Climate Change & Technology

Why?

Climate Change Education in Primary and Secondary Schools:

- Is uneven
- Is at the start of a long journey
- Is an opportunity to create a framework which will reverse the damage we have caused

https://twitter.com/southpoleglobal/status/1270332236999647233/photo/1

Big Picture

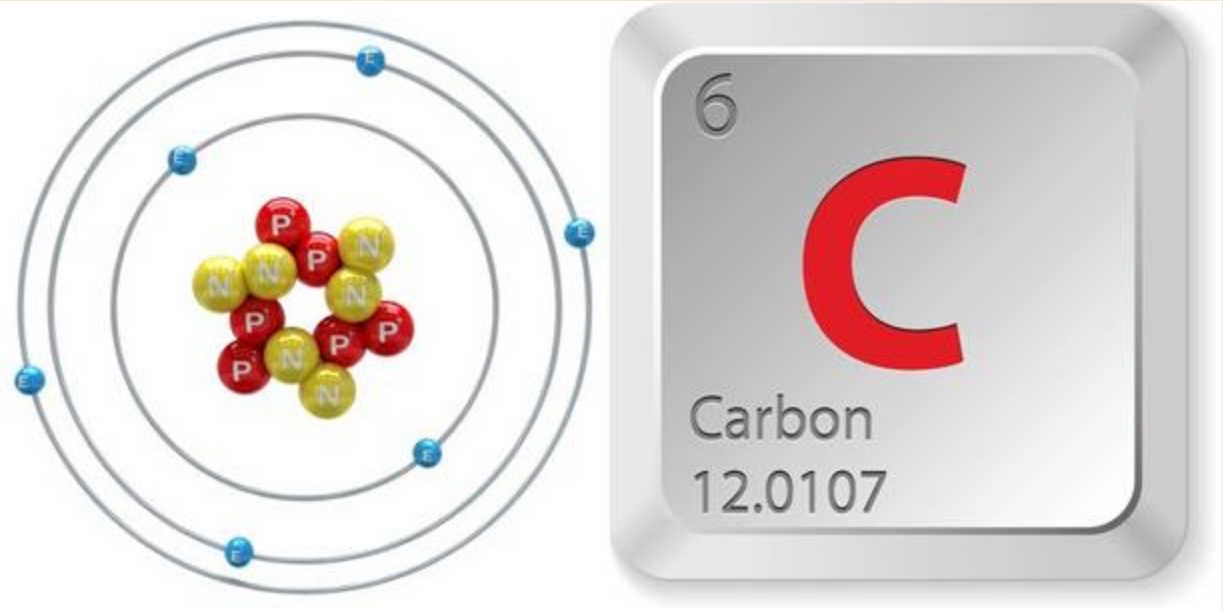
Carbon is vital to all life on Earth

Trees capture carbon through absorption of CO_2

Trees vary in the amount of CO_2 they capture

Being able to calculate the amount of CO_2 we generate and trees absorb will help to save the planet

Climate Change & Technology



Scenario

Avoid Climate Trauma (ACT) need a system which will allow individuals to find out how much carbon a tree will store by the end of its life.

The data needs to be added to a file so that it can be searched for in future.

It will be useful to allow the user to calculate how much carbon a group of trees stores eg 15 mature ash trees.

In the system, ACT also want the user to be able to calculate what their carbon footprint is (the amount of carbon released by eg driving a car 10 miles)

What?

A series of 4 lessons which:

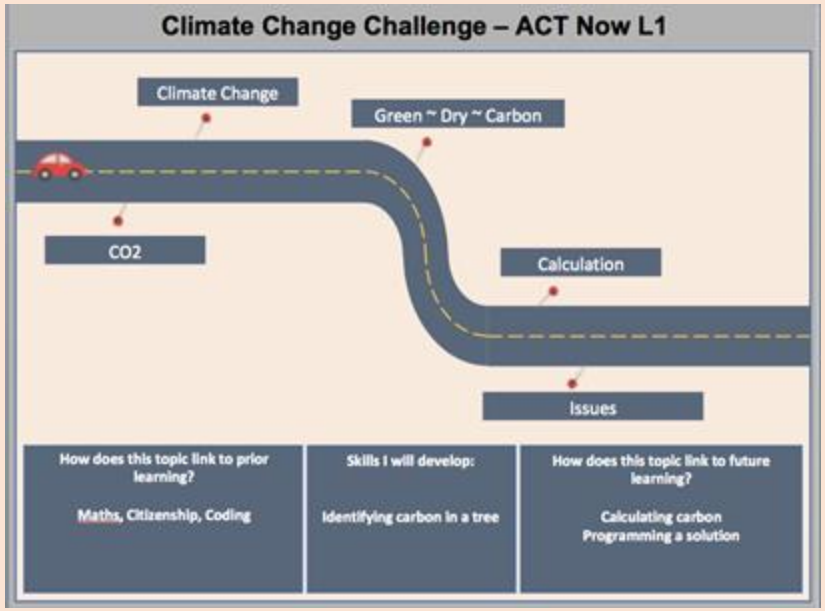
- Leverage STEM to aid understanding
- Incorporate humanistic principles to build moral purpose
- Provide a springboard from which students and teachers are able to carry the message of climate change further forward

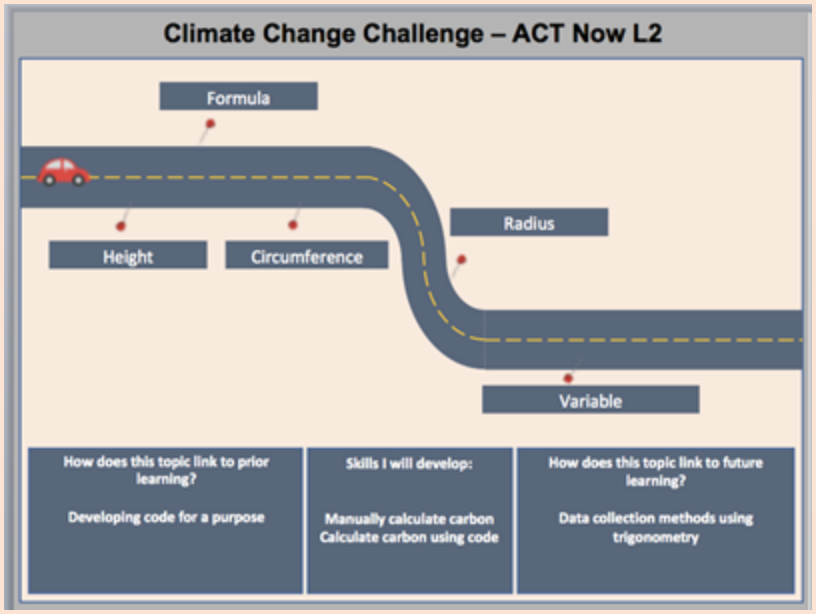
How?

