Please refer to Worksheet Template Icon Key v0.1 for symbols above

"Hello from the 5000mileproject! On 27th July 2012, we will fulfil a dream expedition and the biggest challenge of our lives, to run the length of South America, unsupported, in a year!! Running 15 to 25 miles per day, over 5000 miles; it will be the equivalent of over 200 marathons and we will pull our food, water and equipment. We are both Ecologists and will also be carrying out the world's longest wildlife survey ("Mega Transect") and raising money for BirdLife International and Conservacion Patagonica. We want to share the amazing wildlife and wild places we see, hear and smell along the route with you, so come and join us at www.5000mileproject.org……..!", Katharine and David

Click this Link to show your Class a 2 minute film about the project:
http://www.5000mileproject.org/2012/05/promovideo/

Teacher PART A - Guidelines

WORKSHEET GOALS

In this worksheet pupils will learn about GPS, and will learn how, through SIMPLE maths, that they will become rocket scientists! GPS location devices are now increasingly common and pupils will learn how variable distance and the constant of time can be used to pinpoint them anywhere in the world. Their parents may well not understand how it works, but like David and Katharine, they will. The concept is daunting perhaps but they can follow the worksheet to realise how possible it is.

Mapping to Syllabus

- Ma3 Shape, space and measures

At the end of this worksheet, pupils will

- understand how GPS Receivers work using a series of simple sums in distance and time
- think about how important understanding our location is

NEEDS AND RESOURCES

Required Background

To successfully complete this worksheet, pupils must

- be comfortable using the time (digital and analogue)
- understand simple division with large numbers
- be able to use a pair of compasses

Required Materials

To successfully complete this worksheet, pupils will need

- a pair of compasses

Additional Print Resources

- Not Applicable

Online Resources

- http://electronics.howstuffworks.com/gadgets/travel/gps2.htm
- http://www8.garmin.com/aboutGPS/
- http://www.spacetoday.org/Satellites/GPS.html

