Topic: Our Planet Earth in our solar system

Teacher guide, lesson plan and assessment rubric

Designed for Grade 8-11 extra-curricular facilitation | 2 hours | up to 9 pairs

Session at a glance

Slides: This lesson is supported by the PowerPoint deck **Slides Earth in our solar system**. You can find it in the **same folder** as this teacher guide document.

Learner handout: Print or share **Learner handout and worksheet Sunlight analysis** (in the same folder). Learners use it to write the hypothesis, identify variables, record data, draw a graph, answer analysis questions, and plan their short presentation.

Audience	Grade 8, 9 and 10 learners in an extra-curricular session
Duration	2 hours
Group size	Up to 9 pairs (18 learners) using 10 kits
Kit sensors	Natural light intensity, air temperature and relative humidity
Main goals	Understand how sunlight interacts with Earth and the atmosphere; run a fair test; present results, findings and conclusions
Recommended experiment question	How do light intensity, air temperature and relative humidity change across places with different exposure to sunlight?
Best locations	Full sun, partial shade and indoor near a window, or three outdoor locations with clearly different light exposure
Evidence sources	OLED readings during the activity and/or CSV export from the micro SD card afterwards

Contents

Session at a glance 1

1 Lesson overview (science focus) 2

2 Curriculum alignment 2

3 Background notes for non-specialist facilitators 3

4 Materials, preparation and safety 3

5 Experiment activity plan 5

6 Solar eclipse extension (background + example data) 6

7 Troubleshooting 7

8 Presentation rubric (20 marks) 7

1 Lesson overview (science focus)

Essential question: How does the amount of sunlight at a place relate to the local air conditions we can measure (light intensity, air temperature and relative humidity)?

Learning objectives (by the end of the session, learners can):

- Describe how Earth's position and an atmosphere help make conditions suitable for life.
- Explain why direct sunlight can deliver more energy per unit area than oblique sunlight.
- Plan and carry out a fair test with clearly defined variables and repeats.
- Record measurements with units, calculate averages, and present results using an appropriate graph.
- Write or present a conclusion using claim–evidence–reasoning (CER), including limitations and possible sources of error.

Key vocabulary: Solar System, atmosphere, troposphere, stratosphere, ozone, ultraviolet (UV), greenhouse effect, direct rays, oblique rays, light intensity, temperature, humidity, *relative* humidity, variable, control, repeat, average, anomaly, limitation.

Measurement note (important for scientific accuracy): The kit reports light intensity (often in lux). Lux is a measure of how bright light appears to the human eye, not the total solar energy (irradiance). Use it as a relative comparison between locations, and keep the sensor orientation consistent.

2 Curriculum alignment

Note: Relative humidity is used here as a practical enrichment measure. It supports atmosphere and environmental understanding, but it is not usually named as a standalone CAPS topic at this level.

CAPS connections (summary)

Topic element in this lesson	Closest CAPS connection	Reference
Earth in the Solar System and conditions for life	Natural Sciences Grade 8 Term 4: The Solar System; Earth's position in the Solar System; conditions that support life on Earth	NS Gr 8 pp. 53-54
Sunlight intensity, direct and oblique rays, seasons	Natural Sciences Grade 7 Term 4: Relationship of the Sun to the Earth; changing intensity of solar energy through the year	NS Gr 7 p. 32
Visible light and what light does	Natural Sciences Grade 8 Term 3: Visible light; spectrum; absorption; reflection; refraction	NS Gr 8 pp. 51-53
Atmosphere, ozone and greenhouse effect	Natural Sciences Grade 9 Term 4: Atmosphere; layers; ultraviolet absorption; greenhouse effect	NS Gr 9 pp. 81-82
Scientific investigation and process skills	Natural Sciences Specific Aims and process skills; Life Sciences Specific Aim 2; Physical Sciences specific aims and practical work	NS pp. 10-11; LS pp. 15-17; PS pp. 8-12
Recording, graphing and interpreting data	Life Sciences: record information, measure, interpret, convert tables into graphs; Grade 10 subject orientation introduces graphs	LS pp. 16-17, 23

3 Background notes for non-specialist facilitators

3.1 Earth in our solar system

- Earth is the third planet from the Sun. Its distance from the Sun allows liquid water to exist, which is one reason Earth can support life.
- Sunlight is the main energy source for life on Earth. Plants use light energy to make food, and that energy moves through food chains.
- Earth receives different amounts of solar energy depending on angle. Direct rays concentrate energy on a smaller area; oblique rays spread it over a larger area.

