Light

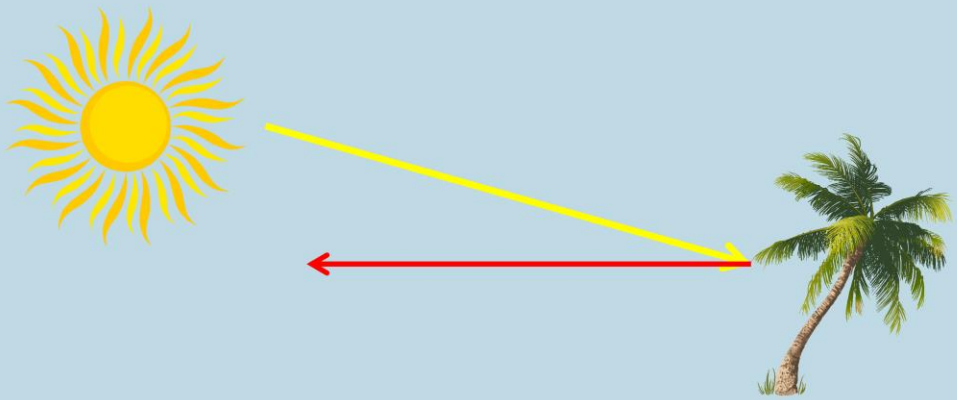
Teacher's Notes – Goals: At the end of this lesson students should understand – 1) Light travels in straight lines, 2) When we see objects we are seeing light reflected off objects, 3)The difference between light sources and light reflectors, 4) The difference between opaque, translucent and transparent materials.

What is a light?

Light is a form of energy, it allows us to see things

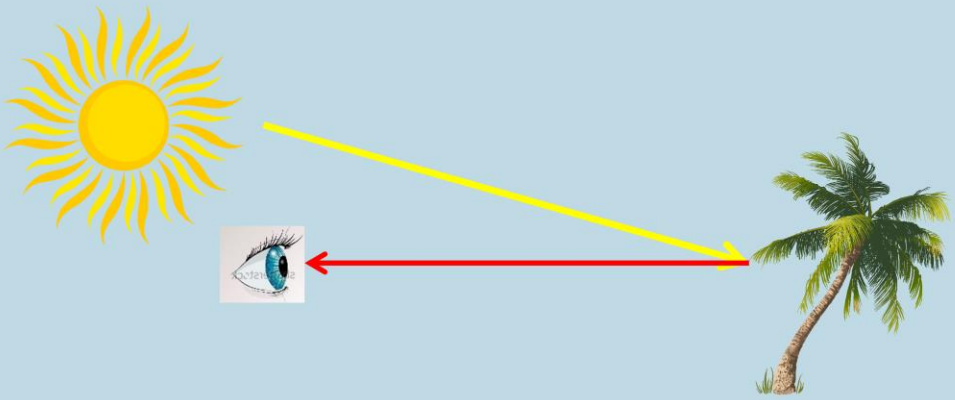
How does light let us see?

When light travels it goes in straight lines. When it hits an object, it bounces off.



How does light let us see?

When the light bounces off an object and into our eye, that lets us see the object.



How does light let us see?

In the picture below, light from the sun hits the book and bounces back to the girls' eyes letting her see the book.

What is a light source?

A light source produces light. Which of these is a light source?








What is a light source?

If you wrote down these as a light source you are correct. All the other objects reflect light, they don't produce it.

The Moon – If you thought the Moon was a light source that was indeed a tricky question. The moon looks like it's giving off light but it is really only reflecting the light of the Sun.

How does light travel?

So how do you think light travels?

In a straight line?

In a curve?

In some other way?

How can we prove which is right?

