Science 8

Optics 6

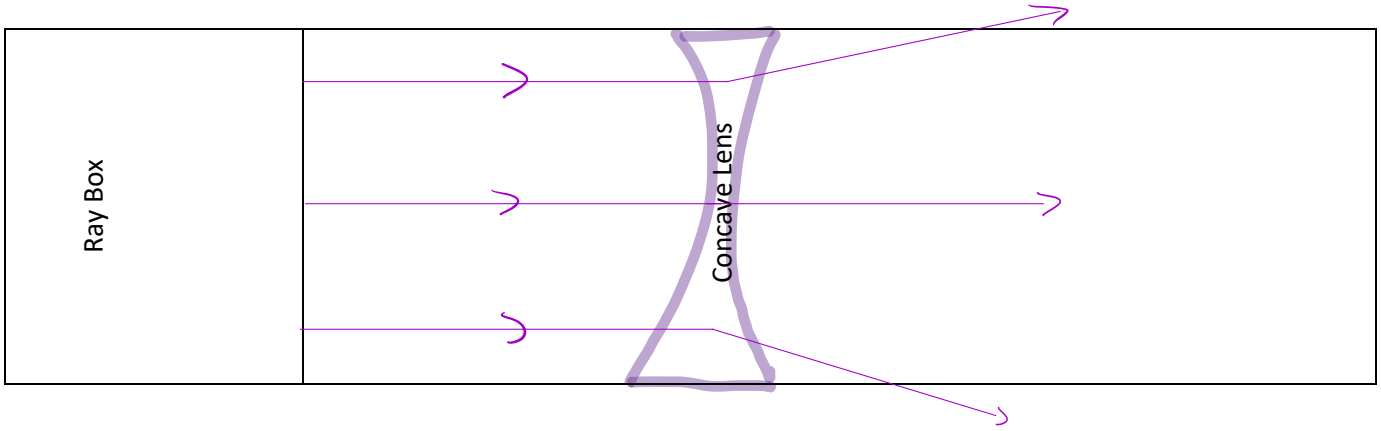
Name: Key
Date:
Block:

1. **Lab activity**
2. **Concave/Convex Lenses**
3. **Law of Refraction**

Lab Activity

For the following, draw the rays that emerge from the ray box and through the convex and concave lens. Make sure to use a **ruler** for all straight lines.

Concave Lens



Are the rays converging (coming together) or diverging (going apart)? Diverge

Where is the focal point? No focal point

Now take a **circular concave lens** and answer the following questions.

- Hold the lens a few inches from your eye to look at an object. Make sure the image is focused.
- Does the object look smaller or larger? Smaller
- Does the object look upright or inverted (upside down)? Upright

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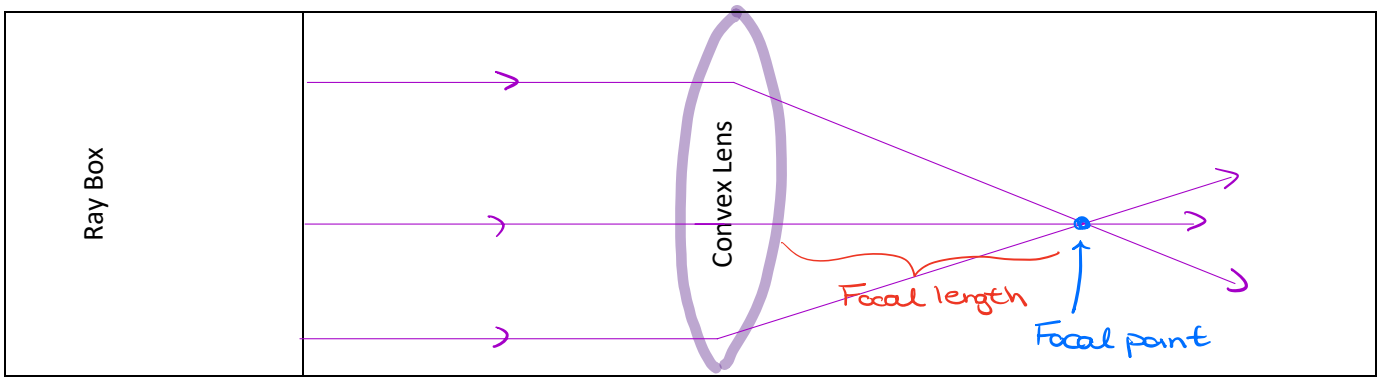
Now compare a concave MIRROR and LENS

	MIRROR	**LENS**
Do the rays converge or diverge?	Converge	Diverge
If the object is far from the concave mirror/lens, it will appear…	Inverted, smaller	Smaller, upright
If the object is close from the concave mirror/lens, it will appear…	Upright, larger	Smaller, upright

Convex Lens



Are the rays converging (coming together) or diverging (going apart)? Converge

Where is the focal point? Behind lens

Can you measure the focal length? (yes or no) If so, what is the focal length in cm? _____

Now take a **circular convex lens** and answer the following questions.