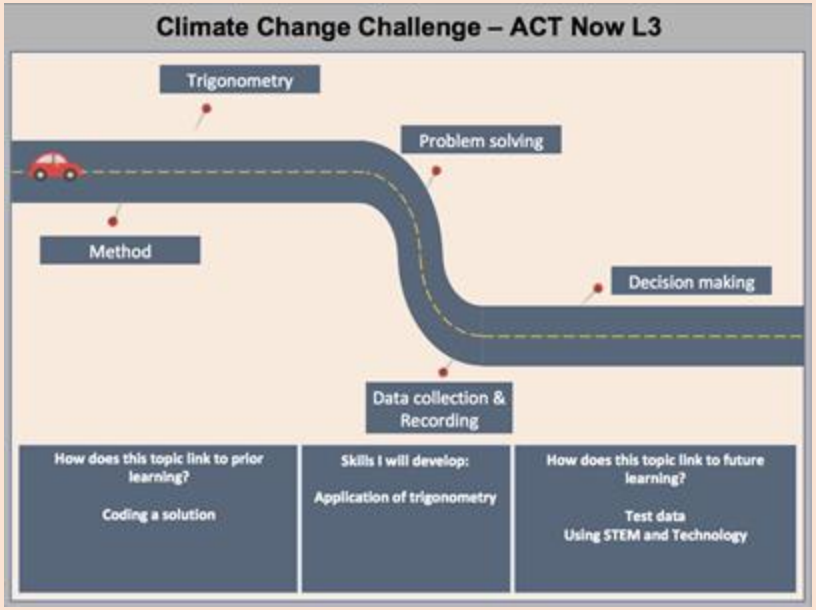
Centre on carbon capture in trees:

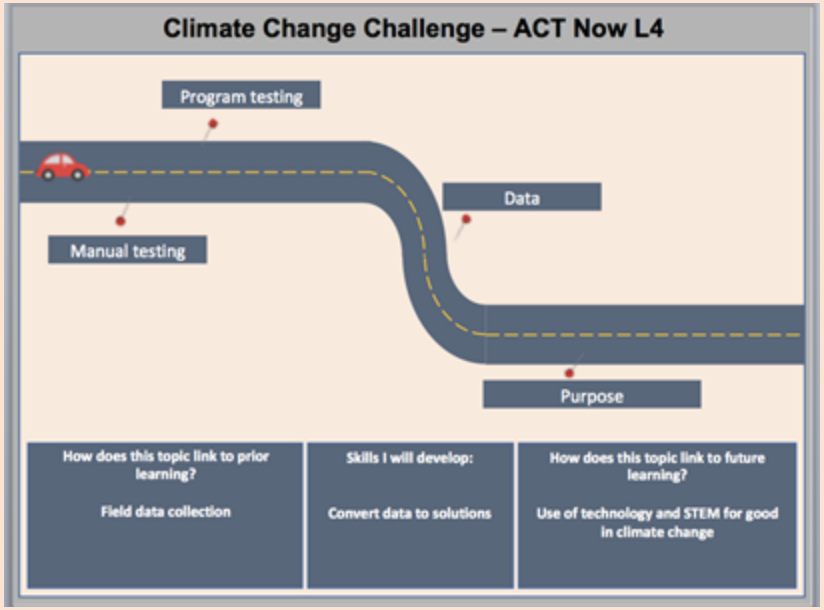
- Provide a scenario – ACT (Avoid Climate Trauma)
- Explore climate change and carbon in general
- Calculate carbon from given data
- Understand Green weight ~ Dry weight ~ Carbon relationship
- Examine and apply formula for carbon calculation in code
- Apply trigonometry to capture tree height
- Capture and record data
- Manually calculate carbon
- Test and refine in code
- Consider the place of science and computer scientists in doing good

Climate Change & Technology

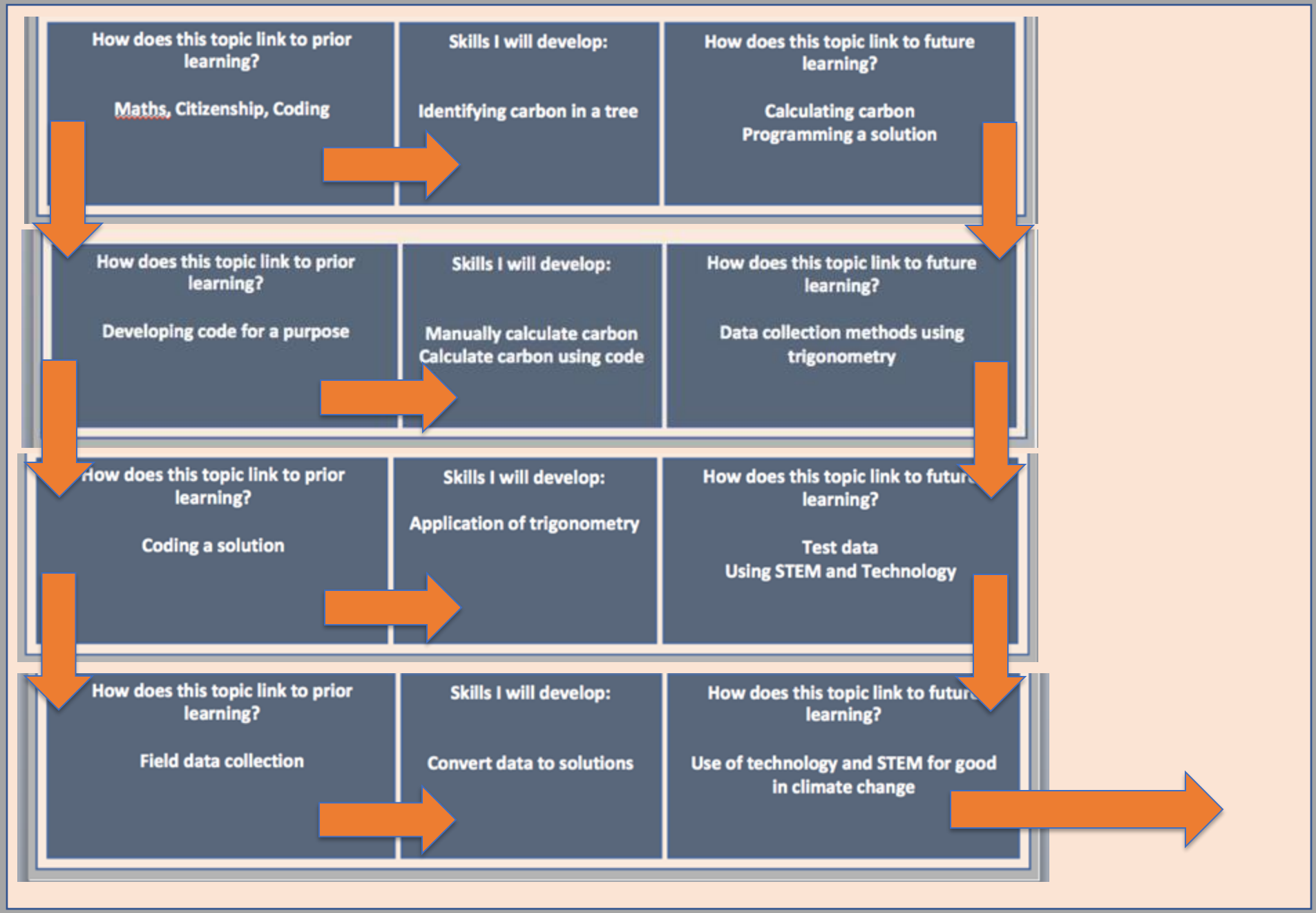








Climate Change & Technology



Calculating carbon Pt2

Circumference cm	Dry Weight kg	KG per CM	Carbon (1/2 Dry weight)
50	106		
100	668		
150	1964		
200	4221		
225	5771		
250	7641		
275	9842		
300	12410		
325	15350		
350	18700		
400	26674		

