Scout Skills
Compass

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INFORMATION SHEET

A compass is an instrument with a magnetised needle which points to (magnetic) north and is therefore used for determining direction. Modern compasses come in different shapes and sizes; indeed, the use of suspended magnetic ore (which always comes to rest in a north-south direction) was used many centuries ago as a primitive form of compass. Today, in one form or another, compasses are used on land, at sea and in the air to help people to specify direction.

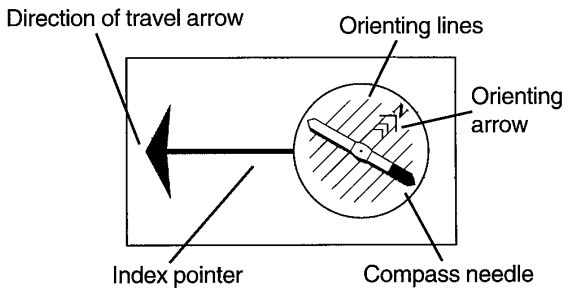
Types of compass

Air damped compass - This is the simplest and cheapest form of compass and does little more than indicate the approximate direction of magnetic north. It takes a long time to stabilise and the slightest movement makes the needle move. This compass should never be used for any sort of hike or expedition.

Simple map setting compass - It is a liquid-filled compass with only magnetic north marked on it and can be clipped onto the side of a map. It is useful for positioning a map until whatever is in front of you in reality is in front of you on the map. This can only be approximate as there is no allowance for magnetic variation. That is, the difference between magnetic north and grid (map) north (this is explained in more detail later on).

Prismatic compass - This is a more expensive type of compass with a prism which enables a compass bearing to be taken while sighting your objective. It can be more accurate than other compasses but it is harder to use and therefore should only be used once the basic principles of map and compass work have been mastered.

Silva-type compass - This consists of a magnetised needle suspended in an alcohol-filled housing. The liquid helps to 'dampen' movement of the needle enabling it to be read more quickly than air damped compasses. The compass housing has etched orienting lines and an orienting arrow, whilst the baseplate (on which the housing is mounted) has the direction of travel arrow and map scales etched onto it. This compass allows for bearings, an accurate method of determining direction, to be worked out and is therefore the compass of choice for hiking and expedition type activities.



CARE OF THE COMPASS

Most Scouts will use a Silva-type compass. Though it is robust it should be treated with the respect that a highly sensitive instrument deserves. Do not drop it or expose it to excessive heat and keep it away from radiators and glove compartments of vehicles or the capsule may develop a bubble which, depending on its size, may impair its efficiency. Store it away from other compasses, steel and iron objects, electrical appliances and electric circuits.

Why use a compass?

As you can see, it is possible to have a varying quality of compass depending upon what job it has to do and of course, ultimately, how much you pay for it!

Apart from determining the direction of north, a compass enables you to work out a compass bearing. This is the angle measured in the number of degrees between 0 and 360 which tells you the direction from one place to another. We call the

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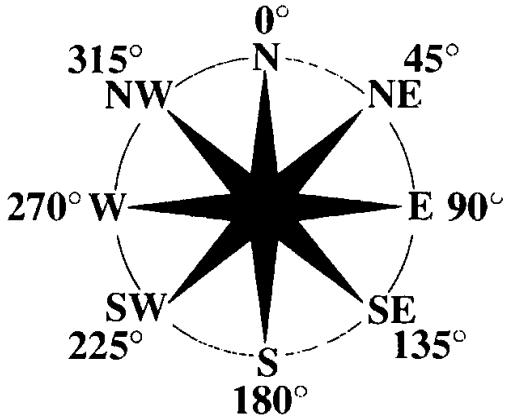
direction north '0' and therefore, it follows that east is 90 degrees, south-west is 225 degrees and so on.

If we just used the points of the compass (north, south, east, west and so on) we would only get eight different directions (or possibly 16 or 32 at most if we further divided the compass points). By using bearings, we can have 360, which enables us to be much more accurate.



Once we have determined a direction (and bearing) in which to travel, it can then be checked at regular intervals to confirm that we are still going in the correct direction whether or not our destination can be seen.

When using a compass proficiently, it is necessary to be able to:

- take a bearing - determine the angle between north and the direction of an object in terms of degrees
- walk on a bearing - use a bearing to get to a destination without necessarily using a map
- set a map - use a compass to correctly position a map in order to represent what can actually be seen.