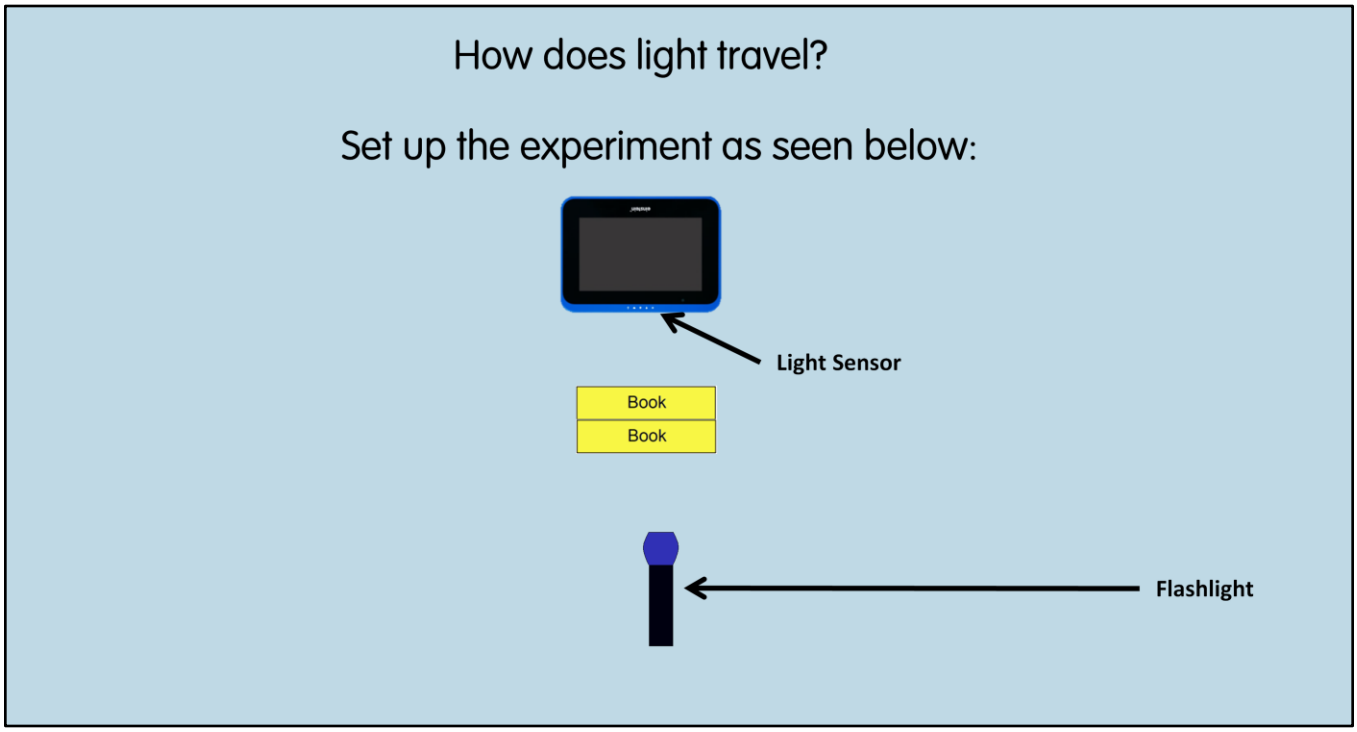
Teacher's notes – This is an opportunity for an open discussion in the classroom. Take suggestions from students about how they think light travels and why. Then have them discuss experiments that might prove their point. Their suggestions don't necessarily have to do with sensors, for instance creating shadow puppets. Time permitting you may even try some of these experiments.

How does light travel?

Let's try an experiment to see if light travels in a straight line

For this experiment you will need:

- An einstein™ device
- An LED flashlight
- Four mirrors
- 2 books



In this experiment the students should not receive any light reading from the flashlight (the books should prevent any light “from reaching the light sensor.).

How does light travel?

- First, try and predict how much light will reach the light sensor.
- Tap and drag the bar above the hand icon to make your prediction.
- Notice the scale on the left side of the graph.
- Turn on flashlight, then tap the Run button to measure.

Teacher's notes – For best results this experiment should be conducted in as dark a room as possible. The graph should show no light.

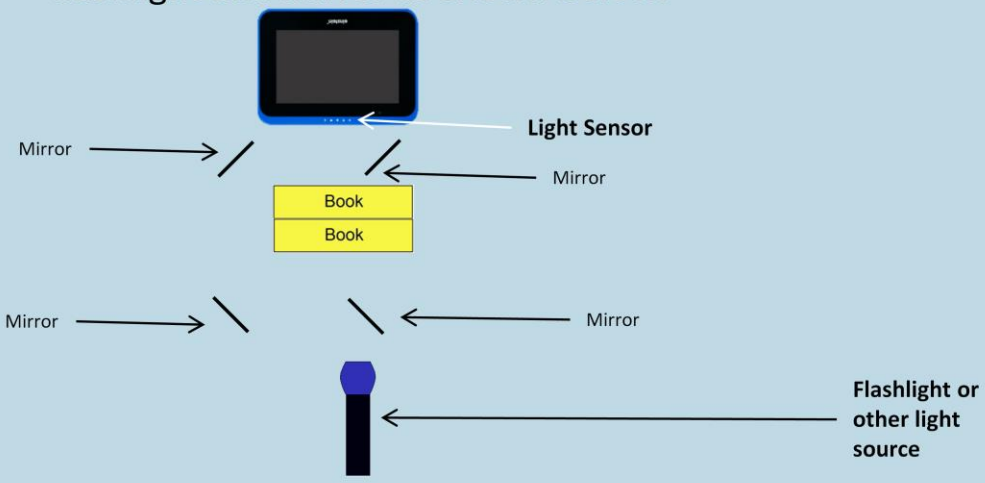
How does light travel?

