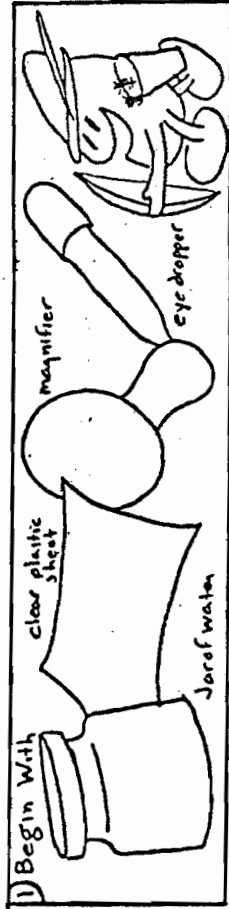
answer key

lenses and the refraction of light


Name \_\_\_\_\_  
Class \_\_\_\_\_ Group No \_\_\_\_\_

# Can a drop of water be a magnifier?


## Experiment 6



2) What does magnify mean?  
It means to make larger.



3) How can you make an object look larger?  
Use a convex lens or magnifier.



4) Cover these words with clear (no color) plastic so the paper does not get wet. Put a drop of water on top of these words.

5) Look at the words through the water. Describe how the words look.  
The drops make the words look larger.

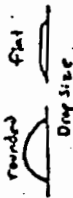
© Grambo 11

6) Does the drop of water make the letters larger or smaller?  
It makes the words look larger.  
How can you tell? (you might use the ruler)  
Use the ruler to see which drops are larger. Look to see which magnifies more.

7) Add more water to the drop on your page.

8) Does making the drop larger magnify the letters more?  
No it does not.


9) Does a rounded drop magnify more than a flat drop? How can you find out?  
Try it. The more rounded the drop is the more it magnifies.



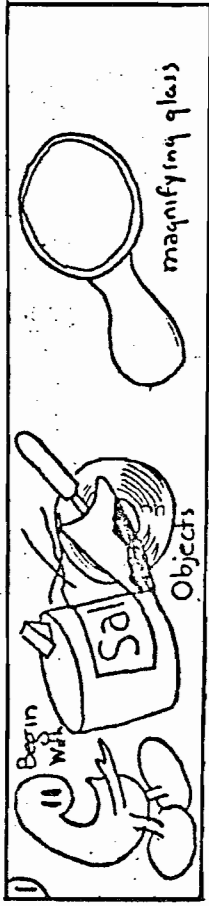
10) What happens to the magnifying power of water when the drop is flattened out?  
Rounded drops make it look larger. As you flatten the drops the size on the image decreases.

Homework -  
1- How can water be used as a magnifying glass?  
The curve of the water drops bend light which makes objects look larger.

11) Look through a jar of water at this page. Describe how the words look.  
The words appear to be larger.



# What else can you discover with a magnifier? Experiment 7



3) Is the magnifying glass the same thickness all over? (feel it and draw what you feel)  
It is fatter in the middle than on the edges.

2) Why would a jeweler use a magnifying glass?  
The jeweler would use it to see small things on the jewelry.

4) How does this thickness affect the picture that you get? (remember the flat water drop)  
The fat magnifiers get a larger picture.

5) How does a magnifier help you see tiny objects? It makes tiny objects look larger.

6) look at the objects through the magnifying glass

Object	Drawing	What you learned
Salt		It is made up of little cubes.
hair		Some hair is seethrough. The root is fatter than the shaft. The ends can be split.
soil		It is made of tiny rocks and leaves.
phonograph record		It has grooves in it that are all bent.

## Homework -

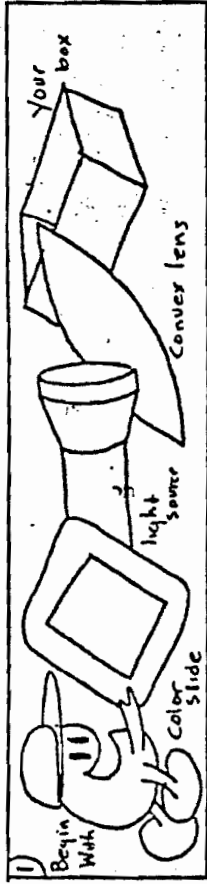
1-look at 5 other objects through the magnifying glass. Make a list with drawings and a description of what you learned about each  
Varies with objects.

answer  
key

lenses and the refraction of light.