- Look through the lens at an object on the other side of the classroom.
  - Does the object look smaller or larger? Smaller
  - Does the object look upright or inverted (upside down)? Inverted
- Now look through the lens at the text on this paper. Make sure the text is in focus.
  - Does the text look smaller or larger? Larger
  - Does the text look upright or inverted (upside down)? Upright

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Now compare a ~~concave~~ convex MIRROR and LENS

	MIRROR	**LENS**
Do the rays converge or diverge?	Diverge	Converge
If the object is far from the concave mirror/lens, it will appear…	Upright, smaller	Inverted, smaller
If the object is close from the concave mirror/lens, it will appear…	Upright, smaller	Upright, larger

Concave/Convex Lenses

Concave Lens

- A lens that is curved in.
- Thinner in the middle.

Convex Lens

- A lens that is curved out.
- Thicker in the middle.

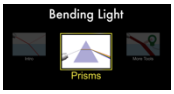
Uses of Concave Lens: (To see for away)

- Binoculars
- Telescopes
- Glasses – Nearsighted

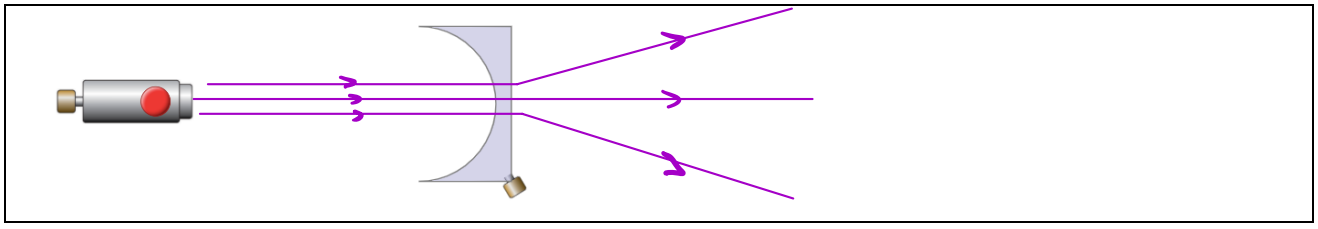
Uses of Convex Lens: (To see up close)

- Magnifying glass
- Camera
- Glasses – Farsighted

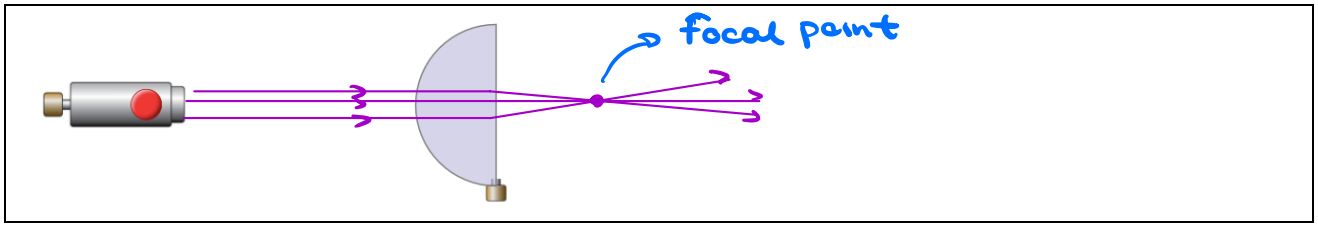
Activity: https://phet.colorado.edu/en/simulation/bending-light

1. Click "Prisms" 

2. Select the "multi-beam" light source. 
3. Place a **concave lens** in front of the light source. Turn the light source on.
4. Sketch what you see (with a ruler!!) in the box below:



5. **Are light rays converging or diverging?** Diverging
6. Take a concave lens. Look at this text. The image is upright (upright/upside down) and smaller (smaller/larger).
7. With the same concave lens, look at something across the room. The image is upright (upright/upside down) and smaller (smaller/larger).
8. Place a **convex lens** in front of the light source. Turn the light source on.
9. Sketch what you see (with a ruler!!) in the box below:



10. **Are light rays converging or diverging?** Converging
11. Take a convex lens. Look at this text. The image is _upright_ (upright/upside down) and _larger_ (smaller/larger).
12. With the same convex lens, look at something across the room. The image is _upside down_ (upright/upside down) and _smaller_ (smaller/larger).

Law of Refraction

- The _bending_ or _changing direction_ of light rays as it moves from one material to another.
- Light rays move at _different speeds_ depending on the _density_ of the materials it is travelling through.