Complete the table to calculate carbon for each tree

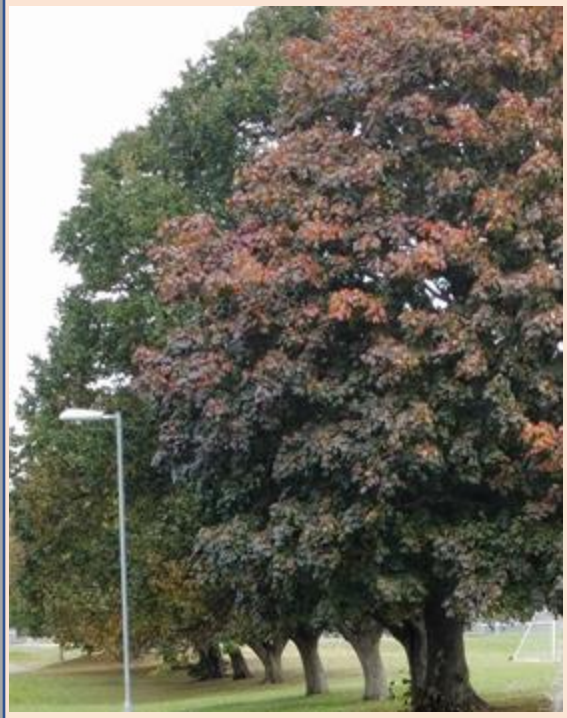
What relationship is there between dry weight and carbon?

Is it better to plant three 100 cm trees or one 300cm tree?

Using a formula

Part 2

- First measure 1.3m up the tree trunk from the ground.
- At 1.3m measure the circumference of the tree.
- Find the height of the tree
- Find the diameter (d) d = circumference ÷ π (Pi = 3.142)
- d < 28 cm GW (green weight) = 0.0577 * d^2 * height
- d >= 28 cm GW = 0.0346 * d^2 * height
- DW (dry weight) = ½ GW
- Carbon = ½ DW



For Example

- An Oak tree has a circumference of 220 cm and height of 15 m
- Diameter = 70 cm
- GW = 0.0346 * 4900 * 15 (2543 kg)
- DW = 2453 / 2 (1271)
- Carbon = 635 kg
- The carbon stored in the tree is 5771 ÷2 = 2885.5 kg

Try it

- Open repl
- Create a program that will take the circumference and provide an estimate of dry weight
- Then your program should calculate the carbon

Coding a formula

Basics:

- Input variables should be integers – name = int(input("Message "))
- Selection statement should choose between the Boolean choices less than 28 <28 and greater than or equal to 28 >= 28
- Calculate diameter – circumference divided by Pi
- Halve green weight then halve dry weight to arrive at carbon weight

Figure it Out V1

Part 3

Step by step

1. Stand with your legs apart and your back to the tree.
2. Keeping your legs straight, bend down and look at the tree between your legs.
3. Move backwards or forwards so that you can just about see the top of the tree between your legs.
4. Measure the distance between your feet and the tree trunk.
5. When you can see the top of the tree between your legs, the distance between your feet and the trunk is about the same height as the tree.
6. Think about how you will measure the distance between your feet and the tree. You could ask someone to count strides or heel-to-toe steps between you and the tree trunk.
7. Wrap a tape measure around the trunk 1.3m from the ground to find out the circumference.

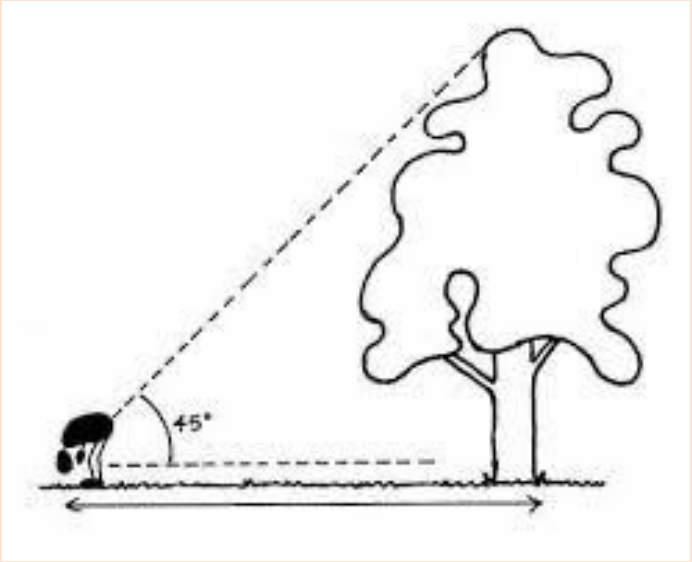
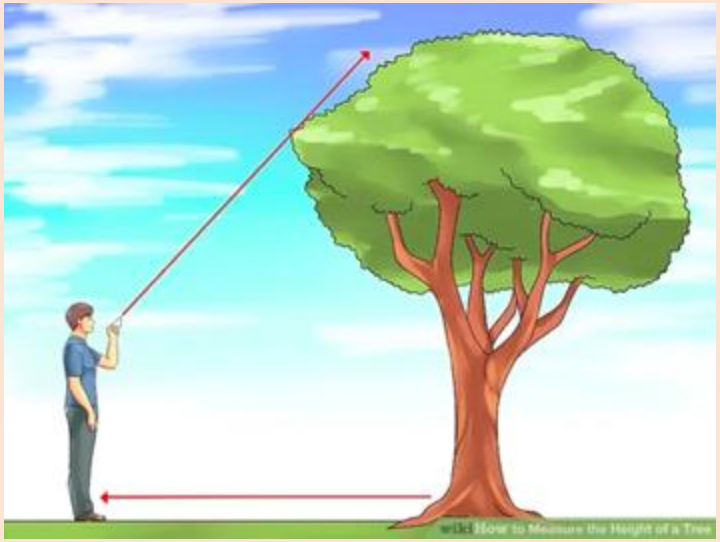


Figure it Out V2



Step by step

1. Hold the triangle in front of one eye by holding a corner opposite from the 90º right angle (see the above picture)
2. Point the rest of the triangle toward you
3. One of the short sides should be horizontal (flat), and the other should be vertical (pointing straight up)
4. You should be able to look up along the longest side by raising your eyes
5. Move back from the tree until you can sight the top of the tree at the top tip of the triangle.
6. Close one eye and use the other to look directly along the longest side of the triangle, until you see the exact top of the tree
7. You want to find the point where your line of sight follows the longest side of the triangle to the very top of the tree
8. Mark this spot and measure the distance from it to the base of the tree
9. This distance is almost the full height of the tree
10. Add your own height to this, since you were looking at the tree from the height of your eyes off the ground

Let's Collect Our Data

Name: ..... Date: .....