3.2 Sunlight and the atmosphere

- The atmosphere is a mixture of gases held around Earth by gravity. Most weather occurs in the troposphere; most ozone is found in the stratosphere.
- Some incoming sunlight reaches the ground, some is reflected, and some is absorbed by gases, clouds and particles. Ozone in the stratosphere absorbs harmful ultraviolet radiation.
- Sunlight reaching the surface can be absorbed (warming land and water) or reflected back to space. Ozone in the stratosphere absorbs much of the Sun's harmful ultraviolet (UV) radiation.
- Relative humidity compares the water vapour in the air to the maximum the air could hold at that temperature. If air warms without adding water vapour, relative humidity usually decreases.
- Humidity patterns can be subtle. Learners should be told that humidity may not change strongly over a short session, and that this does not mean their investigation failed.

3.3 What the kit measures

- Light intensity: how bright the light is at the sensor position (often reported in lux). Use it to compare locations fairly by keeping the sensor height and orientation consistent.
- Air temperature: the temperature of the surrounding air. Allow a short settling time before recording.
- Relative humidity: a percentage value that depends on both moisture and temperature.

3.4 Common misconceptions to avoid

Facilitator note (common confusion): Ozone protects life mainly by absorbing UV radiation. The greenhouse effect is mostly caused by gases like water vapour, carbon dioxide and methane absorbing infrared (heat) radiation. They are related to Earth's habitability, but they are not the same process.

- More light does not always mean a big temperature jump in a short time; air warms more slowly than light changes.
- Humidity is not "water in the air only". It is relative to temperature, so the same air mass can show a different relative humidity when it warms or cools.
- A result that is unexpected is still useful. Learners should explain it with evidence instead of changing the numbers.

4 Materials, preparation and safety

4.1 Materials

- 10 Space STEM kits with charged power supply, functioning OLED display, and optional micro SD cards inserted
- Clipboard or firm writing surface for each pair
- Pencils, ruler and calculator
- Learner handout and worksheet: **Learner handout and worksheet Sunlight analysis**
- Masking tape or cones to mark the chosen measurement locations
- One visible timer or phone stopwatch for the facilitator

4.2 Preparation checklist (before learners arrive)

- Check each kit reads light intensity, air temperature and relative humidity correctly.
- Select three safe measurement locations with clearly different light exposure.
- Decide whether learners will read values only from the OLED screen, save data to CSV, or do both.
- Prepare one demonstration kit at the front to model the procedure.
- Print the slides or keep them open and ready offline.

4.3 Safety and practical norms

- Do not stare at the Sun or point the sensor directly at the Sun while looking along the same line of sight.
- Keep learners in pre-approved areas and away from roads, roofs, laboratory heat sources or unsafe edges.
- Handle the kit gently and keep cables and notebooks tidy to avoid drops and trips.
- Take all readings at roughly the same height above the ground for a fair comparison.