Teacher PART B –Answers

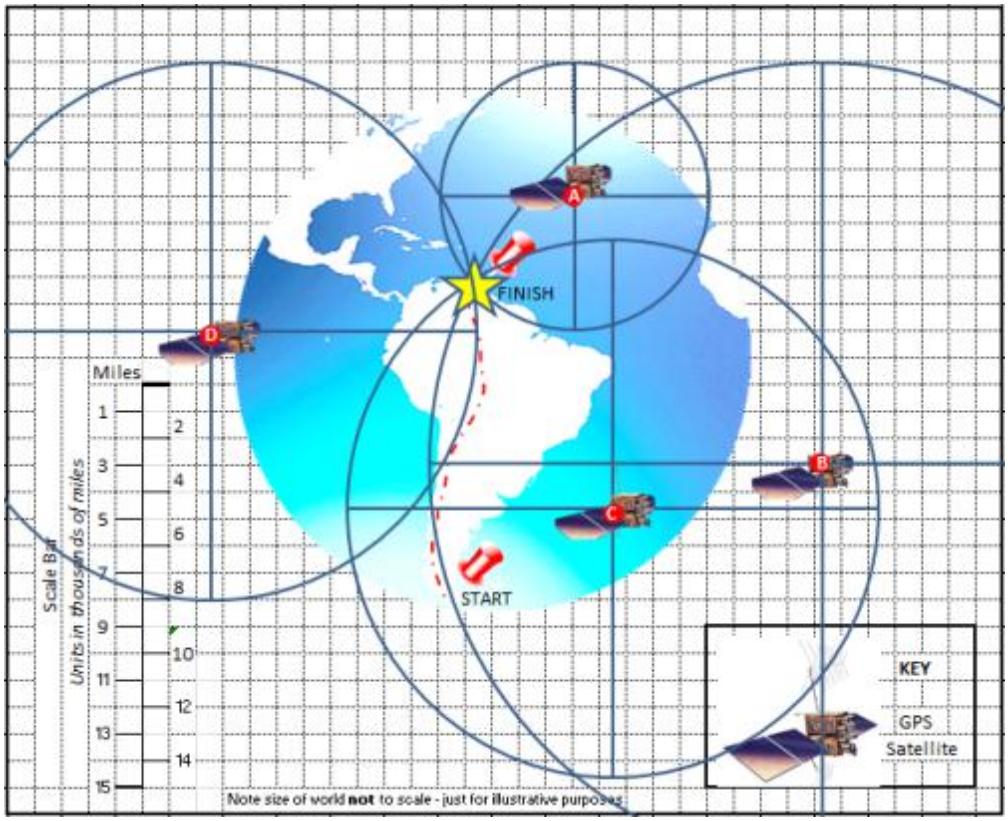
Activity 1

1. Work out where the nearest food and water are
2. Know how long it will take to get to our destination
3. Know which direction to go in to get to the end
4. We can tell others where we are so they can find us if we are in trouble
5. Encourage a wide response of answers – our ability to report position has thousands of civilian uses too!

Activity 2

Speed of light is 186,000 miles/sec (http://www.grc.nasa.gov/WWW/k-12/Numbers/Math/Mathematical_Thinking/how_fast_is_the_speed.htm)

1. 5000 x 2 seconds = 10000 miles
2. 12:10:02
3. 5000 x 3 seconds = 15000 miles away
4. See map master below
5. 5000 x 2 seconds = 10000 miles away
6. See map master below
7. 5000 / 5000 = 1 second
8. See map master below



INFO

Katharine and David's route across South America will take them over many different roads, tracks and mountain paths. They need to know where they are at all times so they need to NAVIGATE carefully. Good navigation skills are essential for them to know how far they need to run that day, and how long it will take to get there. A Global Postion Sytem (GPS) device makes it very easy.

You too will become a navigator and a rocket scientist in this worksheet!

Stuff you'll learn

- ☑ What a 'GPS' is and how a 'GPS' receiver works. You'll be able to surprise your parents as they probably won't even know!!
- ☑ How knowing mathematics is essential to knowing your position and your survival.

Activity 1

First of all – Can you think of three reasons why it is very important for David and Katharine to know where they are at all times in some of the remote places they will be running through?

1. _____
2. _____
3. _____

Activity 2

David and Katharine will carry a Global Position System Receiver (these are often known as a GPS so we'll use that term from now on). The system relies on 24 Satellites in orbet high above the world which communicate with the GPS we carry. In this activity you'll learn how maths is used to let us know where we are.

The Satellites in the sky and the GPS that we hold both contain the same clock, always telling the same time as each other. The satellites talk to the GPS, with a signal that travels really fast through space to our GPS (we can't see it but it's happening). By knowing **how fast** that signal goes, and **how long** it took to get to us, the GPS can work out **how far** that satellite is from us.

And this is the amazing bit, by knowing where 3 or more satellites are you are going to help us work out where we are!

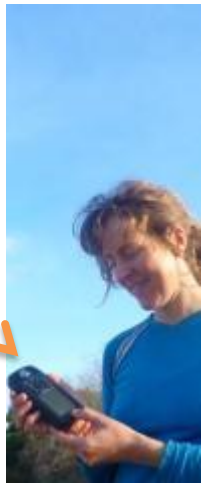
OK, so let's say the signal is fast, really fast, the speed of light in fact! For this example we can say it is **5000 miles per second**, to help our calculations be a bit easier, in fact it is even faster than that!

1. If the signal travels at 5000 miles per second, and our GPS says it arrives 2 seconds later than it sets off from the satellite, **how far** is the satellite away from the GPS?

   _____

2. So if it sets set off at 10 minutes past 12 o clock, and no seconds (on a digital watch it will look like 12:10:00), what time will it arrive?