Tree Data

Tree	C	D	H	GW	DW	Carbon kg	Carbon tonne

Using our Program Solution

Tree	C	D	H	GW	DW	Carbon kg	Carbon tonne

```
in.py > ...
  # M Jones 2023
  # Simple program to calculate stored carbon based on height and
  circumference

  PI = 3.142
  height = int(input("What is the height of the tree? "))
  circum = int(input("What is the circumference of the tree in cms? "))

  diam = circum / PI
  dsq = diam*diam
  if diam < 28:
    gw = 0.0577 * dsq * height
    gw = round(gw,2)
  else:
    gw = 0.0346 * dsq * height
    gw = round(gw,2)
  dw = gw/2
  carbon = dw/2
  print("Diameter = ", diam, "cms")
  print("Green Weight = ", gw)
  print("Dry weight =", dw)
  print("Carbon = ", carbon, "KGs or", carbon / 1000, "tonnes")
```

Use your manual data from the table to calculate the weights of your trees

Part 4

Climate Change & Technology

As part of our module, we have explored why climate change is an issues, used different methods to calculate carbon in a tree and program a solution which a non computer scientist could use.

Working in groups of three, agree a statement which promotes the use of computer science and programming to assist non specialists in understanding carbon.

Record the statement in your ACT portfolio.

Be prepared to share with the group

Resources

Teacher lesson plans

Computer Science and

Can you make a d

ACT – Avoid Climate Trauma

Summary: The purpose of this module is to support computer science and technology students in understanding how technology can be used to assist in collecting data and forecasting carbon storage.

They will apply a range of STEM skills to include system design, programming, and application of mathematics. This will build an awareness of how technology can be a force for good. Interweaved with the STEM content is research and exploration of climate change themes including the role of scientists in taking responsibility for actions.

Key information

Four lessons which can be isolated and delivered as stand-alone sessions or delivered as a module. Students may need greater time to develop basic coding skills. The coding skills may be delivered as the module develops or as a prior course.

Can be delivered within the computer science curriculum at Key Stage 4 and Key Stage 5 or a much wider cross curricular programme in geography, mathematics, citizenship, information technology and computer science.

The module should be delivered with an underlining theme of focusing on the ethics of climate change and the impact that those working in tech can have on the future.

Activity Details

The lessons enable students to:

- Explore why carbon is a problem to be solved
- Investigate the difference between known data and gathering data
- Apply trigonometric methods in gather data
- Converting the raw data into information
- Apply formulaic methods to calculate gross weight, dry weight and carbon in trees
- Evaluate the methods used to collect data
- Consider the use of approximate values
- Design programmed solutions

d (10 minutes)

g the questions "What is carbon?" "Why is carbon an issue?"

ng the answers, have slide 2 displayed showing an appropriate owing the CO2 -> C -> O2 cycle.

Resources

Teacher lesson plans

Initial investigation (15 minutes)

Group the students into groups of 3-4. Provide them with A3 sheets and marker pens.

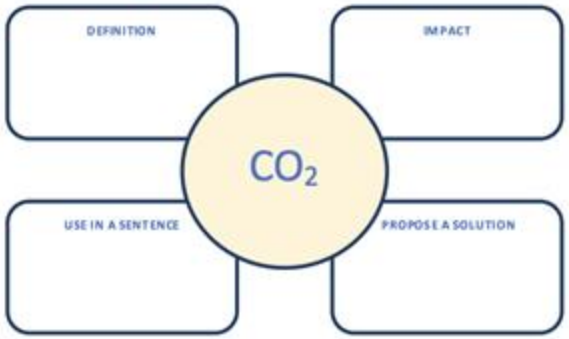
Display on the board, through a digital document or printed on cards, a range of sites students can access to enable exploration of climate and carbon dioxide:

- https://www.bbc.co.uk/bitesize/topics/zhssgk7/articles/zq2m2v4#:~:text=Extra%20carbon%20dioxide%20in%20the,temperature%20is%20called%20global%20warming.
- **https://kids.britannica.com/students/article/carbon-dioxide/273513#:~:text=A%20colorless%20gas%2C%20carbon%20dioxide,0.03%20percent%20of%20the%20air.**
- https://archive.epa.gov/climatechange/kids/basics/today/carbon-dioxide.html

Whilst several sites can be provided, encourage students to find their own sources and record these.

Activity:

Produce a word map using "CO2" as the central element.



Isolate the key words and phrases used when there are discussions of climate change and carbon issues.

Ask each group to present their word maps to the rest of the class, encourage students to incorporate ideas fROm others into their word maps.

Thin or thick trees? (10 minutes)

Using the circumference/Dry weight table, explain that to find out how much carbon a tree has stored requires that we are able to calculate green weight and dry weight and that carbon is typically half of the dry weight in a tree.

The provided table illustrates average estimates of the dry weight of a tree based on the circumference of the tree.

Circumference cm	Dry Weight kg
50	106
100	668
150	1964
200	4221
225	5771
250	7641
275	9842
300	12410
325	15350
350	18700
400	26674

Resources

Teacher lesson plans

Ask students to complete the table to calculate KG per centimetre for each measurement. Tell students that they should aim to provide a conclusion on the relation between increasing circumference, dry weight, and kilograms per centimetre. Students should be able to conclude that as a tree's circumference increases so does weight per centimetre.

Circumference cm	Dry Weight kg	KG per CM
50	106	
100	668	
150	1964	
200	4221	
225	5771	
250	7641	
275	9842	
300	12410	
325	15350	
350	18700	
400	26674	

Pose the question, why is it better to plant 1 tree with a final large circumference rather than a few smaller trees? For example, 8 trees with a circumference of 50 CM versus 1 tree with a circumference of 400 CM.

Using the ACT (Avoid Climate Trauma), students should record their activity and conclusions so far.

How much carbon? (10 minutes)

On the table there is a final column where students should calculate the carbon in a tree. Explain that the process is to halve the dry weight. Tell students that a whole number will be sufficient for this exercise.

Circumference cm	Dry Weight kg	KG per CM	Carbon kg (1/2 Dry weight)
50	106	2.12	
100	668	6.68	
150	1964	13.09	
200	4221	21.10	
225	5771	25.64	
250	7641	30.56	
275	9842	35.79	
300	12410	41.37	
325	15350	47.23	
350	18700	53.41	
400	26674	66.69	

Students should arrive at figures in the table below.