4.4 Schedule

Two Hour lesson Plan

Time	Activity	Facilitator actions
0-10 min	Welcome, hook and scientific question	Ask: Why can Earth support life while many planets cannot? Introduce the **essential question** and explain that learners will test it by measuring and comparing three locations. Confirm safety rules.
10-25 min	Mini-teach background	Use slides to explain Earth's position in the Solar System, direct vs oblique sunlight, atmosphere, and the three measurements from the kit.
25-35 min	Model the method	Demonstrate how to hold the kit, wait for stable readings, and record units correctly (**lux**, **°C**, **% RH**). Emphasise keeping sensor height and orientation consistent and taking repeated readings.
35-40 min	Prediction and hypothesis	Learners complete the **Hypothesis** box in the handout. Offer a sentence frame: *"If a location has higher light intensity, then its air temperature will (increase/decrease/stay similar) and its relative humidity will (increase/decrease/stay similar), because …"* **Quick check:** Ask pairs to also fill in the **Variables** table (independent, dependent, controlled variables and one limitation) before going outside.
40-70 min	Field measurement	Send pairs to assigned locations (A: full sun, B: partial shade, C: deep shade/indoors). Learners complete the **Data recording sheet** in the handout (three readings per location, one minute apart if possible).
70-85 min	Averages and graphing	Support learners to calculate averages using the handout table, then draw the **bar graph** in the handout (colour 1: light, colour 2: air temperature, colour 3: relative humidity). If time allows, guide them through the **analysis questions**.
85-105 min	Interpretation	Guide learners to identify patterns, anomalies, sources of error and limitations. Remind them humidity may show a weak pattern. Ask them to use the handout **Presentation planner** to organise a **claim–evidence–explanation–conclusion** summary before presenting.
105-120 min	Short presentations	Each pair gives a 1–2 minute report using **claim, evidence, explanation and conclusion**. Use the rubric.

5 Experiment activity plan

5.1 Recommended investigation focus

- Independent variable: level of sunlight exposure at the measurement location
- Dependent variables: light intensity, air temperature and relative humidity
- Controlled variables: sensor height, measurement interval, number of repeats, same day and approximate time, same kit orientation, similar recording procedure

5.2 Suggested locations

- Location A: full sun
- Location B: partial shade or dappled shade
- Location C: indoor near a window or a deeply shaded outdoor area

Variables and fair test reminders: A fair test changes only one main factor (sunlight exposure) while keeping other factors as constant as possible. Ask learners to record (or keep the same) sensor height, sensor orientation, time of day, and distance from walls/people that can add shade or warmth. Repeats help reduce the effect of random changes like gusts of wind or passing clouds.

5.3 Step-by-step method

1. Label the three locations clearly.
2. At each location, hold the kit at about chest height and away from your body for 20–30 seconds (to reduce body heat affecting the temperature sensor).
3. Read light intensity, air temperature and relative humidity from the OLED screen (record units), or confirm the kit is logging to the CSV file.
4. Record three readings at one-minute intervals.
5. Move to the next location and repeat.
6. Calculate the average for each variable at each location.
7. Draw a simple bar graph (recommended for comparing locations) or a line graph (only if your x-axis is time) and prepare a short evidence-based explanation.

5.4 If using micro SD CSV export

- Let the kit save the readings during the session and review the CSV file afterwards.
- Use the CSV only to confirm or tidy the values already recorded by learners; do not replace learner observation with teacher-only analysis.
- Keep the same column names consistently across kits if possible, for example: time, location, light_lux, air_temp_c, rh_percent.

5.5 Expected patterns (what learners might observe)

Facilitator alignment note (slides vs real data): The slides describe the *expected direction* of change (more sunlight can lead to warmer air), but remind learners that short investigations are noisy. Wind, shade edges, nearby warm surfaces, and time lag can make temperature changes small or inconsistent.

Discussion prompts: Which variable changed the most between sites? Which changed the least? What controlled variables might not have stayed constant? If two groups got different results at the same site, what could explain the difference?

- Full sun will usually show the highest light intensity (especially if the sensor faces the same way at each site).
- Air temperature differences between sites may be small over a short time. Temperature can be influenced by wind, nearby warm surfaces (walls, tar, concrete), shade, and how long the air has been in the sun (thermal lag).
- Relative humidity may be higher in shade or indoors, but it can also be affected by recent rain, watering, proximity to plants, and airflow. Learners should focus on what their data shows, not what they think "should" happen.
- Encourage learners to make a claim, support it with evidence (numbers/graph), give an explanation that links to science ideas (sunlight absorption, heating, evaporation, and relative humidity), and end with a clear conclusion.