Materials:

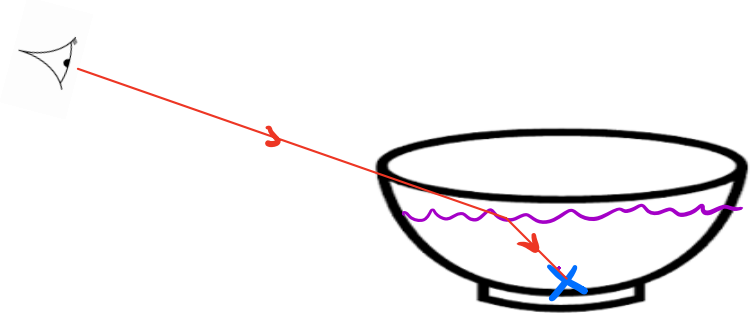
- A small opaque bowl
- A pen
- Water

Procedure:

1. Place the bowl on the lab bench.
2. Have one partner slowly walk away from the bowl so that the X is just out of sight.
3. Without moving your position, have the other partner slowly pour water into the bowl.
4. Switch roles and repeat the experiment.
5. Clean up your materials.

Question:

1. What do you notice when the water is poured into the bowl? 'x' becomes visible.
2. What happens when light passes from one material to another? Light refracts (bend)
3. Draw what you think the path of light is in this experiment:

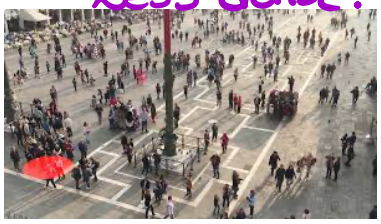


Density

- How tightly the molecules are packed together.

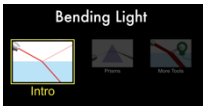
More dense

Less dense.



- The greater the density, the more difficult it is for the light rays to pass through.
- The more difficult, the slower the light rays will travel and will therefore bend towards the normal.

Activity: https://phet.colorado.edu/en/simulation/bending-light

1. Click "Intro". 

2. Confirm that the TOP material is "Air" and the BOTTOM material is "Water".
3. Turn on the light!
4. Bring the protractor over from the bottom left box and line the "0" up with the normal (dotted line). 
5. In the AIR, what is the **angle** between the normal and the incident ray? 45°
6. In the WATER, what is the **angle** between the normal and the refracted ray? 31°
7. Repeat steps 3-6 and fill in the following table:

Experiment	Top material	Bottom material	Incident Angle	Refracted Angle
1	Air	Water	45°	31°
2	Water	Glass	45°	39°
3	Air	Glass	45°	26°
4	Water	Air	45°	70°
5	Glass	Water	45°	52°

less

greater

8. In which experiments was the beam of light going from a material that is **less dense to more dense?**

1, 2, 3

9. In those experiments, is the refracted angle greater or less than the incident angle?

Less, light bends towards the normal.

10. In which experiments was the beam of light going from a material that is **more dense to less dense?**

4, 5

11. In those experiments, is the refracted angle greater or less than the incident angle?

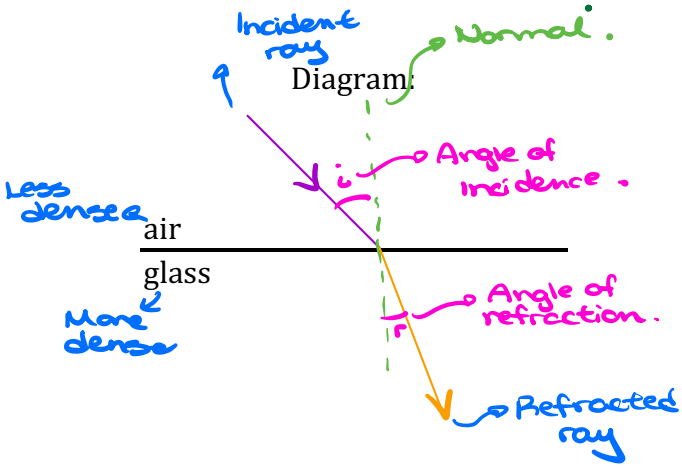
Greater, light bends away from the normal.

