Science in your pocket

Introduction

Have you ever thought about what *else* your phone can do? Sure it makes calls, takes photos, accesses endless information on the internet, tells you where you are, plays games, helps you get fit...This is still your phone remember.

There is more to it too. It also does science! Your phone is a sophisticated measurement device, and this investigation will concentrate on just on the of the many complicated measurements your phone can do.

1a. Questions and predicts - Prescriptive
Aim

To use a **smartphone/device**, to measure the change in intensity of light measurements over distance. This investigation uses the scientific concept of the inverse square law. In a science experiment, we change one variable (the independent variable) and measure another (the dependent variable) and see what the effect of the change is.

Hypothesis

A hypothesis, or testable statement to achieve this aim is:

_____ I move the phone from the light source, then the measurement of light intensity on the app will _____

2a. Learns and plans - Prescriptive

Equipment you'll need
These items may be slightly different in your case

- Smart phone
- ruler
- light meter app on your phone
- light source

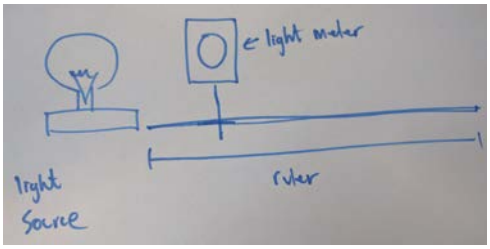
Risk	Consequence	Precaution
The things that could be a risk. - The light sources - _____	What happens of the risk occurs - Eye damage - _____	What to do to stop the consequence - Use caution - _____

Complete the following table to identify appropriate apps on your phone for measuring light intensity. The idea of this table is to make sure that you can search through some available applications in order to choose and justify the appropriate one. Since the app is part of the equipment list, we should be sure of which one is the most appropriate for the purpose.

	App 1 _____	App 2 _____	App 3 _____	App 4 _____
Cost				
Does it measure lux				
Does it record values?				
Does it save data?				
Does it show a graph?				
Other				

Method

- Set up the equipment as shown. A labelled diagram is necessary
- Open the appropriate app on your phone
- Place the smart phone 10 cm from the light source. Record the value given on the smart phone . It'll be a number with the units lux. Lux is a measure of light flux. Flux is the amount of (in this case) light passing through the detector in an amount of time.



- Move the smartphone back 5 cm and take the measurement. Make sure to record it in the table.
- Move all the way back in 5 cm increments

until the end of the ruler increments.

- Record your measurements

3a. Conducts - Prescriptive

Results
Complete the results table below. Also, using a calculator, use the values in the *Distance, r* column to calculate the $1/r^2$ column. We need this later in order to get a plot that is easy analyse.