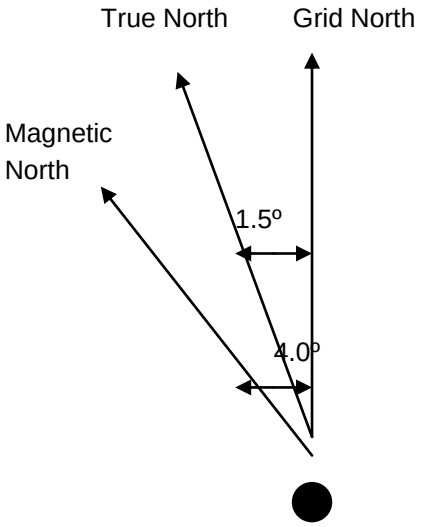
Details on how to do these are covered in the Teach Yourself section.

The three norths

When working with a map and compass, there are three different 'norths' to be considered. Fortunately, in the United Kingdom, for practical purposes, we only have to consider and work with two of them.

True north - each day the earth rotates about its axis once. The ends of the axis are the true North and true South Poles.

Grid north - the grid lines, pointing to grid north, on Ordnance Survey maps divide Great Britain into 100 kilometre sections. They are then further sub-divided into one kilometre squares, east of an imaginary zero point in the Atlantic Ocean, west of Cornwall. The majority of grid lines are 1.5 degrees west of true North and are therefore useful lines to refer to when taking bearings.



Magnetic north - a compass needle points to the magnetic North Pole. Unfortunately, it is not in the same position as the true North Pole. The magnetic North Pole is currently located in the Baffin Island region of Canada and, from the United Kingdom, it is west of true north. The difference between grid north and magnetic north is known as the magnetic variation and its value can be found in the orientation panel or margin of an Ordnance Survey map.

As true north is only about 1.5 degrees off grid north, it is so small that it is normally disregarded and only grid north and magnetic north are used.

Magnetic variation

The magnetic variation (the difference between magnetic north and true north) is caused by the North and South Poles not being directly 'opposite' one another. The lines of the earth's magnetic field do not run in a regular pattern as they are affected by other local magnetic forces and the magnetic pole is always on the move. Some of these lines of magnetic variation are east of true north and others

west of true north. Between the east and west lines there is a line of zero magnetic variation where the compass does point to true north - this line is known as the agonic line currently running through eastern Canada, the United States of America and South America.

However, not only does the magnetic variation change as you move across the earth's surface, it also changes with time. It is important to check the magnetic variation regularly, and this can be found on a map's orientation panel or margin. Remember also to check the year the map was printed as a map that is around 20 years old could be several degrees out. In fact, the magnetic variation also varies from side to side and top to bottom on each and every map but these details can also be found on the map.

This magnetic variation is important when combining a map and compass as you need to convert bearings from 'map to field'. To convert grid bearings (which are indicated by a map) to magnetic bearings (as per the compass pointing to magnetic north), add the current variation by turning the compass housing anti-clockwise. For example, if the current variation was 4 degrees, a grid bearing of 122 degrees would become 126 degrees. This is what the dial should be set at. The reverse is true for converting a magnetic bearing to a grid bearing; subtract the current variation. There are various ways to remember this, but perhaps the best is to reason that, since the country is always larger than the map, the grid bearing should always be made larger when working from the map to the country. Or you may prefer to remember “from field to grid: get rid.”

For expeditions abroad, however, some parts of the world will not only have a different value, but may also be east of true north, in which case, when converting from grid to magnetic bearings, the magnetic variation should be subtracted from the compass bearing.

Deposits of iron-based minerals in the earth’s crust, large iron or steel objects, or objects which contain steel or iron can have a very strong influence on the compass. So do not, for example, use a compass propped against a motor vehicle, or steadied on an iron fence post. Compasses are also strongly affected by the electro-magnetic fields created by power lines and electric wiring. Seemingly innocent objects like cameras, pen-knives, torches, ice-axes, whistles, rucksack frames, zip fasteners and wristwatches can also affect the accuracy of the compass. Find out for yourself what effect these things can have as they are brought closer to your compass.

GPS

What is GPS?

