

Questions

Q: Have you heard from the Vikings before?

Q: Where did they live originally?

Q: What were the typical jobs of the Vikings?

Q: The Vikings settled on the Shetland and Faroe Islands, on Iceland, and on Greenland. How far are these destinations from the Norwegian coast? How did they get there?

Q: What knowledge and skills did the Vikings use to navigate? How did they know that they were on course?

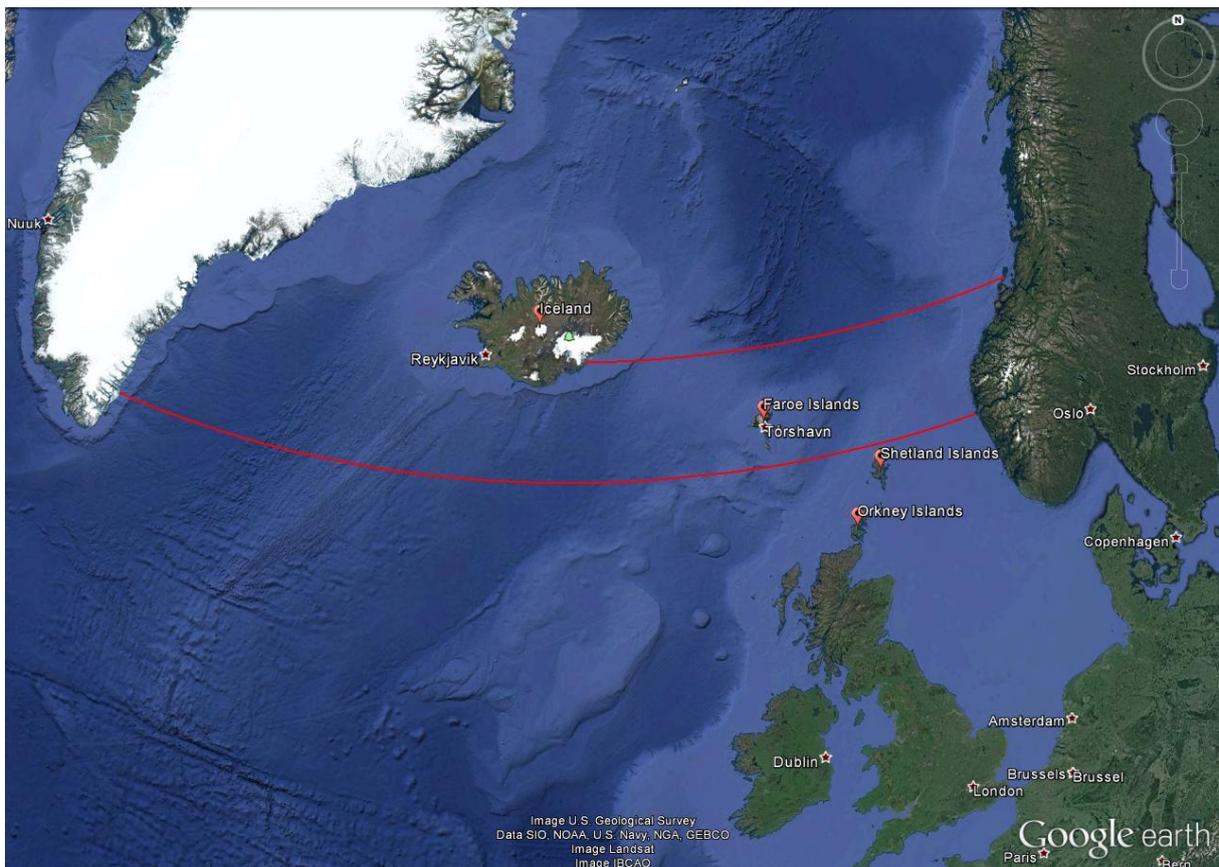


Figure 1: Map of the Northern Atlantic. The red lines indicate 61st and 64th northern latitudes.

Q: Vikings used the technique of sailing along latitude. How did they know that they were on the correct latitude of the destination?

Constructing instructions: The Indian Circle

The list contains items needed for one sundial.