Circumference cm	Dry Weight kg	KG per CM	Carbon kg (1/2 Dry weight)
50	106	2.12	50
100	668	6.68	334
150	1964	13.09	982
200	4221	21.10	2110
225	5771	25.64	2885
250	7641	30.56	3820
275	9842	35.79	4921
300	12410	41.37	6205
325	15350	47.23	7675
350	18700	53.41	9350
400	26674	66.69	13337

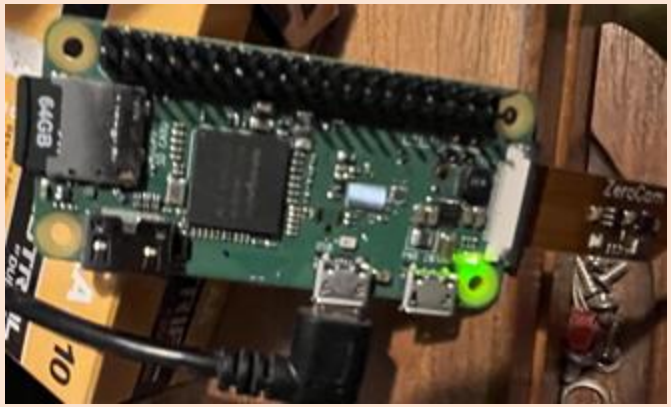
Pose the question, does this final set of data reinforce or reduce the conclusion we arrived at after calculating the KG per CM?

Plenary (5 minutes)

Show the lesson objectives. Pose the questions "What is carbon dioxide?" "Why is CO_2 an issue?" "Are trees part of the answer to addressing climate change?" "Why/Why not?"

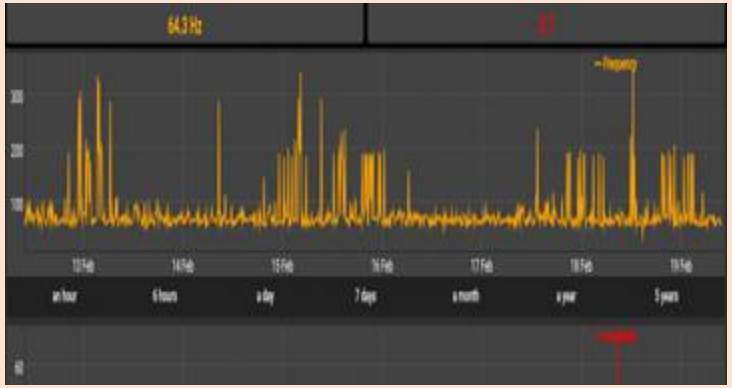
Where next?

Build environment sensors ~ harness hardware and software to monitor vertical and horizontal environment



Create carbon neutral products

Use technology to remotely monitor bee health



Where next?

Plant 2000+ trees

Share the produce

Share the message

Work in partnership

Big Picture

71% of the Earth's surface is covered in water

The oceans control Earth's climate

Plastics in the oceans affect:

Biodiversity

Carbon impact

Oxygen levels

Scenario

SoS – Save our Seas are a charity formed to address the problem of plastics in our oceans

SoS have committed to providing solutions which can be adopted worldwide

SoS have commissioned you to explore the issues and develop tools which can be used to combat this climate emergency area

Are you Ready?

14 LIFE BELOW WATER

SUSTAINABLE DEVELOPMENT GOALS

14 LIFE BELOW WATER

I C A N

Investigate the Problem	Consolidate Understanding	Advocate for Change	Navigate a Solution

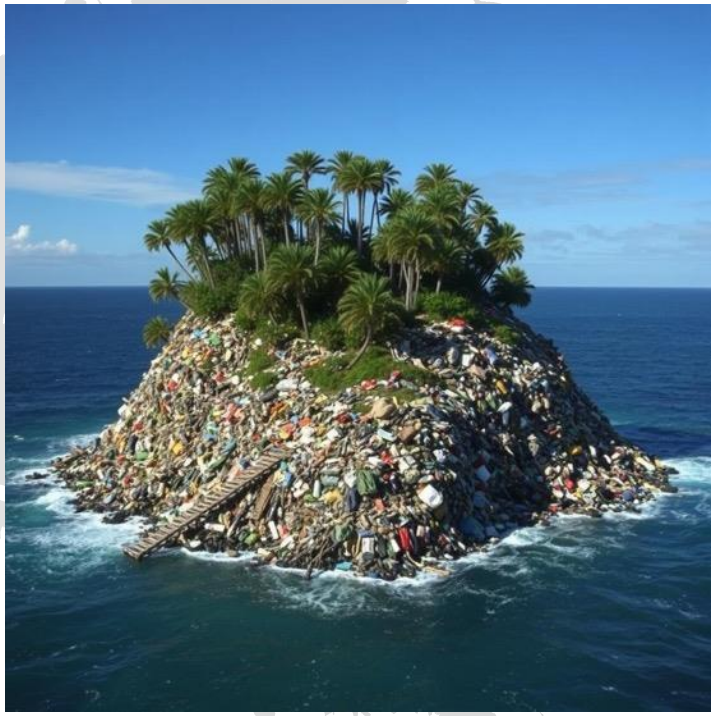
SUSTAINABLE DEVELOPMENT GOALS

How?

Lessons 1- 3:
Explore the impact of plastics in our oceans

Lessons 4 – 6:
Identify key steps we can take

Lessons 7 – 10:
Understand how to apply technology in solving climate problems



Teacher Planning Guide

Climate Emergency & Plastics Pollution

If Not You Then Who?