How much light got through?

Teachers' Notes – This setup is somewhat complicated, you should double check the students' set up. You may need to hold the flashlight close to the mirror.

How does light travel?

Okay now we're going to add a mirror to the experiment. Set up the flashlight and mirror as shown below.

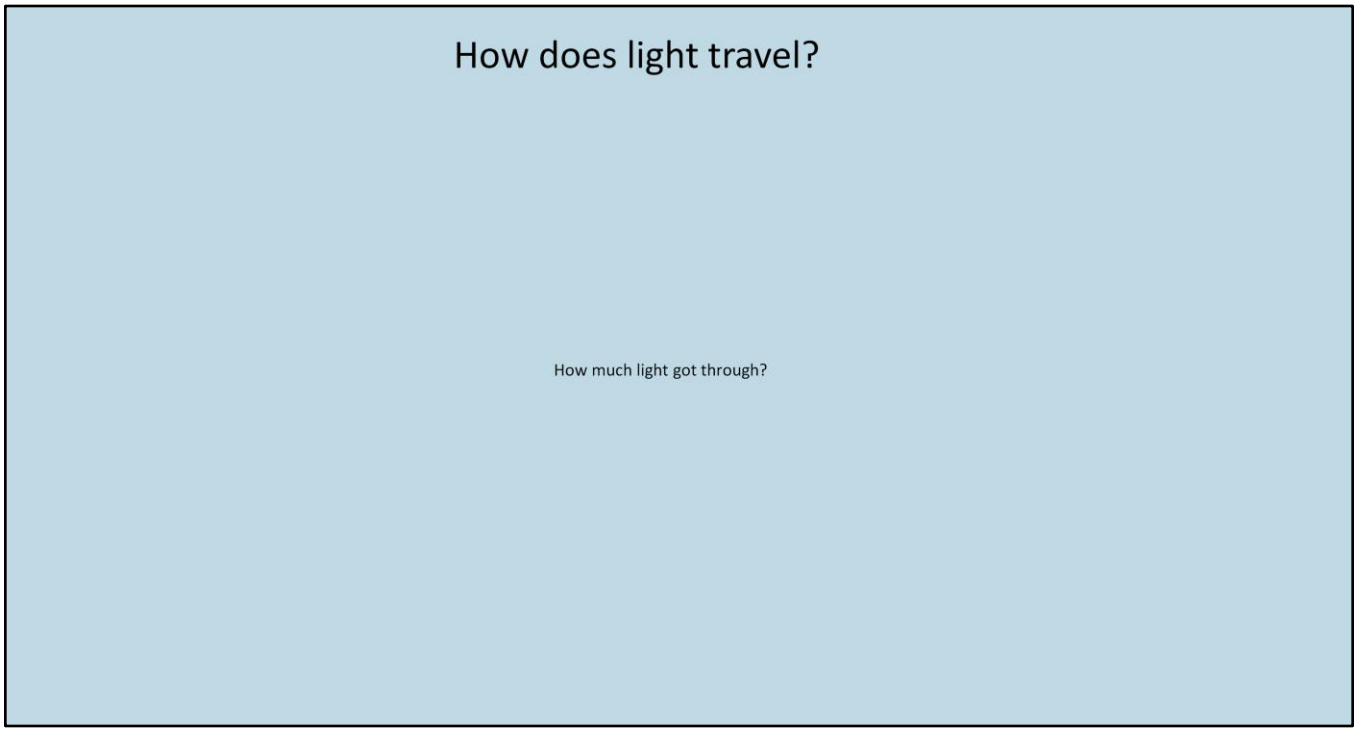


Teachers' Notes – Important points for better results: Conduct the experiment in as dark a room as possible, use as powerful and focused a light source as possible and elevate the einstein™device slightly (a thin book is ideal for this). This setup is somewhat complicated – if the mirrors are not set up at the correct angle no light will reach the sensor. To help out there is a sheet available at einsteinworld.com/experiments (it is called *Layout for the Light Stuff Activity*). You can print out this sheet on A3 paper and set up your experiment using the sheet. Alternatively you can have the students create setup sheets which you can check before the experiment. Note that if students encounter difficulties this is also an opportunity to explain how to troubleshoot experiments and how we can even learn from "failed" experiments.