GPS is an acronym that stands for Global Positioning System. It is a network of satellites that continuously transmit coded information which makes it possible to accurately identify locations on earth by measuring distance from the satellites. The satellites transmit very low power radio signals allowing anyone with a GPS receiver to determine their location on Earth. And the system can be used for free.

GPS allows you to record or create locations from places on the earth and helps you navigate to and from those spots. GPS can be used everywhere except where it’s impossible to receive the signal. The signals travel “line of sight” so they will pass through clouds, glass, and plastic, but will not go through solid objects such as mountains or buildings, subterranean locations or underwater.

GPS provides amazing accuracy. Basic survey units can offer accuracy down to one meter. More expensive systems can provide accuracy to within a centimeter.

The 3 Segments of GPS

1. Space segment (the satellites)
2. Control segment (the ground stations)
3. User segment (you and your GPS receiver)

- The space segment

This is the heart of the system and consists of 24 satellites that orbit about 12,000 miles above the earth’s surface. They are arranged in their orbits so a GPS receiver on earth can always receive at least four of them at any given time.

- The control segment

This controls the GPS satellites by tracking them and providing them with corrected orbital and time information. There are five control stations located around the world.

- The User Segment

This is simply you and your GPS receiver.

How does GPS work?

The GPS receiver needs to know two things – a) where the satellites are (location) and b) how far away they are (distance). The GPS picks up coded information from the satellites. Even though the GPS receiver knows the precise location of the satellites in space, it still needs to know how far away the satellites are so it can determine its position on earth. There is a simple formula that tells the receiver how far it is from each satellite (a bit like working out how far away the thunderstorm is by counting the number of seconds from seeing the lightning to hearing the thunder).

So once we have both satellite location and distance the receiver can determine a position. To determine your three-dimensional position (latitude, longitude and altitude) the receiver will lock onto four satellites. Once the GPS has calculated a position you are ready to start navigating. Most GPS units will display a position page or a page showing your position on a map (map screen) that will assist in your navigation.

The unit stores data about where the satellites are located at any given time. This data is called the almanac. Sometimes when the GPS unit is not turned on for a length of time the almanac can get outdated or "cold". When the GPS receiver is "cold", it could take longer to acquire satellites. A receiver is considered "warm" when the data has been collected from the satellites within the last four to six hours.

Even with GPS technology becoming better every day, it is still a good idea to have backup navigation. Having a map, compass, and the knowledge to use them is good, safe and prudent practice. Remember GPS is a complement to navigation and should not be your only navigational tool.

Further information and resources

Ask other leaders experienced in the use of the map and compass for advice and ideas. Do they know of opportunities for practice or learning how to use them?

There are also plenty of books available on this subject, both at a beginner's level and more advanced. Chapter 5 of "Nights Away" contains a useful section about navigation, and for a very comprehensive book about route-finding with map and compass look at "Land Navigation" by Wally Keay published by the Duke of Edinburgh's Award.

High street shops selling camping and hiking equipment may also be able to offer advice.

TEACH YOURSELF

Understanding how to use a compass is like many other activities: it's easy when you know how. Practice is also the only way to get it right and remember it. Although this sheet can help you through the different stages, the only effective way to learn is to go out and use the compass for real. Ask experienced leaders for advice and also take part in a hike or expedition to put the skills into practice.

Time

Up to one hour may be required to become familiar with the parts of a compass and the principles of how to use it, especially in conjunction with a map, but more time will be required in shorter sessions to put it into practice.

Equipment

A Silva-type compass and an Ordnance Survey map of the area you are in.

Learning all about it

Before having a go, you will need to read the information sheet if you have not already done so.

Taking a bearing

1. Hold the compass flat in your hand with the direction of travel arrow pointing towards your destination or objective

2. Turn the compass housing until the compass needle lines up over the orienting arrow. Ensure the North Pole of the needle, usually red, is used

3. Read off the magnetic bearing (the number of degrees) from the mark on the compass housing indicated by the index pointer

4. Keep the housing in that position and check your bearing at regular intervals by lining up the needle with the orienting arrow and walking in the direction indicated by the direction of travel arrow

Walking on a bearing

This is used when you can initially see your objective or destination and don't need a map. It is important to work out a compass bearing before the situation changes (this might be due to the weather, the terrain you are in or a delay resulting in darkness). Any of these factors may mean you can no longer see where you are aiming for and, therefore, you will need to rely on the compass bearing.