United Nations Sustainable Development Goal 14

Life Below Water

Table of Contents

Teacher Planning Guide

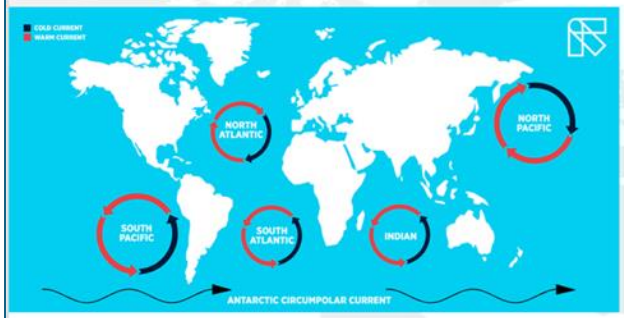
28	20 minutes		41-42	30 minutes	Slide 41 presents a scenario to the students. SoS are asking them to develop their AI so that it can identify turtles that may be in or near the garbage patches. Slide 42 is hidden and contains the video tutorial for this part of the project. You may wish to keep this hidden to see how well students work independently. The workbook contains a brief and set of instructions for students to develop the AI so that it can identify turtles. This is in the '**Step 3 – Biodiversity alert!**' section.	Turtle dataset https://tinyurl.com/2mdjntjb Video Tutorial https://tinyurl.com/5648rfup	nd model sea sheets. ove the slider to ' tool and enter a est of your country rmanently flooded tion densities – refugee status. e of planning and	https://tinyurl.com/bdz9szva
			43	30 minutes	This is an optional task not included in the workbook. If you have time, and for more advanced students, this task directs students to divide the Mixed folder into subfolders so that there is data which can be trained on a much wider set of marine life. Slide 43 directs students to the Ocean Life dataset Dataset https://tinyurl.com/38yv79vz	Ocean Life dataset https://tinyurl.com/38yv79vz		
			44	30 minutes	Slide 44 encourages students to consider how they would advise organisations in the use of AI based on their experiences. This is a reflective task where students are encouraged to review what they have achieved and how ithers may benefit from their experiences.			
29	20 minutes				Students may need to be taken through a review of what they have accomplished. This can be achieved through a mix of recap on the previous slides and rereading of the workbook activities.		nd read through t can be seen that Students should vel. The	https://tinyurl.com/bdz9szva
			45	10 minutes	Slide 45 asks students to complete a number of end questions in their workbooks. This is designed to embed what has happened in this section of the project			
30	50 minutes		46		Slide 46 is hidden. If appropriate, award students an Eco Technology Award for their work on developing an AI and raising awareness of how technology can be used in the addressing the climate emergency	Editable certificate link https://tinyurl.com/4dujxp4m	bservers of the that is being	https://tinyurl.com/4rh8t3nw
			47	5 minutes	Slide 47 is a copy of the original, broad objectives for the whole project. Use this to remind students of what they have achieved			

Content

Lessons 1 - 3: Explore the impact of plastics in our oceans

UN Sustainable Development Goal 14 – Life Under Water

Where does all the plastic go?



There are 5 major garbage patches but how do they become concentrated instead of being spread out evenly?

Using this link, consider:

- What is a 'gyre'?
- How does a gyre affect where the garbage is?
- Is the garbage just on the surface of the ocean?

L 3

Content

Lessons 4 - 6: Identify key steps we can take

UN Sustainable Development Goal 14 – Life Under Water

SoS Need you!

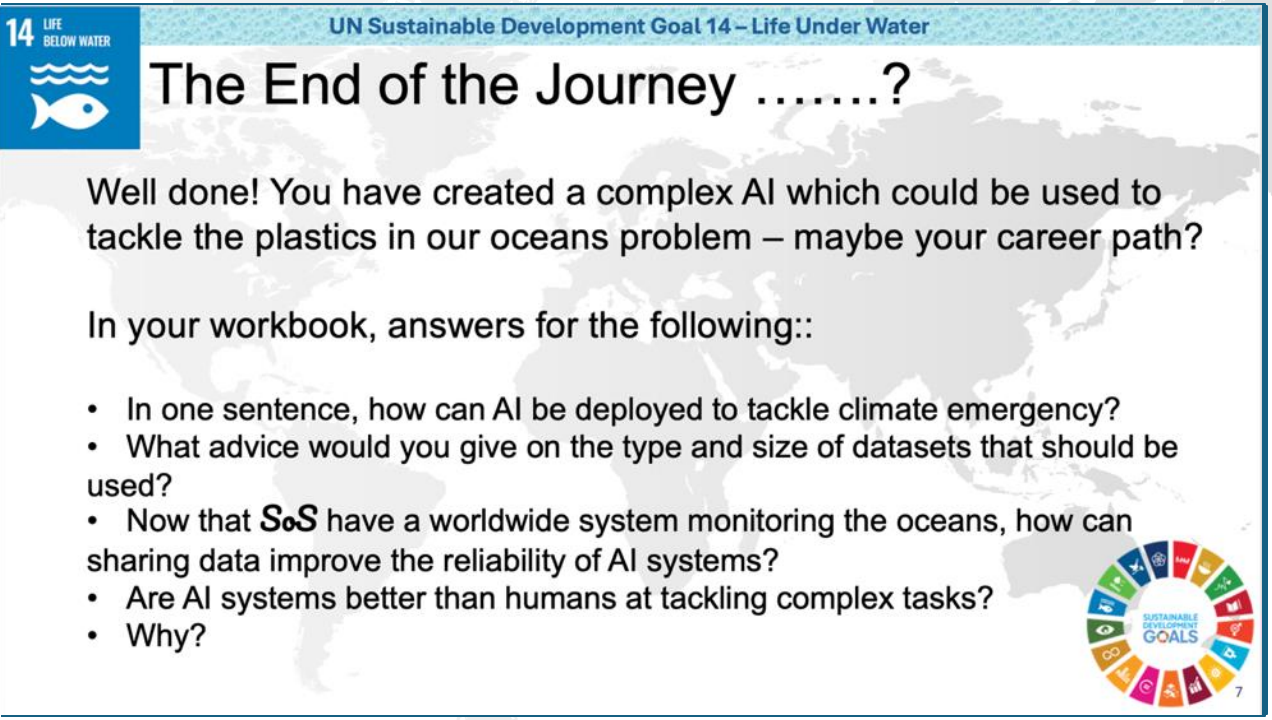
SoS have asked you to create a set of information cards highlighting the problem of plastics in our oceans

Examples have been provided to help you decide on approach

L 6

Content

Lessons 7 – 10: Understand how to apply climate technology in solving problems



L 10

14 LIFE BELOW WATER

Recognising Achievement

SUSTAINABLE DEVELOPMENT GOALS

Recording Progress

SoS – Save our Seas

Save our Seas are a charity formed to address the problem of plastics in our oceans.

SoS have committed to providing solutions which can be adopted worldwide.

SoS have commissioned you to explore the issues and develop tools which can be used to combat this climate emergency area.

In undertaking the exploration of this area, you will build your knowledge of why plastics in our oceans are a major contributing factor to pollution are, marine biodiversity loss, global warming and ….

Once you have explored the issues you will investigate ways in which you can help solve the problems and use AI to identify pollution.

Keep your workbook up to date to earn your Marine Eco Warrior Certificate!

Getting to grips with the issues

The infographic provides information on 7 facts. We can see that by dumping 10 million tons of plastic into the oceans each year has several impacts.

https://plasticoceans.org/the-facts/

Using the infographic, identify one of the other facts and suggest how we could lessen impact.

.....

.....

.....

.....

Me - We – Us

Table agreement:

Me – I hold a belief that

.....

.....