Conclusion:

When moving from a material that is __less__ dense to a material that is __more__ dense, the light rays will:

1. Slow down
2. Bend towards the normal

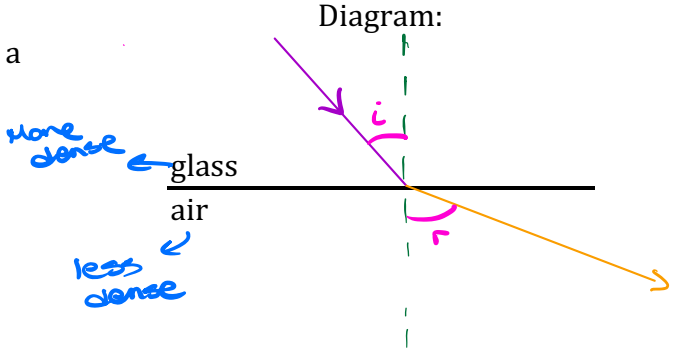
Diagram:



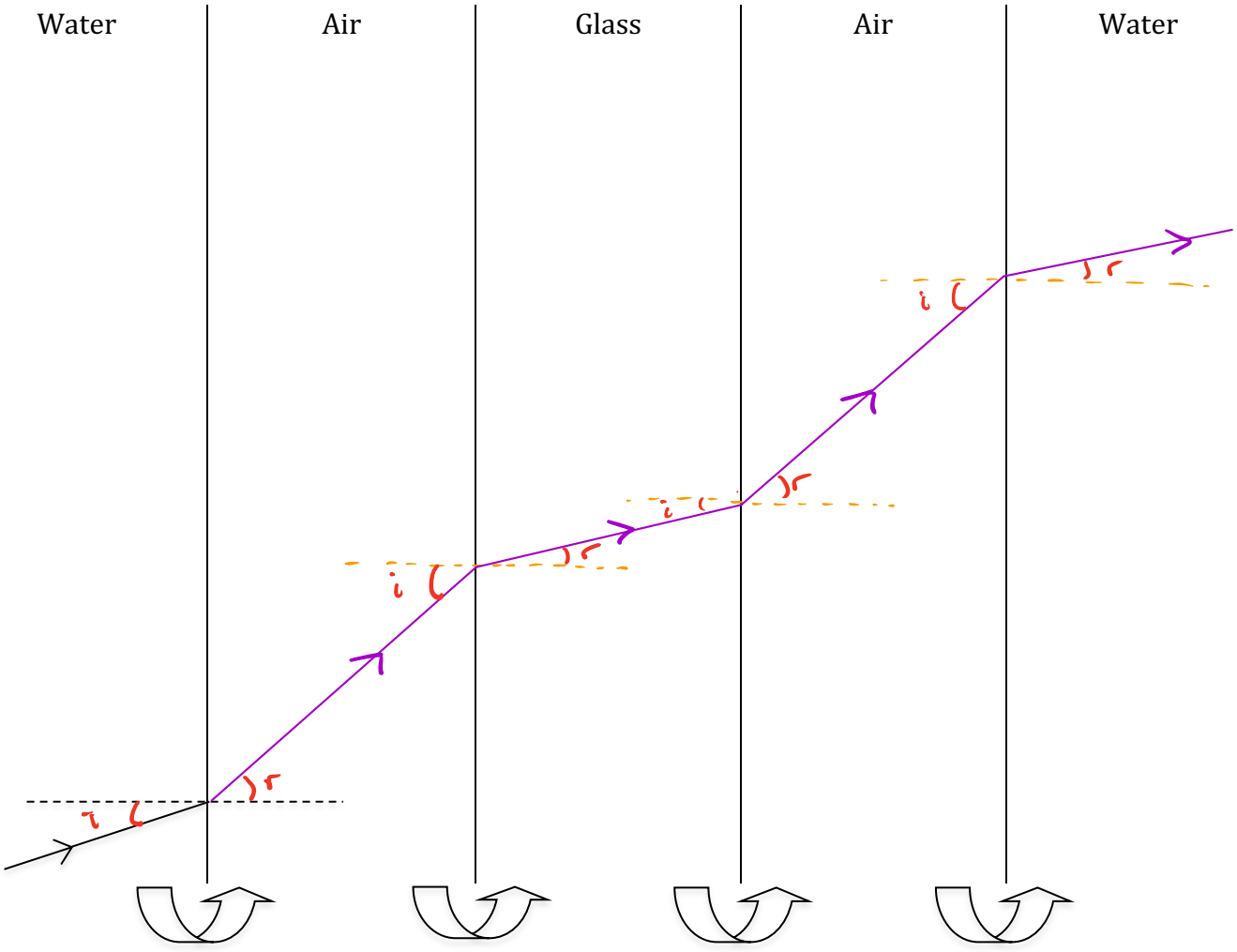
When moving from a material that is __more__ dense to a material that is __less__ dense, the light rays will:

1. Speed up
2. Bend away from normal.

Diagram:



Draw a sketch of how light behaves as it passes from left to right through the following materials. Remember there is a NORMAL at every boundary!



Material more or less dense?	Material more or less dense?	Material more or less dense?	Material more or less dense?
Light will bend toward or away from normal? Away	Light will bend toward or away from normal? Toward	Light will bend toward or away from normal? Away	Light will bend toward or away from normal? Toward