



# BepiColombo: Mission to Mercury

## Lesson Overview:

This presentation will aid you in teaching some of the space curriculum with mention to a current space mission to Mercury called BepiColombo. There are interactive parts where students can ask and answer questions.

## Objectives:

- Name the eight planets
- Know how long it takes for Earth and Mercury to orbit the Sun
- Know how gravity changes with distance
- Appreciate how conditions change with BepiColombo's orbit
- Describe what an eclipse is
- Understand why there are seasons

**Outline for lesson:** Time 80-90 minutes (not including experiments)  
Should be split into 2 lessons- Stopping/Starting at slide 20

**Slide 2** Time: 5 minutes

Introduction to topic, brief class with what the objectives are

**Slide 3-12** Time: 10 minutes

Ask students to name the planets on the screen going from the Sun outwards. After each click of the mouse, the answer will be shown. Ask students what they notice about the planets and their distribution. They can be informed about the different sizes/distances from the Sun, and how the planets are spherical bodies, not just circles.

Answers to questions on the slides:

How hot do you think the planets are: This varies which seasons, which side is facing the Sun, atmosphere causing greenhouse effects etc but generally the temperature of the planet decreases the further away from the Sun you get.

How long is an Earth year: 365 days (this can be linked to leap years if you want to say 365.25 days)

Which planet do we live on: Earth, the third planet from the Sun.

Why do we explore different planets: This can progress knowledge about how the solar system formed, and give us information about our own planet. Technologies arise from planetary exploration that help us in our lives. Another key factor is simple curiosity.



What are the differences are in how they all look: Different sizes, colours, patterns, rings etc.

**Slide 13 & 14** Time: 5 minutes

Students can be questioned as to why there are leap years, you may wish to elaborate to say not exactly 365 days (depending on current curriculum). Ask students why they think Mercury has a much shorter orbital time. The answers being because it is closer to the Sun, it has a smaller orbital circumference, it also moves round the Sun quicker than Earth.

**Slide 15** Time: 3 minutes

Link to a YouTube video explaining why people don't fall off the Earth in the Southern hemisphere. Explains how gravity is a centripetal force, not just a downward force.

**Slide 16** Time: 5 minutes

This slide exists so that it can be explained how gravity gets weaker at longer distances. This can be explained by either doing an experiment and/or showing the YouTube video linked at the bottom of the slide. As the ball gets closer to the center mass, the sheet (like space) is more curved, causing the ball to accelerate.

The experiment would in principal be the same as the link, but the students could hold the sheet (a blanket or parachute would work too, just close the hole in the middle for the latter case) then throw on the balls themselves. Heavier objects would work well for the planets, and something like marbles/cricket balls would work well for asteroids/moons.

**Slide 17** Time: 5 minutes

The side of Mercury that is closer to the Sun experiences hotter temperatures than the nightside. These temperatures are extreme and may be difficult to comprehend, however on this slide are compared to more everyday examples. This slide leads onto the BepiColombo mission.

**Slide 18** Time: 5-10 minutes

Lesson starter: Ask the class if they have heard of ESA before (European Space Agency). If they haven't, do they know what NASA is? (American Space Agency). Inform the class that there are space agencies other than NASA. ESA is the European space agency and there is also a UK Space Agency. We work with both. What previous/current space missions do they know about?

This slide is there as an introduction to the BepiColombo mission. It can be explained that BepiColombo is a current mission to Mercury funded by the European and Japanese space agencies. The YouTube link on the slide links to an animated ESA video which talks about BepiColombo in a fun way

BepiColombo launched in October 2018 and will get to Mercury in 2025. The nominal mission is 1 Earth year, with a likely one Earth year extension. It is the third ever mission to Mercury, its predecessors being Mariner-10 and MESSENGER, both NASA missions.

Note: A student may comment on how the colour of Mercury has changed on this slide. This is because the "colourful" image has exaggerated colour. This means that scientists have changed the colour of the



planet to help identify the different features of the planet. The colour of Mercury would be a dull grey if you looked through a telescope.

Answers to questions on slide:

What is Mercury made out of: Mainly iron, but this will be researched more by BepiColombo

Why does Mercury have a magnetic field: This is one of the questions that BepiColombo will try to answer, as we are not quite sure as to why at the moment.

Why is the core of Mercury so large (70% of volume compared to Earth's 17%): Thoughts are that another body hit Mercury, causing it to lose a lot of its lighter materials, which would leave a larger core in comparison to the rest of the planet.

How did Mercury form: There are current theories as to how the planet formed, but these will be refined through the data that BepiColombo will measure.

### **Slide 19-20** Time: 5-10 minutes

Slides 19 and 20 can be used to explain how the mission needs to survive both temperature extremes. Students could be asked what techniques could be used to help this i.e. heaters for night side and heat sink (transfers heat to back of space module to be emitted) for the day side. (End of lesson 1).

### **Slide 21-22** Time: 10 minutes (Lesson 2)

This slide shows how lunar/solar eclipses occur, a direct link to the syllabus. There are relevant lines on the diagram to show how there would be a shadow on the planet to cause a lunar/solar eclipse.

You ask students to pretend to be the Sun/Moon/Earth and to orbit on another to get them to see the geometry of the scenario.

This can be linked to BepiColombo. When Mercury (and the spacecraft) are on the opposite side of the Sun to Earth, (analogous to an eclipse), what difficulties might we face? (We will have to wait to receive the data from BepiColombo, as the Sun will block our communication).

### **Slide 23-26** Time: 10 minutes

The seasons are caused due to the axial tilt of the planet. Earth has a tilt of about  $23^\circ$ . When the northern hemisphere is tilted towards the Sun, summer occurs in the north, (and winter in the south). When the northern hemisphere is tilted away from the Sun, winter occurs in the north (and summer in the south). Mercury in contrast has a tilt of about  $0.1^\circ$ , so students could be asked to think about what Mercury's seasons (or lack of) would be like. Mercury has a sort of season, but this is due to its orbit not being a circle.

### **Slide 27-31** Time: 15 minutes (not including experiment)

These slides are used to explain the hours of the day. The sun is at multiple points in the sky, which may be a good way to get students to think about what sort of shadows would be cast at different times of the day. You can also talk about how the seasons are different in the northern and southern hemisphere. A



viable option would be making a sundial from a stick and a torch (or use the sun, a stick and some chalk). If you use the Sun, you can get students to make a mark the position every hour, so they can see how it changes. If you use a torch, you could simulate sunrise/noon/sunset by angling the torch or moving it like the Sun moves. These slides can be used to explain how the length of the day is related to the spinning of the planet, as Mercury has a much longer rotation rate, this comparison may make it easier for students to understand.

### **Summarise what's been learnt**

At the end of the lesson, you can summarise what has been learnt, and ask the students to answer questions on the subject. It may be useful to add to the PowerPoint based on your own use/experience to specialise it to your own situation. The students can then be asked to complete the worksheets associated with this lesson.