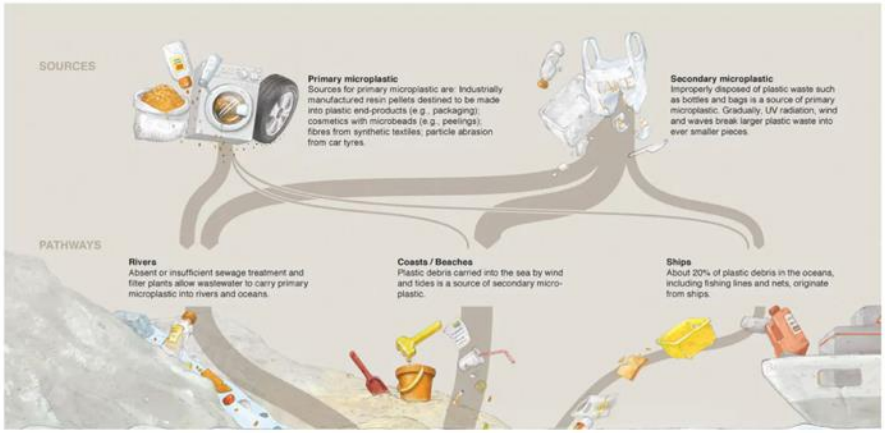
We agree that the following fact is valuable

.....

.....

Recording Progress

Impact – Macro to Micro



https://tinyurl.com/33c8rkbx

Part 1

Working in your table groups, explore the top third of the infographic. As a group, which of the two sources of microplastic would you tackle?

Agree a statement which highlights the issue (make it clear which source of microplastic it is you are addressing). Your statement should be capable of raising awareness of the issue.

.....

Part 2

Continuing working in your groups, identify one of the impacts and choose an image that
represents this. A good source of images is pixabay.com. Consider search terms such as 'impact', 'marine impact', 'climate impact', 'ocean pollution'.

Include the URL of the image for later access.

Paste the image here:

Recording Progress

Microplastics Versus the Climate

A major greenhouse gas is mentioned in the first part of the video here https://www.youtube.com/watch?v=k1Jt6e2OPHY

Name the gas produced by degrading plastic – the formula has been given to you.

CH_4 = ……

SoS have spent a lot of time exploring the effect of carbon dioxide and are worried that not as much time is spent on providing information on other gases.

SoS have asked you to explore the gas above. They would like to know what the effects of the gas is and how long it remains in the environment.

Here is a link to get you started (but you can use your own):
https://tinyurl.com/39r3v3bb

% Contribution to global warming ……..

How many more times harmful it this gas when compared to carbon dioxide

……..

What percentage reduction would reducing methane emissions lead to limiting global warming to 1.50° C ……..

How many years is the gas active in the environment after it has been released

……

Well done! That's a lot of figures.

Bring it together

SoS now have a much better idea of how plastics in the oceans has an impact on marine life, greenhouse gas, seal levels and human life. This is all part of what is now becoming known as the **'climate emergency'**. Your contributions can help to reduce impact – the more people know the more we can turn **'climate emergency'** into **'climate celebration'.**

To help in reducing impact, SoS have asked you to create a short report based around the work you have undertaken with the Climate Central app.

Working with one other person, one of you should download the document here https://tinyurl.com/4rh8t3nw and share it with your partner. You can now contribute to the document at the same time.

There are 3 tasks to complete first:

- Temperature rise
- Water level or Year
- Population movement

Once you have added your ideas and evidence, agree on a statement that explains how the dumping of plastics in the oceans is affecting the climate emergency. Even better, extend the statement to suggest the steps that we (individuals, groups, companies, nations) should take. Consider how technology, such as the forecasting app at Climate Central can convey important messages.

This link https://tinyurl.com/u46v7t7r may help you in gathering data and ideas.

Recording Progress

Step 1- Create the Solution

Open the project file and train it (your teacher will show you where the project file is)

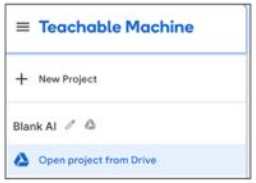
Video support files:

Getting Started with AI Video 1.mp4

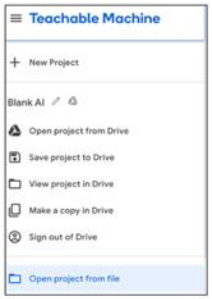
Getting Started with AI Video 2.mp4

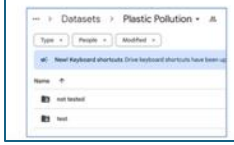
Teachable Machine support files for this part:
Image dataset

Blank AI.tm (if you are starting from scratch) **OR** PlasticsV1.tm (if you are starting with a basic model)



OR





The End of the Journey…….?

- In one sentence, how can AI be deployed to tackle climate emergency?

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- What advice would you give on the type and size of datasets that should be used?

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- Now that SoS have a worldwide system monitoring the oceans, how can sharing data improve the reliability of AI systems?

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- Are AI systems better than humans at tackling complex tasks?

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- Why?

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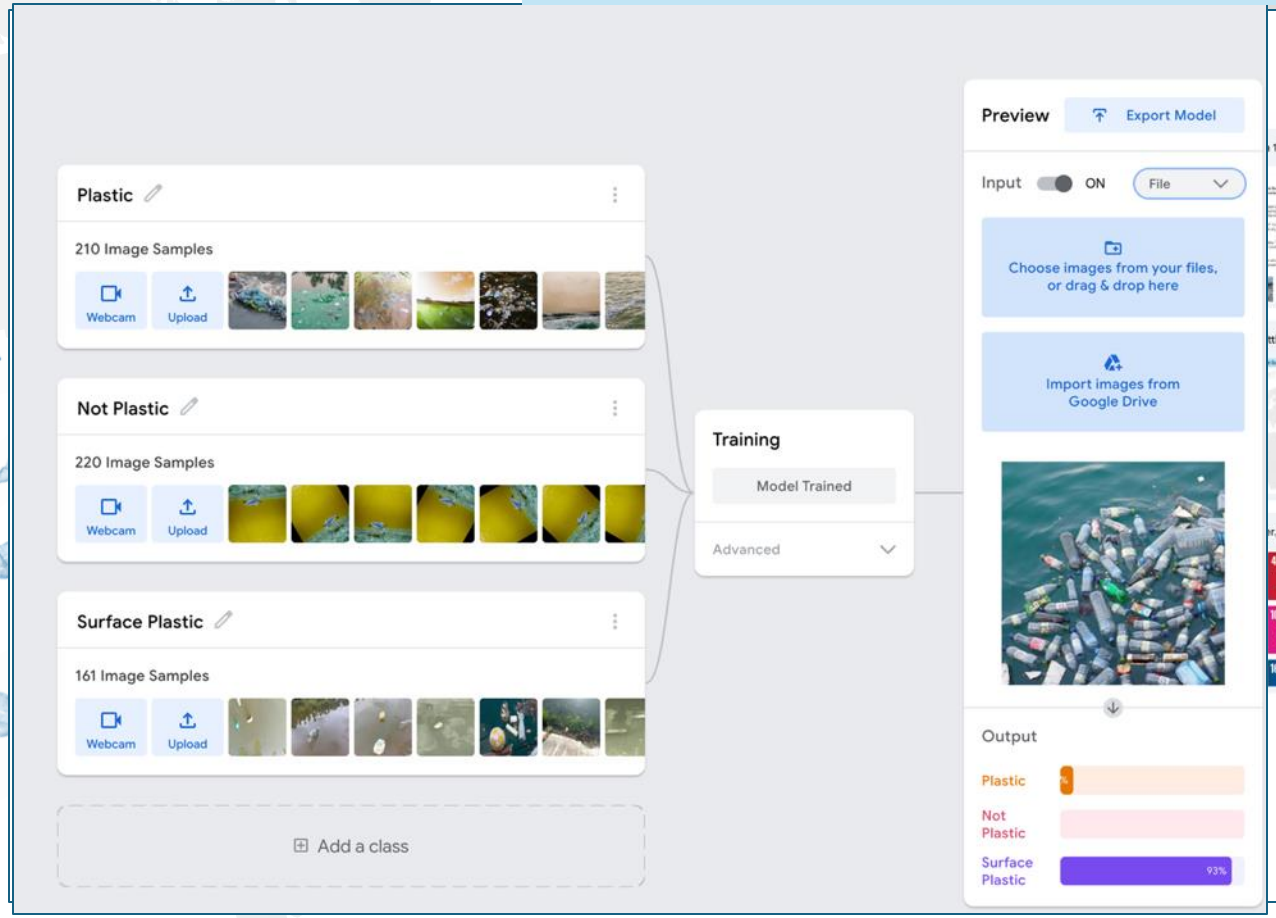
14 LIFE BELOW WATER