6 Solar eclipse extension (background + example data)

6.1 What is a solar eclipse?

A **solar eclipse** happens when the **Moon passes between the Sun and Earth**, blocking some or all of the Sun's light from reaching a specific area on Earth for a short time. This causes a rapid drop in sunlight intensity at ground level.

Safety: Learners must never look directly at the Sun. This extension uses example eclipse data and images from the slide deck; it does not require observing an eclipse.

Why include this in the lesson? An eclipse is a real-world case where sunlight intensity changes dramatically over minutes. It helps learners connect the Solar System model (Sun–Moon–Earth alignment) to the same kinds of measurements they made locally (lux, °C, % RH).

- **Light intensity (lux):** should drop rapidly as the Moon covers more of the Sun, then rise again as the eclipse ends.
- **Air temperature (°C):** may decrease slightly, often with a time lag, because the ground and air cool after receiving less sunlight.
- **Relative humidity (% RH):** may increase slightly if temperature drops (even if the amount of water vapour stays similar). Changes are not guaranteed and depend on local weather.

6.2 Using the eclipse example data in the slides

1. Show the eclipse slides (Sun–Moon–Earth alignment and the 2017 eclipse data screenshot).
2. Ask learners: *What variable is changing during an eclipse?* (Sunlight intensity reaching the ground.)
3. In pairs, learners compare: (a) their three-location results and (b) the eclipse pattern. Which shows a bigger change in lux? Which shows a clearer temperature response?
4. Whole-class discussion: Why might air temperature respond more slowly than light intensity? What other factors (wind, clouds, surfaces) could affect the pattern?
5. Optional extension question: If you repeated today's experiment at the same site every minute for 20 minutes, would you expect a steadier pattern than moving between locations? Why?

Note: The eclipse data shown in the slides is a screenshot from a solar eclipse observed in the USA in 2017. Use it as an example of how quickly lux can change when sunlight is blocked; it is not meant to match learners' local values exactly.

7 Troubleshooting

- Readings jump around: ask learners to wait longer, hold the kit still, and keep hands away from the sensor openings.
- Temperature differences are tiny: remind learners that sunlight can change quickly, but **air temperature** often changes slowly and is strongly affected by mixing (wind). Discuss thermal lag, and check that the temperature sensor is not being warmed by hands or bodies.
- Humidity pattern is unclear: treat this as a real scientific outcome and discuss weather, airflow and recent rain or watering.
- Too much time spent outside: shorten to two readings per site and complete averages together at the front.

8 Presentation rubric (20 marks)

Criterion	4 Excellent	3 Competent	2 Developing	1 Beginning
Results recorded accurately	Results are complete, correctly labelled and clearly organised.	Most results are complete and labelled correctly.	Some results are missing or unclear.	Results are mostly incomplete or inaccurate.
Graph or visual summary	Graph is appropriate, neat, labelled and easy to interpret.	Graph is mostly correct with minor labelling issues.	Graph is present but hard to interpret or partly incorrect.	No clear graph or visual summary.
Findings from evidence	Findings match the data and compare locations clearly.	Findings mostly match the data.	Findings mention the data but with weak comparison.	Findings are vague or not supported by data.
Conclusion and explanation	Conclusion answers the question and explains patterns using science ideas about sunlight, temperature and humidity.	Conclusion answers the question with some explanation.	Conclusion is present but explanation is limited.	Conclusion is missing or unrelated.
Communication and teamwork	Both partners contribute, speak clearly and keep within time.	Most of the presentation is clear and shared.	Uneven participation or unclear speaking.	Presentation is difficult to follow or done by one person only.

Suggested quick scoring guide: 18-20 outstanding, 14-17 strong, 10-13 adequate, below 10 needs support.