How many times did you record the data? _____

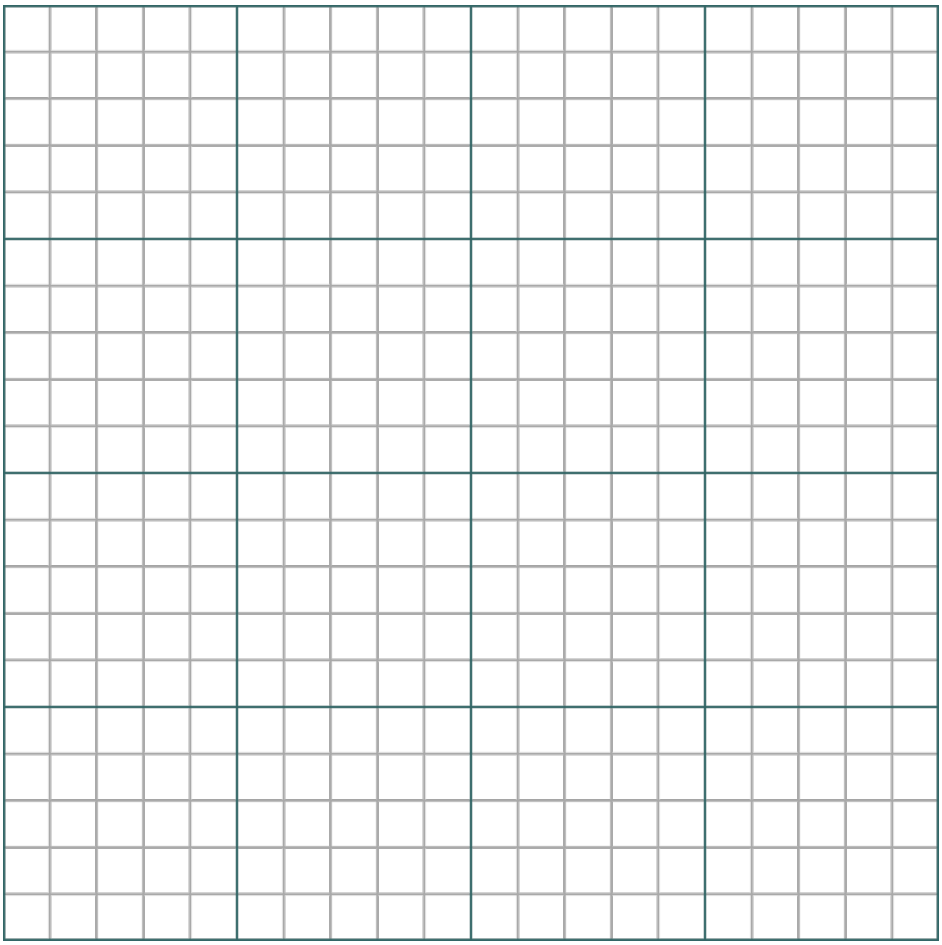
Light intensity, phone (lux)	**Distance, r (m)**	**$1/r^2$**
	0.10	
	0.15	
	0.20	
	0.25	
	0.30	
	0.35	
	0.40	
	0.45	
	0.50	

4a. Processes and analyses - Prescriptive

Plot your tabulated results on the following graph. On these plots, the y-axis will be the Intensity and the x-axis will be the $1/r^2$ measurement. It should be a straight line graph. This is why we use the $1/r^2$ calculation, rather than the distance measurement which gives a different shape that is easier to interpret.

When plotting graphs, there is a handy mnemonic to use in order to make sure your graph is *CUTLASS*.
C - Crosses. Use crosses instead of dots, dots can be seen as marks)
U - Units. Use appropriate units, like lux and meters
T - Title, the graph needs a title
L - Line of best fit. If you can, make a line of best fit. In this case we will. The line of best fit will give us a chance to make prediction. Line of best fit is not a join the dots
A - Axes. Use the correct axes. The independent variable (what you change) in the x-axis and the dependant variable (what you measure) on the y-axis
S - Scale. Your axes need to have appropriate scales and they need to be spaced incrementally
S - Size. Use the space provided, We want your graph to be as big as it can be. This is for as much clarity as we can manage

Intensity vs $1/r^2$ for phone



5a. Problem Solving - Prescriptive

Discussion
This is the section where we think about the results and what they mean.

What is the relationship between Intensity and distance? Can you find a mathematical expression for the relationship? Does your conclusion match your hypothesis?

Try and complete a risk assessment for an industry or career application that deals with light intensity.

Control for variables. List variables that can be controlled or changed etc.

	Control variable	**Independent variable**	**Dependant variable**
Variable	No light source	The thing you change: _____	The thing you measure: _____

Further investigation
How would you make the investigation better? What else could you measure with a phone? What else to phones measure and why?

If you were to extend your investigation, what would your next hypothesis be? Try to use your results from this investigation to help you guide your next investigation

Remember:
A hypothesis is a testable statement that should like something like:

"If _____[I do this] _____, then _____[this]_____ will happen."

Hypothesis

6a. Communicates - Prescriptive

Conclusion
Answer the question that we asked in the Aim.

There **is/is no**t a relationship between light intensity and distance.