- A stick or a rod as gnomon (25 cm high, 1 cm thick)
- Anything to put marks and draw lines on the ground (depends on surface, e.g. chalk, stick, stones, marbles)
- Cord (length depends on size of shadow path)
- Pencil
- Clock

This tool can have nearly any size. However one should first test, if the object foreseen as the gnomon in fact casts a shadow that is useful for this activity. The tip of the gnomon should produce a shadow well visible throughout the better part of the day. In essence, the thickness of the gnomon (e.g. rod, stick, pole) should be in suitable relation to its height. Keep in mind that the Sun produces an umbra and a penumbra. A good rule of thumb is that the height and the thickness should have a ratio between 25 und 30. The size of the gnomon indicated above should work in most cases.

The activity should be initiated several hours before local noon, i.e. in the morning and a well after sunrise. The weather forecast should predict rather clear skies throughout the day. Together with the students, find a flat area, where the gnomon (rod, stick) can be fixed upright.

Activity: The Sun leads the way

Put up the gnomon in the morning. Mark the position of the shadow of the tip of the gnomon and enter the time in the table of the worksheet. On concrete, chalk would be a good idea. On sand or soil, small stones can be used. Return regularly (every hour at least) during the day and continue to mark the shadow and record the time so that the path can be followed. This task could be distributed among different students, e.g. according to a time table. It is important that the path of the shadow is covered at least a few hours before and after local noon, i.e. when the shadow is shortest.

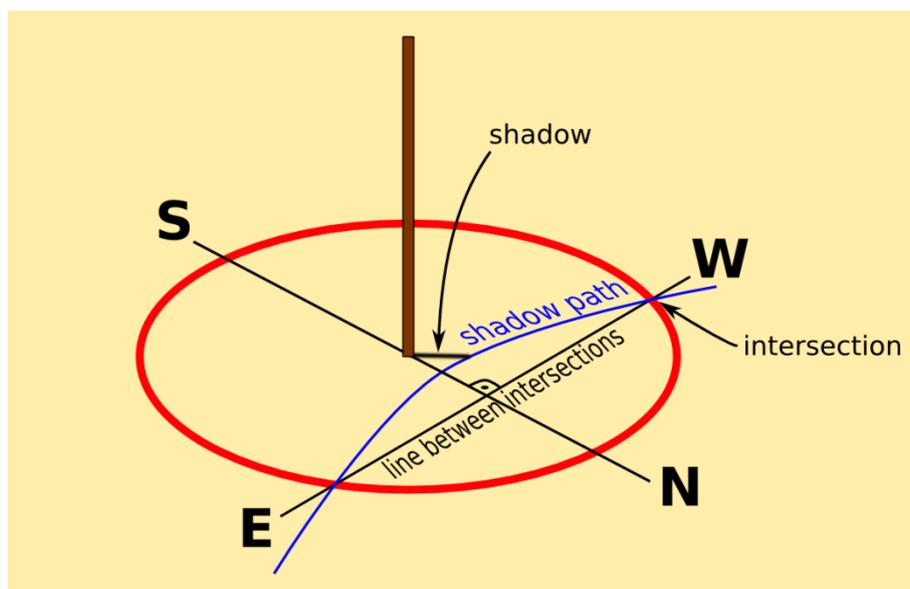


Figure 2: Illustration of how the Indian Circle can help find the cardinal directions (Credit: MichaelFrey, https://commons.wikimedia.org/wiki/File:Indischer_Kreis-Schräg.svg, „Indischer Kreis-Schräg“, translated and cleaned up annotations by Markus Nielbock, <https://creativecommons.org/licenses/by-sa/3.0/legalcode>).

Questions

Q: Why does the shortest shadow during the day point north?

Q: What time was it, when the Sun was in the south?

Q: Why does the clock show something else than 12 h at local noon?

Q: The length of the shadow at local noon changes throughout the year. Why?

Q: Imagine you repeat the experiment at different latitudes. At any given day during the year, would the shadow at local noon be shorter or longer at higher latitudes? Explain why.