Name \_\_\_\_\_  
Class \_\_\_\_\_ Group No \_\_\_\_\_

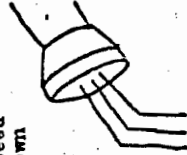
# What is a Convex lens? Experiment 8



1) Describe what happens when light moves from one medium to another. Light will slow down or speed up. It will appear to bend.

2) How can you get light to bend?

Make light speed up or slow down



3) Describe where the thickest part of your magnifying glass is. [Draw a picture]

The thickest part is in the middle

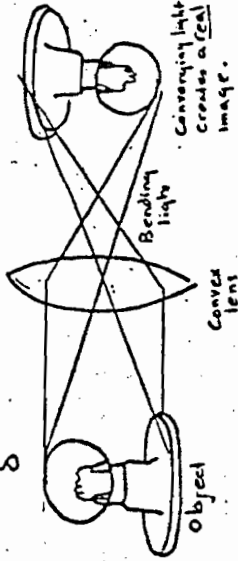


© Grambo

5) Define -  
**Lens** - A curved piece of glass or plastic that bring together or spread out rays of light.

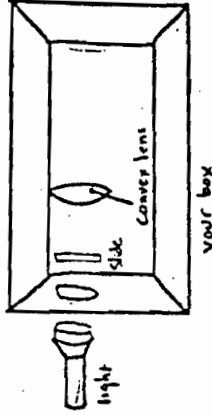
6) A magnifying glass is a lens. It is a convex lens. The thickest part of this lens is in the middle

7) As light enters the lens it is bent. The light coming out of the convex lens is bent inwards



The lens will project an upside down image on a wall.

8) Set this up



Turn on the light. Describe the image you get.

An image of the slide is projected on the box.

Homework -

1- How does a convex lens affect light?

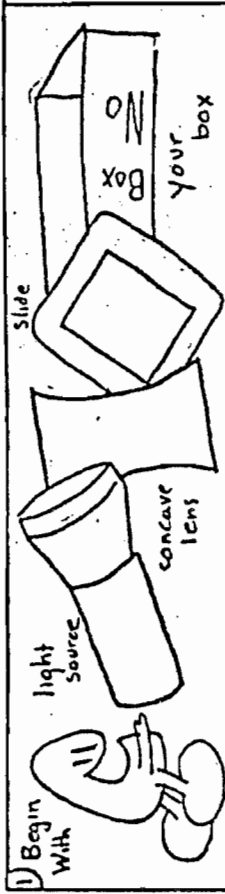
It bends light inward to focus an image behind the lens.

Lenses and the refraction of light

Name \_\_\_\_\_  
Class \_\_\_\_\_ Group No \_\_\_\_\_

# What is a Concave lens?

## Experiment 9



2) Look at this printed page with the concave lens. Describe how it makes the words look?  
It makes the words look smaller



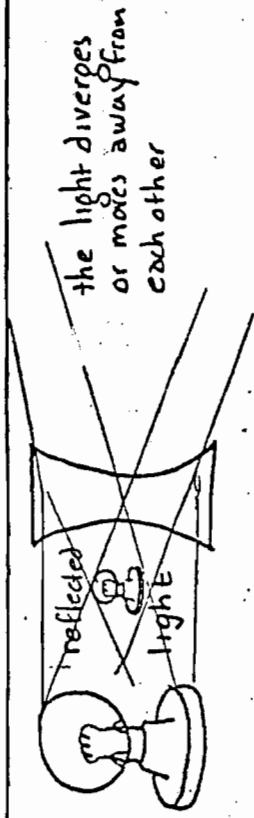
3) How can you tell the concave lens from the convex lens?  
The convex lens is fat in the middle and small on the sides. The concave lens is skinny in the middle and fat on the sides. Concave lens reduces pictures.

