Pilot Assessment Schedule – 2023

Physics, Earth and Space Science: Demonstrate understanding of the effect on the Earth of interactions between the Sun and the Earth-Moon system (92046)

Assessment criteria

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of the effect on the Earth of interactions between the Sun and the Earth-Moon system involves: • describing observations of interaction • describing science ideas that support the observations of interactions • describing the effect of interactions on the Earth.	*Explain the effect on the Earth of interactions between the Sun and the Earth-Moon system* involves: • linking science ideas with observations to explain interactions and their effect on the Earth.	*Analyse the effect on the Earth of interactions between the Sun and the Earth-Moon system* involves: • integrating science ideas with observations to discuss interactions and how their effect varies on the Earth.

Evidence

	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
PART ONE	The Moon does not generate its own light; it reflects sunlight. Half of the Moon will always be lit up by the Sun. As the Moon orbits the Earth, its varying position means that the Sun lights up different regions, resulting in different lunar phases being observed on Earth. This is because the Moon orbits the Earth, and the Earth orbits the Sun. It takes 27.3 days for Moon to orbit Earth, but the time between New Moon to New Moon is 29.5 days. The Moon must travel further than 360˚ in its orbit to be at the same relative position between the Sun and Earth, because as it orbits Earth, Earth also orbits the Sun. The Moon reflects increasing amounts of light as it moves from New Moon to Full Moon and then decreasing light as it moves from Full Moon to New Moon. When the Moon and Sun are on opposite sides of the Earth, we see the half that is fully lit by the Sun as a Full Moon. During 3rd quarter Moon, we see the other half of the lit side, because the Moon and Sun are at a 90˚angle. When the Moon is between the Earth and the Sun it is New Moon. The Sun is behind the Moon, so we see the dark side. At 1st quarter, we can see half of the lit side of the Moon, because the Moon and Sun are at a 90˚angle.	• Identifies that Moon's orbit around the Earth causes phases. • States that it takes the Moon 27.3 days to orbit Earth. • Describes why New Moon to New Moon takes 29.5 days. • Describes positions of Moon and Sun for the three phases of the Moon. • States that the moon rises at different times.	• Explains why New Moon to New Moon takes 29.5 days. • Explains two phases in terms of relative positions of Earth-Moon-Sun. • Explain why the Moon rises at different times.	• Compares the three phases of the moon in terms of amount of light and relative positions of Moon, Earth, and Sun. • Links time of the moon rising to its orbit relative to the Sun and Earth's spin.

	The lunar orbit is slower than the Earth's. The Moon rises 30 to 70 mins later each day / night than the previous day / night due to the fact that the Moon's orbit has moved every day. This shift means Earth has to rotate a little longer to bring the Moon into view, which is why the Moon rise is later each day. It also appears in a different part of the night sky as a result.			

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence.	1A	2A	3A	4A	1M	2M	1E	2E

	Evidence	Achievement	Merit	Excellence
PART TWO	Tides are caused by the gravitational pull exerted on the Earth by the Moon, and to a lesser extent, the Sun. The gravitational pull of the Moon is strongest on the side of Earth closest to the Moon and creates a bulge in the water – high tide. This is caused by the Moon pulling the Earth towards it. The other high tide occurs on the other side of the Earth. Low tides occur between high tides. As the Earth spins, different areas of the planet face the moon, and this rotation causes the tides to cycle around the planet. This means that there are two high tides and two low tides every day because the Earth rotates through two tidal "bulges" every lunar day, coastal areas experience **two high and two low tides every 24 hours and 50 minutes**. Spring and neap tides change the level of high and low tides. When the Sun, Moon and Earth are all lined up, the Sun's tidal force/gravitational pull works with the Moon's tidal force. The combined pull can cause the highest and lowest tides, called spring tides. When the moon faces the Earth at a right angle to the Sun, the pull of the Sun and the Moon are weaker. This causes high tides that are lower than usual. These tides are known as neap tides. Spring and neap tides only occur twice a month because they occur when its either a New or Full Moon for spring or first and last quarter for neap tides. Perigean (king) tides occur when the Moon is closest to the Earth in its monthly orbit (perigee) when it is in alignment with the Sun and Earth as well, and when it is either a full Moon or New Moon phase. Because there are three conditions that must be met for a King tide they are not as frequent as other tides and also irregular.	• States that the Moon exerts gravitational pull on the Earth causing the bulge. • Describes the formation of high and low tides. • Defines perigee. • Defines apogee. • States that spring and neap tides occur every 14 days due to the phases of the moon.	• Explain why the Earth experiences two high and two low tides a day. • Explains why we experience king tides. • Explains why we experience spring, neap tides.	• Full discussion including differences in frequency of high, spring and neap tides. • Full discussion for why we experience king tides at irregular intervals.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence.	1A	2A	3A	4A	1M	2M	1E	2E

	Evidence	Achievement	Achievement	Excellence
PART THREE	The Earth is tilted on its axis. The tilt orientation does not change as it orbits the Sun every 365.25 days. This means that different parts of the Earth receive direct sunlight at different times in its orbit, causing different seasons. In January (Dec-Feb), the Southern Hemisphere is tilted towards the Sun and receives more direct radiation for a longer time, causing summer. At the same time the Northern Hemisphere is tilted away from the Sun and receives less and shorter periods of solar radiation, causing winter. During July (Jun-Aug), the opposite is true. In March and September, solar radiation is directly over the equator. During March-May the Sun is heading towards the north, causing spring in the Northern Hemisphere and autumn in the Southern Hemisphere. During September-November the Sun is tracking southwards causing spring in the Southern Hemisphere and autumn in the Northern Hemisphere. At the Equator they have the same amount of daylight and darkness (12 hours) throughout the year, due to the Sun striking the surface at about the same angle regardless of the earth's orbital position. Thus the Equator experiences moderate changes in temperature, while in New Zealand these changes are greater.	Describes (can come from diagrams): • Earth's tilt and orbit cause seasons. • variation in amount of radiation causes seasons. • summer and winter in two hemispheres at the same month. • autumn and spring in two hemispheres in same month. • temperature variation smaller at Equator (or greater in New Zealand).	Explains: • one season in detail referring to position and tilt of Earth • why it is summer in Southern Hemisphere, while it is winter in Northern Hemisphere (or opposite), due to orbit or radiation • why the Equator has less of a temperature variation than New Zealand.	Discusses: • how the relationship between the Earth and Sun, in terms of orbit and tilt, causing variation in radiation and seasons. • why there is a small variation in radiation at Equator, compared to New Zealand.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence.	1A	2A	3A	4A	1M	2M	1E	2E

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 13	14 – 19	20 – 24