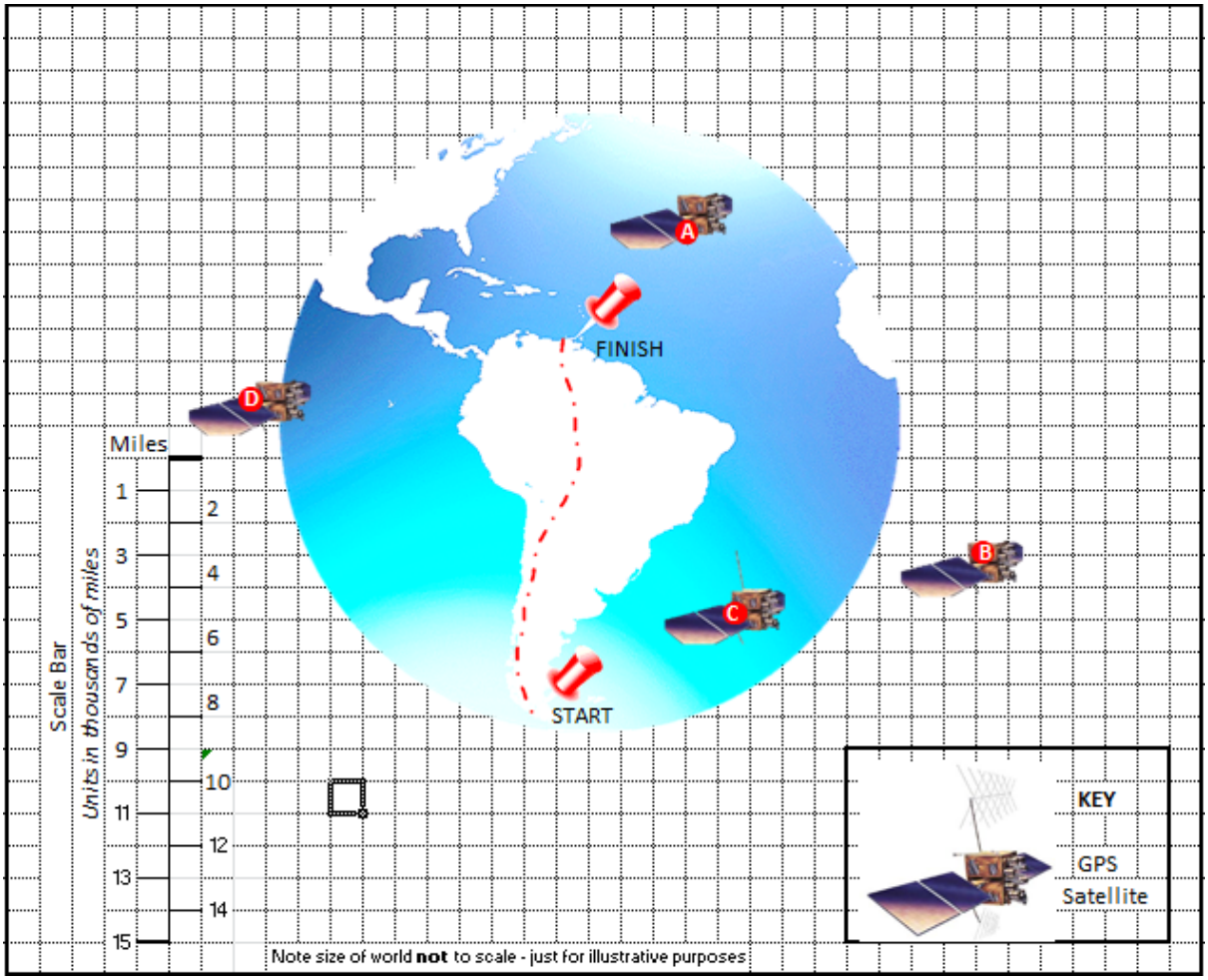
   _____



3. We are on earth somewhere, but where? Our GPS has received a signal from **Satellite B** exactly 3 seconds after it was sent – we know how fast it goes (see above) so how far is the satellite away from where we are?

   _____

4. On the following map use a set of compasses to mark a ring around Satellite B with the distance set on the scale provided at 15,000 miles (this is the **radius**). Put the point of the compasses into the red spot on Satellite B and mark a ring around it (don't worry if it goes off the page – rocket scientists think *outside the box*!)