4) Define-  
Concave - To bend in  
Convex - To bend out

5) If a concave lens were put into a projector it would not make a real image on a screen

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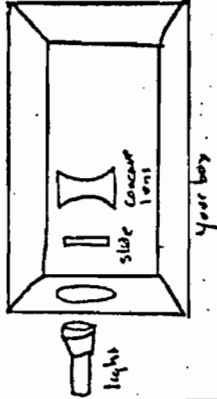
6)



The lens will focus an image in front of the lens. The image however can not be seen so we call it a virtual image

7) Set this up

What happens to the image of the slide?



No image appears due to the fact that the focus is in front of the lens.

### Home work -

1- What is the difference between a concave and convex lens?

See box 3

2- What is the difference between a real image and a virtual image?

A real image you can see. You can not see a virtual image.

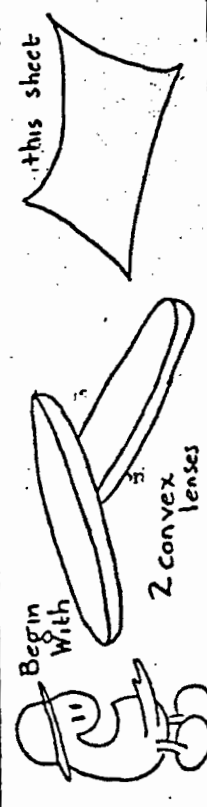
# answer key

lenses and the refraction of light

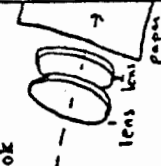
Name \_\_\_\_\_  
Class \_\_\_\_\_ Group No \_\_\_\_\_

# What happens when you put lenses together?


## Experiment 10

1) 

2) How do you think the words on this page would look if you viewed them through 2 convex lenses?  
The words would look larger

Try It 


3) What does focus mean?  
To bring light together to form an image.



4) Why must you move the lenses close together or further apart to get a clear picture?  
This will allow you to focus the lenses. Lenses focus at specific distances.

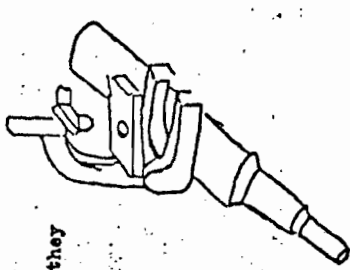
© Grambo

5) How can many lenses help you see better?  
They can make small objects look larger.  
They can make things look clear. As in eyeglasses which help the eye to focus on things.



6) How can lenses help scientists and police?  
Microscopes (with lenses in them) help these people see small things that the naked eye alone can not see.

7) Many lenses are used in microscopes and telescopes. Explain (after looking in an encyclopedia) how a microscope or telescope works.  
The drawings should show the lenses and how they bend light to enlarge small objects. Consult your encyclopedia.



### Homework

1- How can two lenses work better than one?  
The lenses work together to enlarge an image. The magnification powers of the lenses multiply.

Lenses and the refraction of light

Name \_\_\_\_\_  
Class \_\_\_\_\_ Group No \_\_\_\_\_



### Quiz on Experiments 1-3

1- Prove light travels in a straight path.

Do the experiment with the cards and the flashlight. If light is coming out of a room it lights up what is in front of the room not what is on the side of the door.

2- Define

Refraction - The bending of light

3- Why does a pencil look bent when you put it in water?  
Light slows down when it enters the water. The slowing down makes the pencil appear to bend.

4- How does a prism affect light?

It bends light so much that it breaks up into the colored lights it is made of.

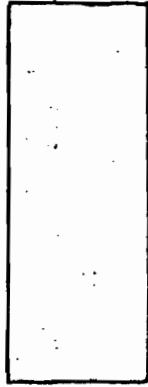
5- How is a rainbow formed?

Light enters a water drop, where the light is bent. Light then breaks up into colors. If there are enough water drops doing this, you get a rainbow.

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Lenses and the refraction of light

Name \_\_\_\_\_  
Class \_\_\_\_\_ Group No \_\_\_\_\_



### Quiz on Experiments 6-10

1- How can you use water to magnify an object?