1. Turn the housing of the compass until the bearing you require is against the index pointer
2. Turn the compass until the needle lies over the orienting arrow
3. Pick out a landmark along your direction of travel line and walk towards it
4. Check your bearing and your objective at regular intervals.

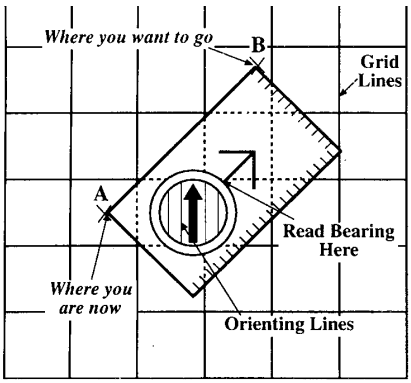
Setting a map with a compass

This is for when you are using a map in conjunction with a compass to reach a given destination, probably in unfamiliar territory.

1. Turn the compass housing until the magnetic variation for the area is shown against the index pointer
2. Place the direction of travel arrow pointing along the vertical grid line with the direction of travel arrow pointing to the top of the map
3. Turn the map with the compass in this position until the compass needle points to the north mark on the compass housing
4. Your map is now 'set' and you should be able to recognise actual features from your map in front of you.

Combining map and compass

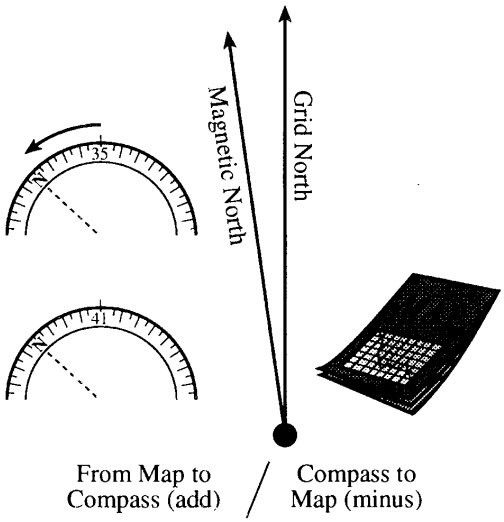
1. Place the compass on the map so that one long edge joins the start point and your destination, with the direction of travel arrow pointing towards the direction you wish to travel (the direction of the map does not matter for this exercise)
2. Turn the compass housing until the orienting arrow points to the top of the map and the orienting lines are parallel to the grid lines
3. Take the compass off the map and read off the bearing at the index pointer and add (or subtract) the local magnetic variation
4. Turn the whole compass so that the needle comes to rest over the orienting arrow, with the red part to the north
5. Hold the compass in front of you, pick out a landmark along your line of travel and walk towards it.



Common errors

When first learning how to use a compass, there seem to be many things to take into consideration - here are a few things which often 'go wrong'.

- Failing to add on the magnetic variation. If the magnetic variation is, for example, 6 degrees and you forget to add it on, you will be 105 metres off course for every kilometre travelled in a straight line. This gets proportionally bigger over greater distances



- Not having the direction of travel arrow pointing from your start to finish. If you make this mistake you will walk 180 degrees out from your intended route

- Orienting arrow pointing to the bottom of the map. Again, you will walk (180 degrees out) in the opposite direction

- Not taking account of the magnetic effects of iron and steel around you. For example, watches, steel buckles, cars, buried pipes, reinforced concrete, wire fences, railway lines and other compasses (and even magnetic rocks) can influence your compass. That is, these items might attract the compass needle in preference to the magnetic North Pole therefore giving you an inaccurate reading. If in doubt, try to move away from such objects.

Avoiding obstacles

Sometimes when using a map and compass you will come across obstacles such as a lake, wood and so on that cannot be crossed and you must get round them somehow. The problem is to avoid the obstacle without losing direction.

The obstacle may be by-passed by going round it by a series of right angles; walk at 90 degrees to your original route, count the number of paces until you clear the object. Turn 90 degrees again, so that you are not parallel with your original bearing and walk past the obstacle. Turn 90 degrees again and walk the same number of paces. Then, finally, turn through 90 degrees to bring you back on your original course.