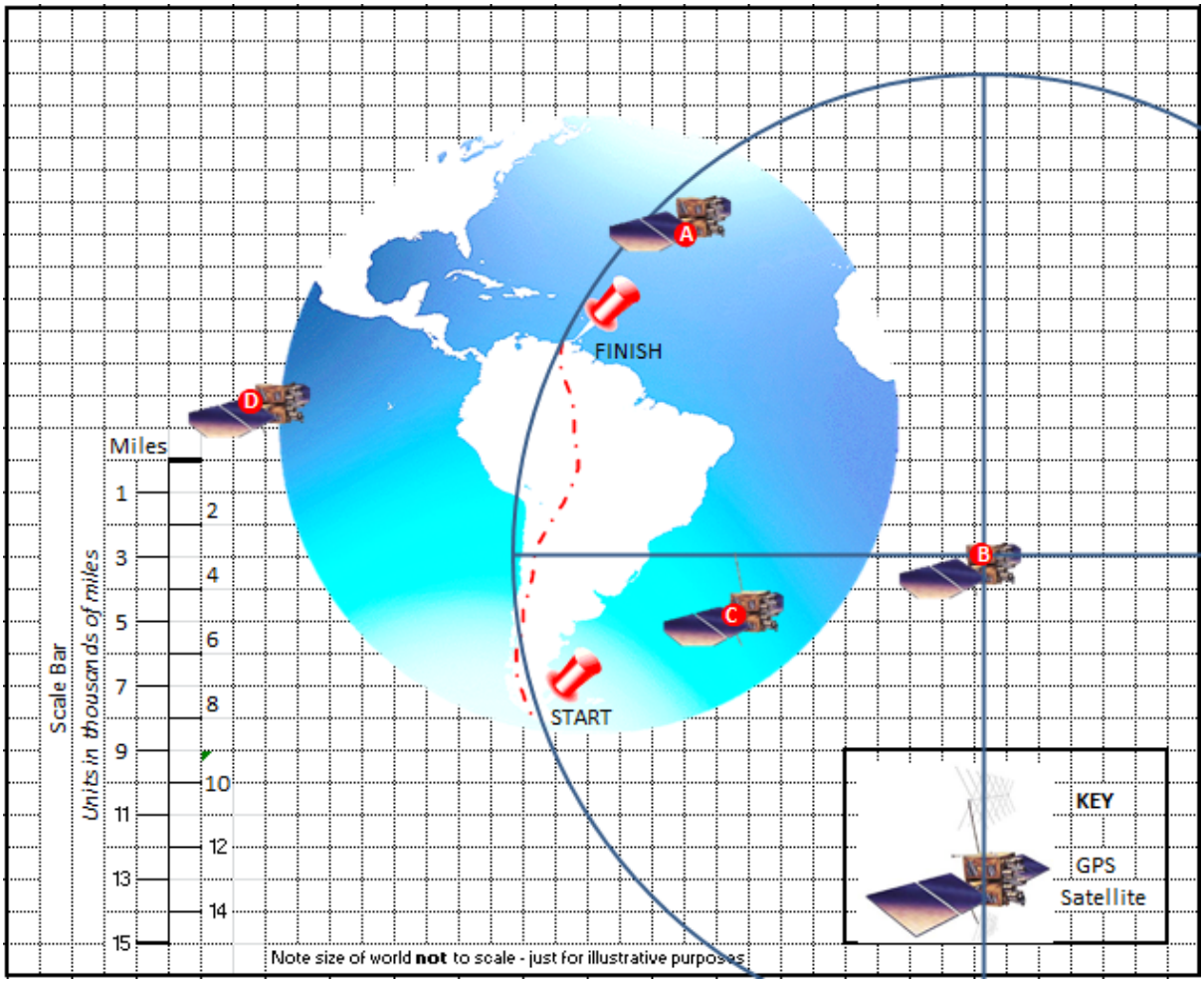


We could be anywhere on the line you have drawn, but **well done** because you have already put us onto the continent of South America, that's great!

5. Now, we need to be a bit more accurate. The signal from Satellite D arrived in 2 seconds, work out how far it must be away from us.