How does light travel?

- First, try and predict how much light will reach the light sensor.
- Tap and drag the bar above the hand icon  to make your prediction.
- Notice the scale on the left side of the graph.
- Turn on flashlight, then tap the Run button  to measure.

Teacher's notes – For best results this experiment should be conducted in as dark a room as possible. The graph should measure the reflected light.



Teachers' Notes – The left side of the graph is numbered, showing the amount of light let through in lux, however at this stage it si enough for students to understand that the higher the bar the more light so they can answer the question in those terms. This slide can be answered by the students on their tablet or as a class discussion either with the whole class or in their teams.

How does light travel?

What was the difference between the two experiments and how do you explain the different results

Teacher's notes – This is for an open class discussion. At the end students should understand that the light travels in a straight line but is reflected from the mirror to the light sensor. Optional – Have one of the students draw on the whiteboard the path that the light takes from the flashlight to the light sensor to show that it is traveling in a straight line. A mirror is used because it is designed to reflect light as perfectly as possible.

How does light travel?

Why did we use a mirror in the experiment?

Teacher's notes – This is for an open class discussion, it can be combined with the previous slide if desired.

Opaque, Translucent and Transparent

In this experiment we saw that light travels in a straight line. In addition, the light cannot shine through a book. That is because the book is opaque meaning light cannot penetrate it.

Teacher's notes – At this point we are transitioning into the second part of the lesson. In this section we will be discussing and experimenting with the difference between opaque, translucent and transparent materials.

Opaque, Translucent and Transparent

We can divide materials into three categories: Opaque, Translucent and Transparent

Opaque, Translucent and Transparent

Opaque materials do not let any light through them

Opaque, Translucent and Transparent

Translucent materials let some light through them

Opaque, Translucent and Transparent

Transparent materials let almost all light through them

Opaque, Translucent and Transparent

Let's do an experiment to test different materials

Opaque, Translucent and Transparent

For this experiment you'll need:

- An einstein™ device
- An LED flashlight
- Different materials to test (your teacher will give you the materials)

Teachers' Note – You should prepare several samples of different materials to test, make sure you have at least 2 types of opaque, translucent and transparent materials – Writing Paper, Newspaper, Cardboard, Plastic Wrap, Glass, Wax Paper, Aluminum Foil etc. and give them to the students or let them select on their own.

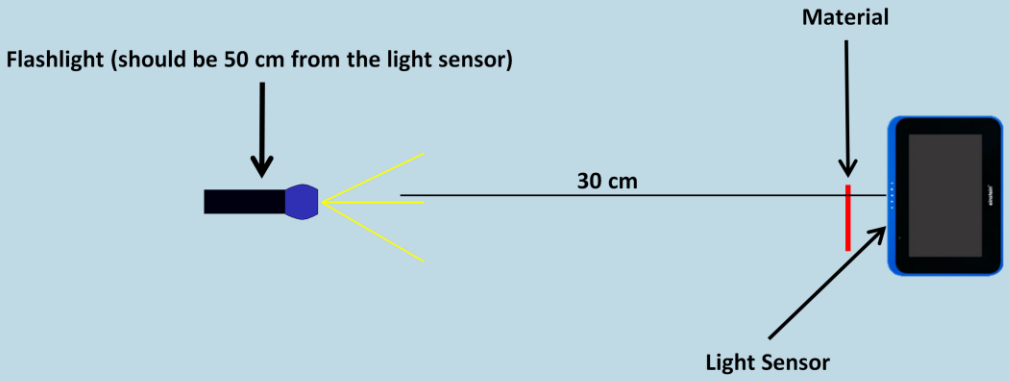
Opaque, Translucent and Transparent

First let's predict whether or materials are Opaque, Translucent or Transparent.

- Hold each material in front of the screen.
- If the material blocks the screen completely it's opaque, if you can see the screen but can't read the writing it's translucent, if you can read the writing, it's transparent.
- Note your prediction for each material.