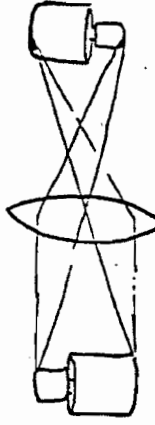
The curved drop acts as a convex lens which will enlarge an image of an object.

2- What is a convex lens?

It is a lens that is fatter in the middle than on the sides. It will magnify an object.



3- Show how a convex lens works



4- How is a convex lens different from a concave lens?



A concave lens reduces the image the convex lens enlarges the image

5- How does a microscope or telescope work?

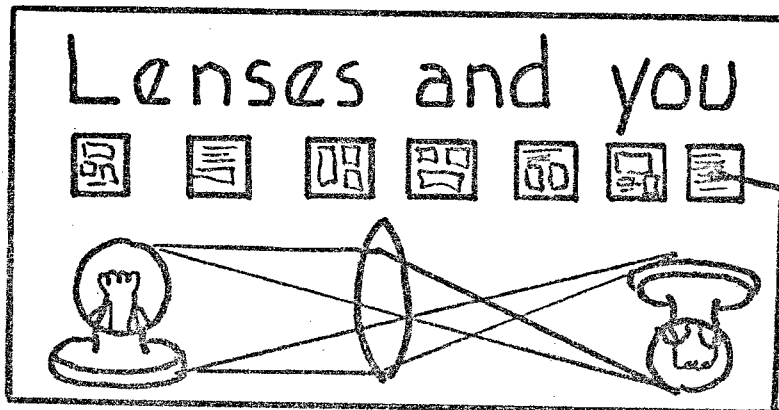
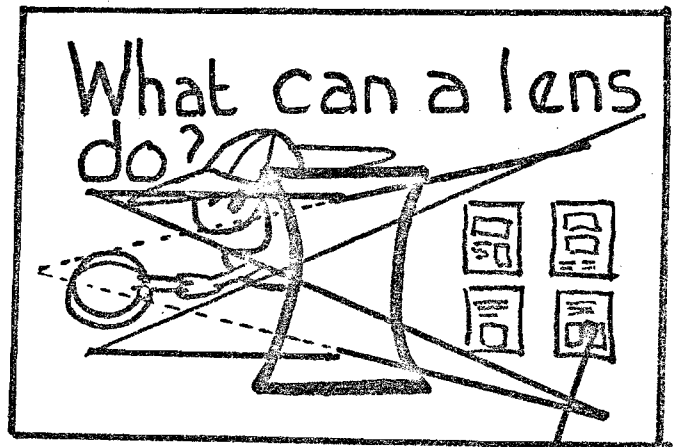
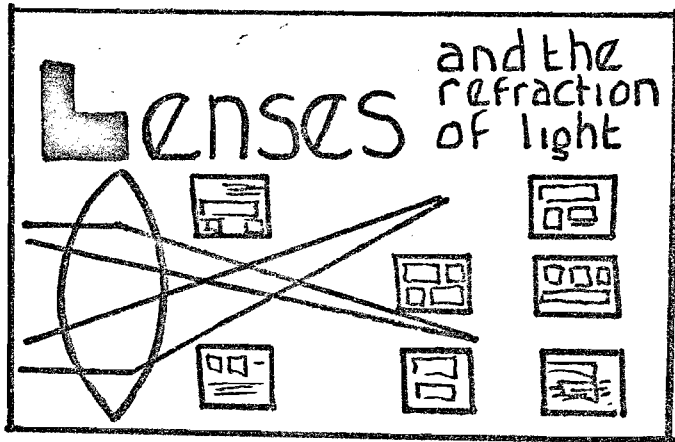
See experiment ten box seven.

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answer key

# Bulletin Board Ideas

Students love to see their work on display. A bulletin board is a great place to show off their work. Tests and worksheets can be hung on the bulletin boards shown below. Please feel free to copy any or all of the designs below, or combine parts of them to create your own design. You can make a transparency of the designs below and project them onto a bulletin board, with the use of an overhead projector, for easy tracing.



Student  
work  
sheets