_____

6. Now draw on the circle of possibilities from the centre of Satellite D on the map on the next page



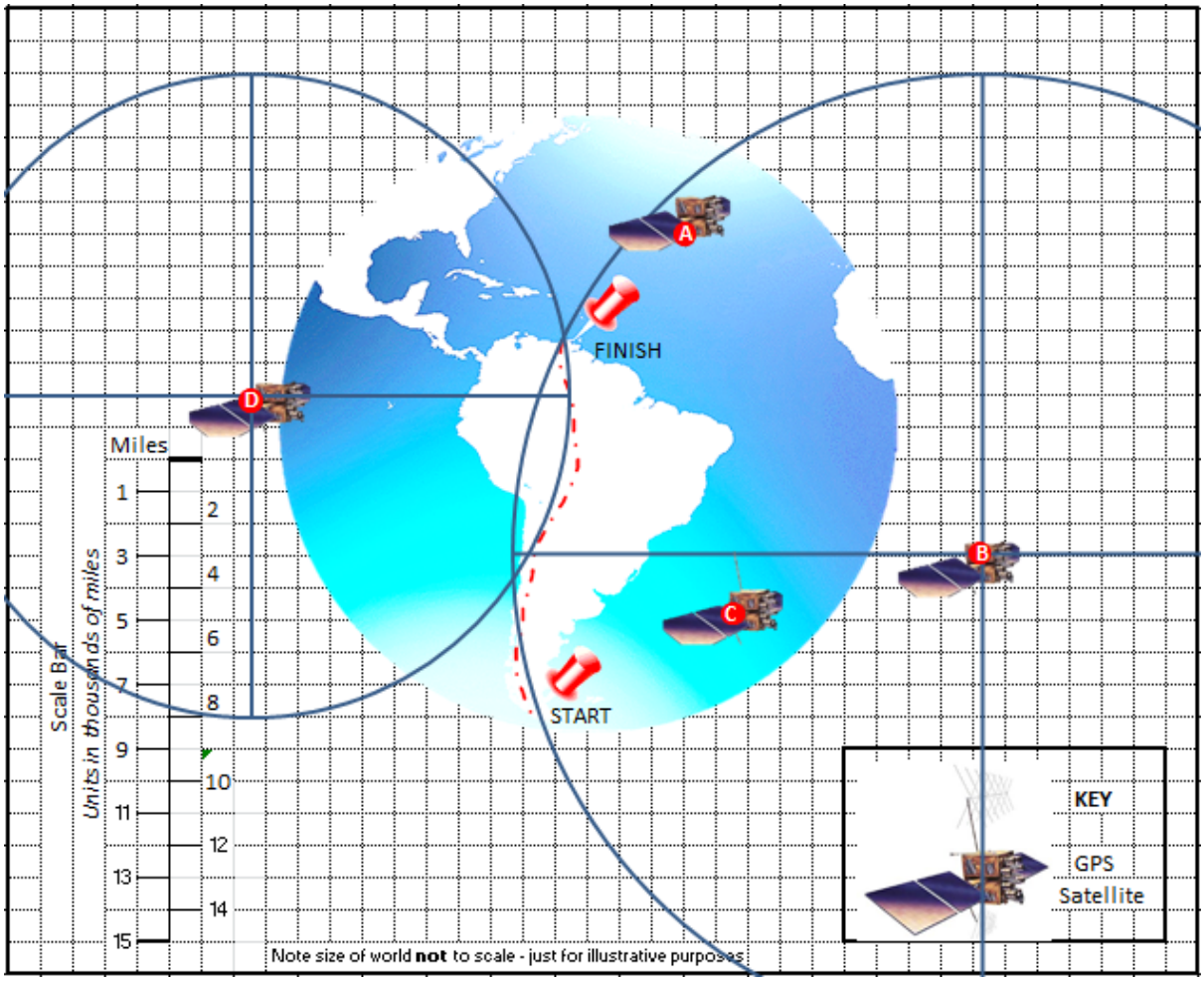
Wow, if you have mapped it correctly you should have two circles which cross eachother twice. That means we **MUST** be at one of those two points! You have found **the only two points on earth** where we can possibly be, thank you!

But which one is it? We need two more satellites to be really sure – let's find them

7. Satellite A is 5000 miles away – how long will its signal take to arrive at our GPS?

_____

8. Satellite B is 10000 miles away. With this information and your answer for satellite A, above, can you draw the two extra circles onto the following map?



Did all the lines cross at one point?

You have found us, thank you! We are finished and so are you. You have just taken one giant step for mankind and are a big step towards being both a Navigator and a Rocket Scientist!!!!