This may seem rather pedantic, but it does work (providing the number of paces and turns are accurate). This can be vital if the weather takes a turn for the worse. An error of just 2 degrees over a journey of just six kilometres means that you will miss your target by 200 metres. This, if you find yourself fog-bound and it's the only habitation for 20 miles around, could be fatal.

Can you do it?

When you feel confident about using a compass, check how you are doing and see which of the following you can tick off.

Name the parts of a Silva-type compass □

Take a compass bearing □

Set a map using a compass □

Walk on a compass bearing □

Walk around obstacles maintaining the correct direction □

Explain the importance of magnetic variation □

Explain the difference between true north, magnetic north and grid north □

So you want more?

Have a go at orienteering - this is using a map and compass over a given area in the form of a competition.

Learn how to take and use back bearings.

Learn how to draw a resection of map which would enable you to locate your position.

HOW TO TRAIN OTHERS

This section is designed to give some practical ideas about how you can help other people to understand how to use a compass. This might be leaders or Scouts - either in an informal way on a Troop night or more formally on a skills workshop, training course or similar.

Objectives

By the end of the session, participants will be able to:

I. Describe the different parts of a Silva-type compass

II. Explain the difference between true north, magnetic north and grid north

III. Demonstrate how to take a compass bearing

IV. Demonstrate how to set a map using a compass bearing

V. Demonstrate how to walk on a compass bearing.

Time

Allow up to one or two hours to explain the principles of how to use a compass and to have an initial go at putting it in to practice. Follow-up sessions at a later date will be important to reinforce the learning.

Equipment

- Silva-type compasses and various Ordnance Survey maps (including one or more of the local area)
- Visual aid of a Silva-type compass and its component parts (the attached compass outline could be used as an overhead projector transparency - see final page)
- Equipment as per the training activities chosen.

Training methods

There is no substitute for letting participants get 'hands-on' experience but there will need to be some introduction and explanation. This and the activities and games will obviously need to be adapted according to whether it is adults or Scouts who are the participants (details on all the aspects that should be covered can be found in the information sheet and Teach Yourself sections).

Here is a typical session outline that you may wish to follow or adapt:

- Start with making a simple compass (see overleaf) and outline the purpose of a compass
- Follow this by explaining the difference between magnetic, true and grid north, and the importance of magnetic variation
- For Scouts it might be advisable to play a game or activity which checks their knowledge and understanding of the compass points (see "Training Activities" overleaf for a couple of ideas)
- Outline the different parts of a Silva-type compass. This can either be done by showing a visual aid or a large example of a compass or, better still, having a go at constructing a paper version, as in the attached example
- If possible, go outdoors at this stage and, using a map and compass, show the participants how to have a go at setting a map, taking a bearing, walking on a bearing and combining a map and compass. It might be helpful if participants are in pairs for this activity so that they can help each other. Large groups might mean that not everyone has a go or learns effectively
- Once the participants are happy with the principles of how to use a compass, have a go at some of the activities outlined below either individually or as a series of bases. You could also arrange a short hike, perhaps in unfamiliar territory, to reinforce what they have learned. It will also be helpful to follow up with some of these activities at a later date.

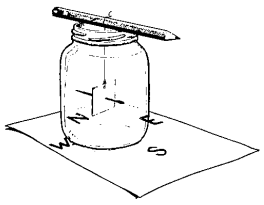
MAKE YOUR OWN COMPASS – METHOD 1

Equipment

Sewing needle	Sheet of thin paper
Pencil	Sheet of A5 paper
Permanent magnet	15cm of cotton
Empty jam jar	Felt-tipped pen

What to do

- The needle is held down with one finger and stroked with one pole of a permanent magnet. It is important that the needle is always stroked in the same direction. The more times the needle is stroked the more molecules are pulled into line and the stronger the magnet will become
- Cut a 2cm square of thin paper and push the magnetised needle through it
- Make a small hole in the top of the paper and carefully tie a length of cotton through the hole
- Tie the paper and needle to the pencil and rest it across the top of the jam jar. The jam jar prevents the wind and air currents moving the needle
- Mark the A5 sheet of paper in felt-tipped pen with the points of the compass (N/E/S/W)



Sheet of thin paper, sheet of A5 paper, 15cm of cotton, felt-tipped pen

Gently lift the jar and rest it until the north lies in the same direction as the pointed end of the magnetised needle. You now have a compass!