Opaque, Translucent and Transparent

Now let's test your predictions. Set up your experiment as shown below:



Teachers' note – It is very important that the flashlight be held still, if a clamp is available that would be best. You can also use a lamp but lamplight tends to be stronger so should be placed further away from the sensor. Make sure when you are measuring Direct Light it does not reach all the way to the top of your scale, that means the light is too strong and should be held further away from the sensor.

Opaque, Translucent and Transparent

First we'll test the direct light.

- Turn the flashlight on and tap the Run button  .
- When the measurement stops note what the light level was.

Teacher's Note – This reading is done so that students can compare the direct light reading to the light readings through the different materials. Students should keep track of the direct reading so they can compare it to the next set of readings.

Opaque, Translucent and Transparent

Now we'll test the materials.

- Hold a material between the flashlight and the light sensor. Turn the flashlight on and tap the first Run button 
- Repeat, using a second material, this time tapping the second Run button.
- You can test and compare up to 6 materials.

Teacher's Note – Students should keep track of the light levels of the different materials. Again they do not necessarily have to keep track of the exact measurements but the relative height of the bars is good enough.

Opaque, Translucent and Transparent

How close were your predictions?

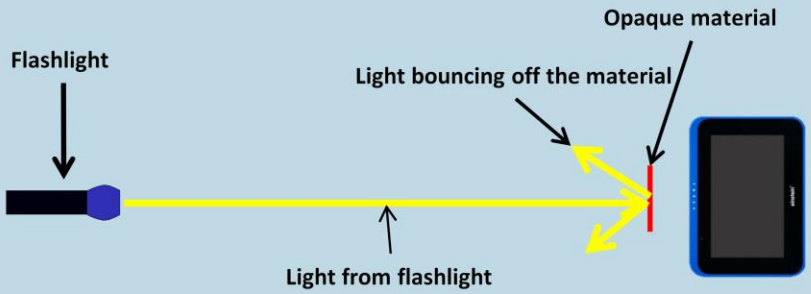
Opaque, Translucent and Transparent

So what makes opaque, translucent and transparent materials different?

Teacher's Note – Students should discuss, either as a class or in small groups what they believe is the difference between these materials.

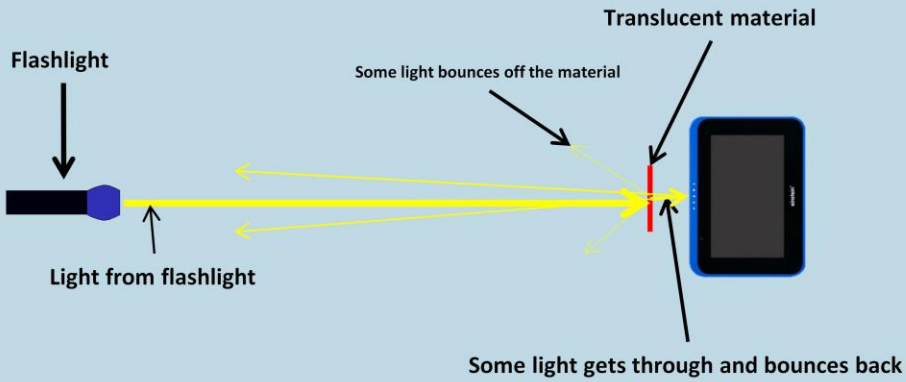
Opaque, Translucent and Transparent

When an opaque material comes between the flashlight and the light sensor, none of the light gets through – it all bounces off the material.



Opaque, Translucent and Transparent

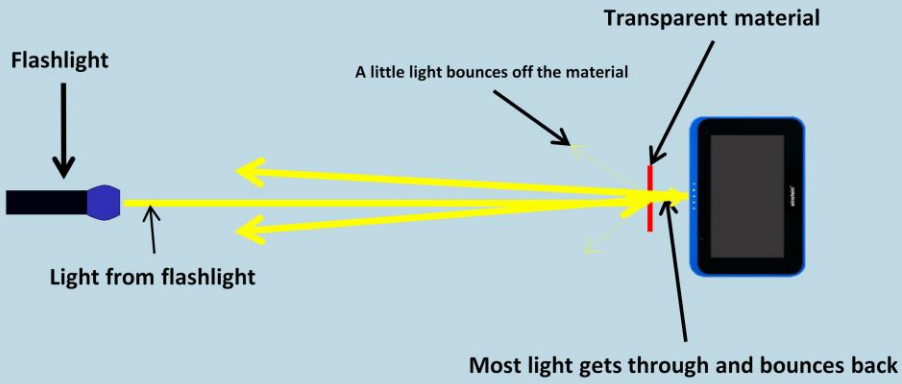
When a translucent material comes between the flashlight and the light sensor, some light gets through. Some of this light bounces back which is why we can partially see through translucent material.



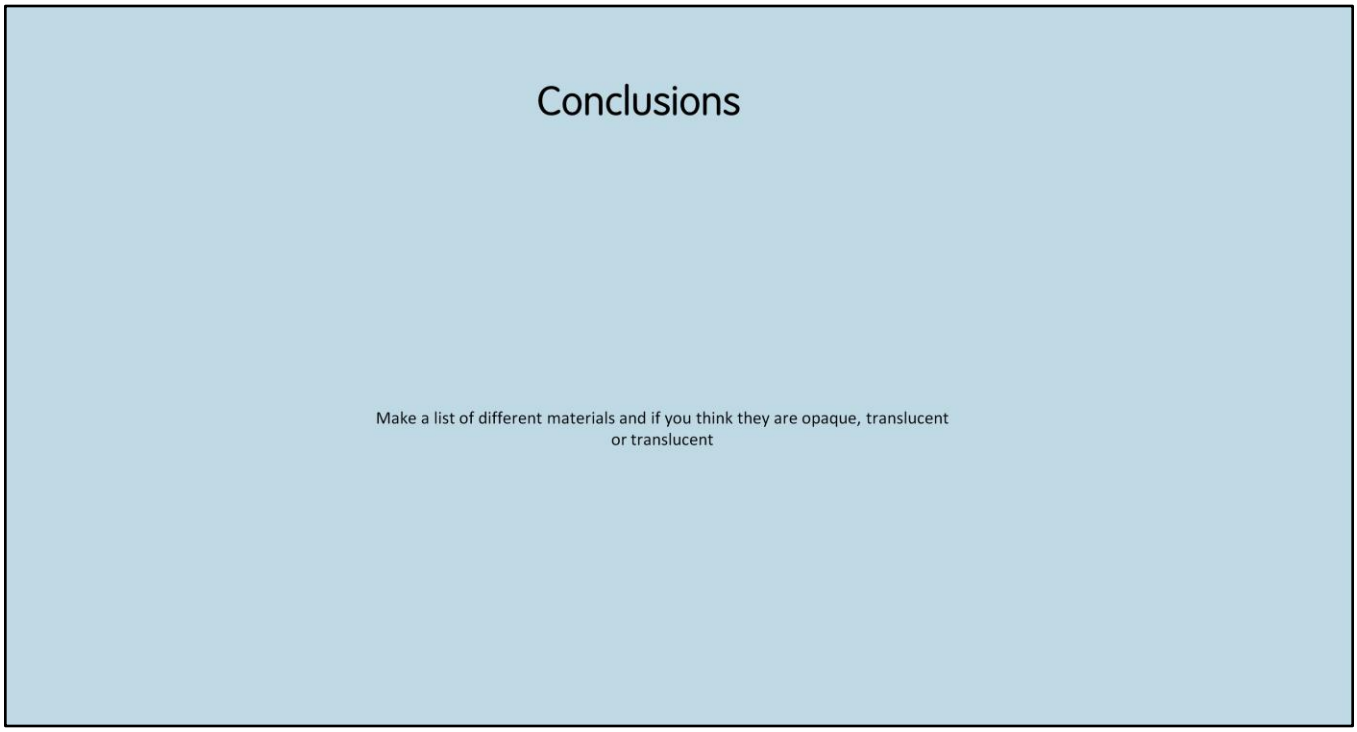
Teacher's Note: It is important to emphasize that some light bounces off the translucent material otherwise we wouldn't be able to see the translucent material. Light also bounces off the tablet allowing us to see the tablet.

Opaque, Translucent and Transparent

When a transparent material comes between the flashlight and the light sensor, most of the light gets through. Most of this light bounces back which is why we can see through transparent material.



Teacher's Note: It is important to emphasize that a little light bounces off the transparent material otherwise we wouldn't be able to see transparent material at all. Light also bounces off the tablet allowing us to see the tablet.



Teacher's Notes – Students can use einstein™World to create a list of materials and whether they are opaque, translucent of transparent or you can conduct a class discussion. At the end of the discussion students should be able to extrapolate from their experiment in order to classify materials they have not yet tested.


The End