We used a mobile phone application to measure the change in intensity of light measurements over distance. It was found that the results from an inverse square law investigation using a phone was able to be produced.

The implications of this are that our phones are incredibly powerful measurement devices capable of far more than what they fit-for-purpose design are:

Advancing Science & Engineering through Laboratory Learning

Science in your pocket - part b

Introduction

In the previous part of this investigation we have used a smartphone to measure the relationship between light intensity and distance. We can now do the same investigation with a light meter in order to make a comparison between the smart phone and a lab-based measurement device

1b. Questions and predicts - Prescriptive

Aim

To use a **light meter**, to measure the change in intensity of light measurements over distance. This investigation uses the scientific concept of the inverse square law. In a science experiment, we change one variable (the independent variable) and measure another (the dependent variable) and see what the effect of the change is.

Hypothesis

A hypothesis, or testable statement to achieve this aim is:

_____ I move the light meter from the light source, then the measurement of light intensity will _____

2b. Learns and plans - Prescriptive

Equipment you'll need
These items may be slightly different in your case

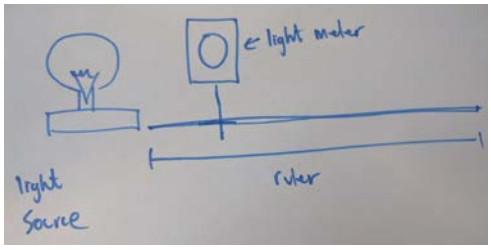
- light meter
- ruler
- Smartphone (for light source)

What are the safety concerns with this investigation? List three risks and corresponding consequences and precautions

Risk	**Consequence**	**Precaution**
The things that could be a risk. - The light source - _____	What happens of the risk occurs - Eye damage - _____	What to do to stop the consequence - Use caution - _____

Method

- Set up the equipment as shown. A labelled diagram is necessary
- Place the light meter 10 cm from the light source. Record the value given on the light meter . It'll be a number with the units lux. Lux is a measure of light flux. Flux is the amount of (in this case) light passing through the detector in an amount of time.
- Move the light meter back 5 cm and take the measurement. Make sure to record it in the table.
- Move all the way back in 5 cm increments until the end of the ruler increments.
- Record your measurements



3b. Conducts - Prescriptive

Results

Complete the results table below. Also, using a calculator, use the values in the *Distance, r* column to calculate the $1/r^2$ column. We need this later. We need this column in order to get a plot that is easy analyse.

Light intensity, lux meter (lux)	Distance, r (m)	$1/r^2$
	0.10	
	0.15	
	0.20	
	0.25	
	0.30	
	0.35	
	0.40	
	0.45	
	0.50	

4b. Processes and analyses - Prescriptive

Plot your results in the following graphs. On these plots, the y-axis will be the Intensity and the x-axis will be the $1/r^2$ measurement. It should be a straight line graph. This is why we use the $1/r^2$ calculation, rather than the distance measurement which gives a different shape.