MAKE YOUR OWN COMPASS – METHOD 2

Equipment

Needle - magnetised as in Method 1.

Piece of cork or polystyrene

Saucer of water

Sheet of A5 paper

Felt-tipped pen

What to do

- Rest the magnetised needle on a small piece of floating cork or polystyrene in a saucer of water. The magnetised needle will turn the cork or polystyrene into an approximately north-south direction
- Mark the A5 sheet of paper (using the felt-tipped pen) with the points of the compass
- Gently lift the saucer onto the middle of the compass card. Turn the card until the north lies in the same direction as the pointed end of the magnetised needle.

MAKE A TRAINING COMPASS

Equipment

Card

Scissors

Brass split paper fastener

What to do

- Photocopy the page overleaf
- Cut out the three parts
- Pinch or cut holes in the centre marked '+'
- Fasten the parts together using a brass paper fastener or press stud.

TRAINING ACTIVITIES

Compass Change

Equipment

None required

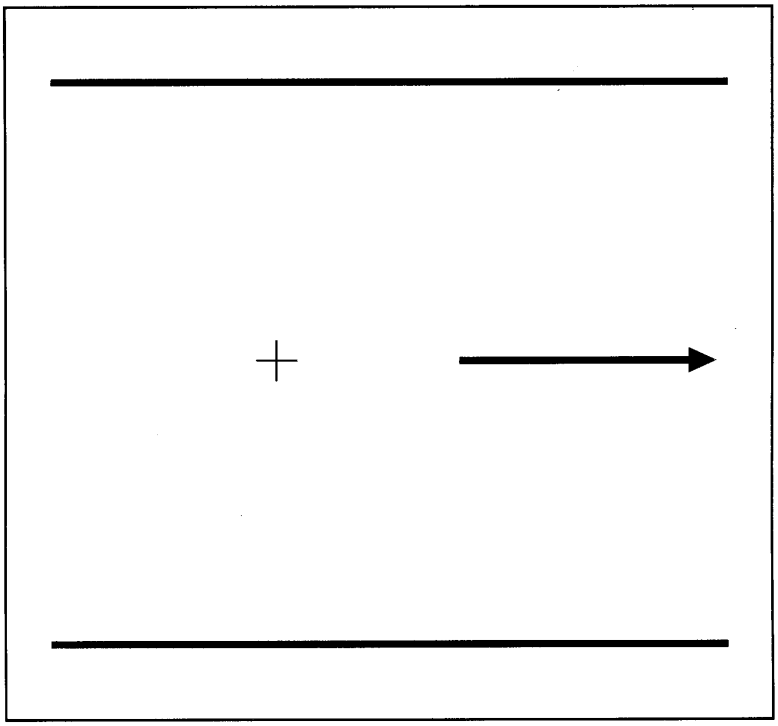
In small groups, the participants form a circle facing inwards. Each participant represents a main compass point (N, NE, E, SE, and so on), except one person who is 'it'. This person stands in the centre of the circle. 'It' calls out two compass points. The participants representing these points then attempt to change places and 'it' tries to take the place of one of them. The participant then left without a place in the circle becomes the next 'it'.

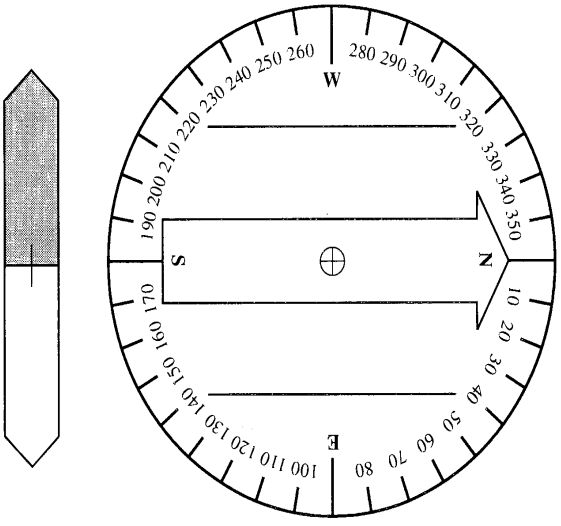
COMPASS POINT

Equipment

None required

The participants stand together in the middle of the room all facing the same direction. The Leader tells the Scouts that they are, for example, facing south. The compass points are then called out and the last Scout to face the direction named each time is out of the game.

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