Resources

https://tinyurl.com/5brejcp6

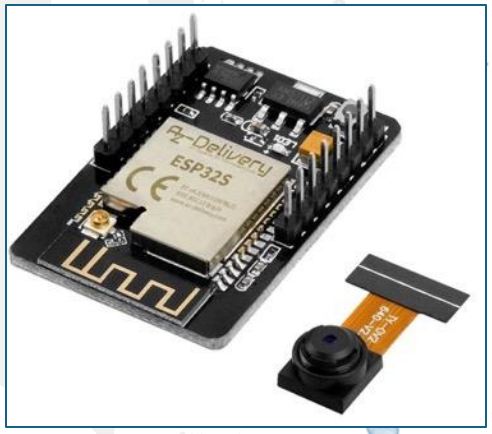


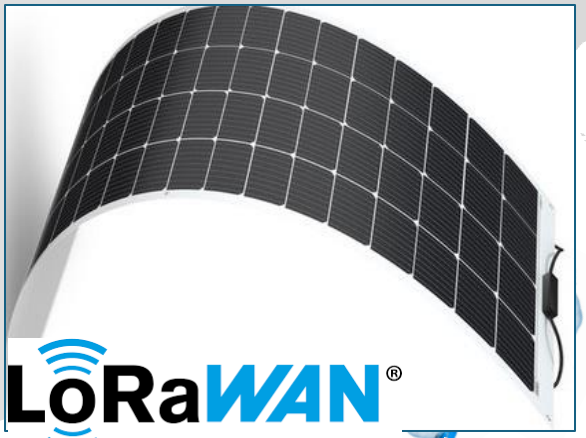
SUSTAINABLE DEVELOPMENT GOALS

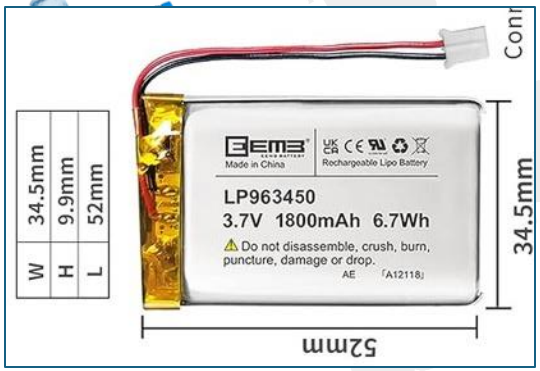
14 LIFE BELOW WATER

Where Next – Ocean, Land, Air ….?

Wi-Fi







SUSTAINABLE DEVELOPMENT GOALS

Where next?

Tell the world

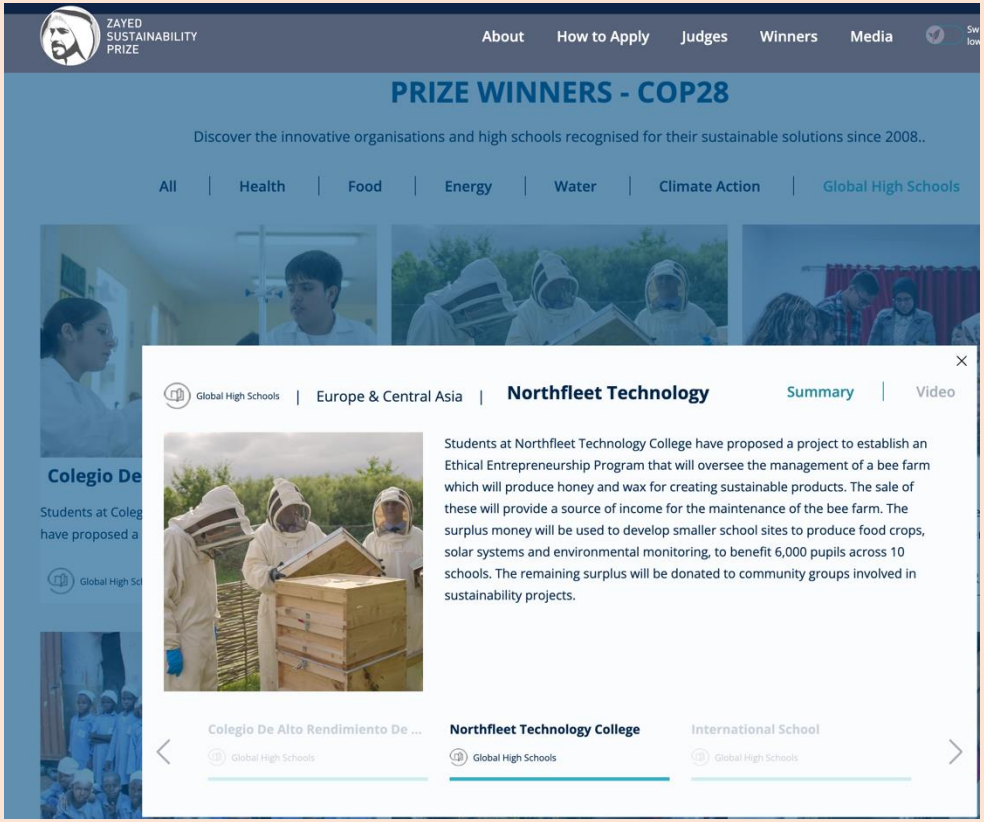
Educate for climate voice

Take the climate change challenge out of the classroom

And keep telling the world …

Climate Change & Technology

Where next?



Climate Change & Technology

Michael Jones

ACT – Measure Carbon in Trees
https://tinyurl.com/yewa8e54

SoS – Ocean Plastics
https://tinyurl.com/5brejcp6

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