When plotting graphs, there is a handy mnemonic to use in order to make sure your graph is *CUTLASS*.
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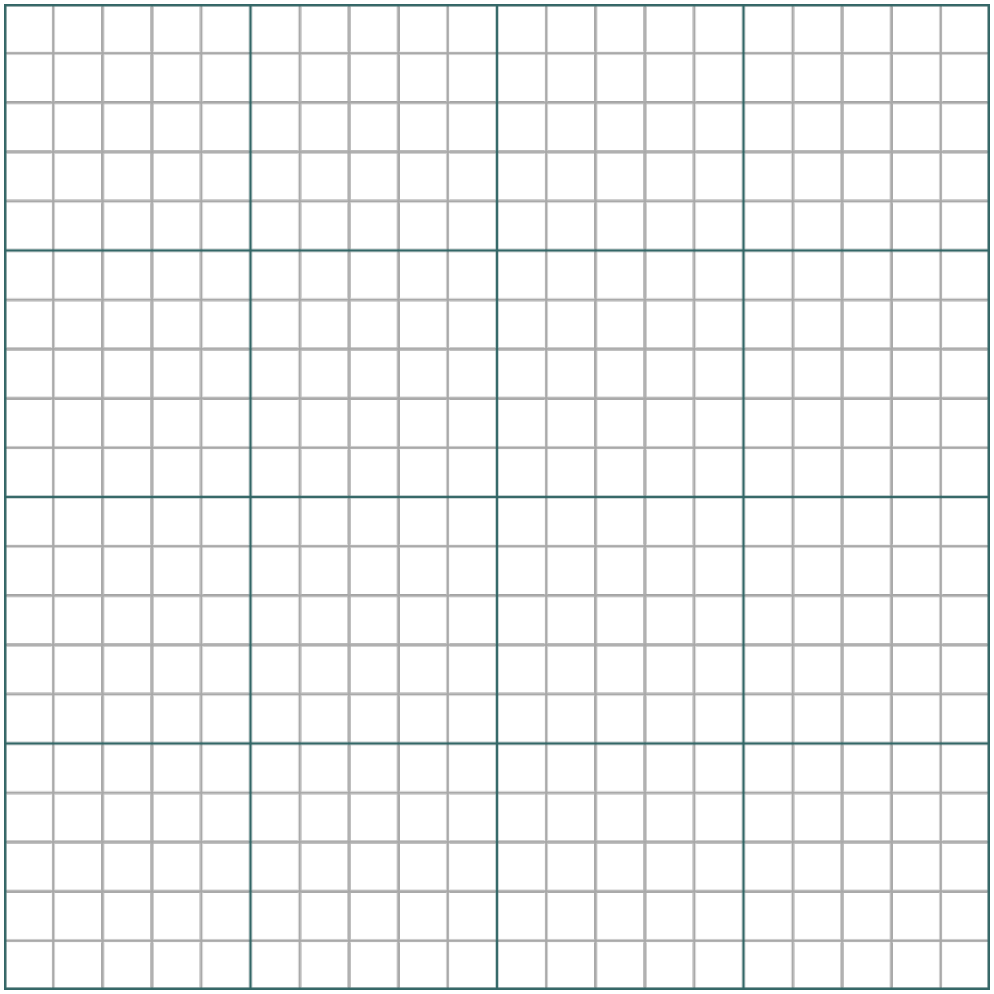
S - Size. Use the space provided, We want your graph to be as big as it can be. This is for as much clarity as we can manage

Intensity vs $1/r^2$ for light meter



5b. Problem Solving - Prescriptive
This is the section where we think about the results and what they mean.

Now that you have done this investigation with a phone and a light meter, you can make a comparison between the two.

List similarities and differences between a light meter and a Phone	
Similarities ● They both measure light intensity ● The results are comparable ● _____ ● _____	**Differences** ● They measure in different ways ● One is in my pocket, the other in the lab ● _____ ● _____

What is the relationship between Intensity and distance? Can you find a mathematical expression for the relationship? Does your conclusion match your hypothesis?

Control for variables. List variables that can be controlled or changed etc.

Try and complete a risk assessment for an industry or career application that deals with light intensity.

	Control variable	**Independent variable**	**Dependant variable**
Variable	No light source	The thing you change: _____	The thing you measure: _____

Further investigation
How would you make the investigation better? What else could you measure with a light meter?

If you were to extend your investigation, what would your next hypothesis be? Try to use your results from this investigation to help you guide your next investigation

Remember:
A hypothesis is a testable statement that should like something like:

"If _____[I do this] _____, then _____[this]_____ will happen."

Hypothesis

6b. Communicates - Prescriptive

Conclusion
Answer the question that we asked in the Aim.

There **is/is no**t a relationship between light intensity and distance measured with a light metre.

It was found that the results from an inverse square law investigation using a lab-based measurement device was produced.

The implications of the comparing mobile phones and light meters are: