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| **Lesson Title  LESSON PLAN**  **—** | | |
| **LESSON SUMMARY** | |  |
| **OBJECTIVES** | **1.**  **2.** | |
| **EQUIPMENT LIST** | **•** | |
| **RESOURCES** | **•** | |
| **DIFFERENTIATION/**  **ADAPTATIONS** | **•** | |

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| **TIMETABLE & DESCRIPTION OF ACTIVITIES** | | |
| TIME  ACTIVITY  RESOURCES | DESCRIPTION | RESEARCH |
| 00:00 – 00:10  Starter  [Resources] |  | 4c. Memory: Provide opportunities for pupils to retrieve knowledge they previously learnt – Research shows that longer (at least a week) intervals are more effective [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=26) |
| 00:10 – 00:xx  Activity 1:  [Resources] |  | 1a. Preconceptions: Understand the preconceptions that pupils bring to science lessons [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=11)  6b. Language of science: Show the links between words and their composite parts [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=34)  Misconceptions research on IOP Spark: xxx[Find [here](https://spark.iop.org/misconceptions)]xxx  3a. Modelling: Use models to help pupils develop a deeper understanding of scientific concepts – models help pupils to link observations to the sub-microscopic and symbolic levels and to build a richer understanding**.** [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=19)  2b. Self-regulation: Model your own thinking to help pupils develop their metacognitive and cognitive knowledge – you can provide a useful example for pupils by making your thinking processes explicit [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=16) |
| 00:xx – 00:xx  Activity 2:  [Resources] |  | 5a. Practical work: Know the purpose of each practical activity [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=28)  Xxx taken from BEST [www.bestevidencescienceteaching.org](http://www.bestevidencescienceteaching.org)  7c. Feedback: Provide feedback and comments rather than marks [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=40) |
| 00:xx – xx:xx  Plenary  [Resources] |  | EEF Teaching and Learning Toolkit, Feedback strand: When giving feedback, compare what a learner is doing right now with what they have done wrong before. [Link](https://educationendowmentfoundation.org.uk/evidence-summaries/teaching-learning-toolkit/feedback/) |

Find research-based lesson activities at [www.bestevidencescienceteaching.org](http://www.bestevidencescienceteaching.org)

Use the [IOP research-based students’ misconceptions database](https://spark.iop.org/misconceptions) to find common misconceptions, diagnostic questions and resources to address the misconceptions.

**Bank of research notes for the research column:**

1a. Preconceptions: Understand the preconceptions that pupils bring to science lessons [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=11) e.g. by:

* using diagnostic questions (e.g. those in the [IOP students' misconceptions database](https://spark.iop.org/misconceptions))
* having class discussions based on concept cartoons;
* getting pupils in groups to write down/discuss what they know about a topic at the start of a module (a list of their ideas can be kept and revisited to show pupils how their thinking has changed over the course of several lessons)

1b. Preconceptions: Develop pupils’ thinking through cognitive conflict and discussion [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=12)

1c. Preconceptions: Allow enough time to challenge misconceptions and change thinking – throughout teaching sequences it is useful to revisit misconceptions**.** [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=13)

2a. Self-regulation: Explicitly teach pupils how to plan, monitor, and evaluate their learning [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=15)

* Encourage pupils to engage in the planning-monitoring-evaluation cycle as part of their physics lessons

2b. Self-regulation: Model your own thinking to help pupils develop their metacognitive and cognitive knowledge [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=16)

* Show pupils how you think. Make your thinking processes explicit. Work through problems in front of a class, talking through how you’re approaching it.
* Encourage pupils to become increasingly independent over time.

2c. Self-regulation: Promote metacognitive talk and dialogue in the classroom [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=16)

* Argumentation is a specific form of dialogue that can help pupils make reasoned claims that are backed by evidence.
* It is helpful to discuss wrong ideas and why they’re wrong, as well as why the right idea is right, and this helps pupils to examine their preconceptions.

3a. Modelling: Use models to help pupils develop a deeper understanding of scientific concepts [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=19)

* Models help pupils to link observations to the sub-microscopic and symbolic levels and to build a richer understanding**.**

3b. Modelling: Select the models you use with care [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=20)

* Identify how the model will aid understanding
* Make sure pupils are familiar with the underlying idea that the intended model is based on

3c. Modelling: Explicitly teach pupils about models and encourage pupils to critique them [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=21)

* Pupils need to understand how models relate to reality (the similarities and differences) and why they are used.

4a. Memory: Pay attention to cognitive load – structure tasks to limit the amount of new information pupils need to process. [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=25)

* Working memory is limited
* Avoid splitting attention
* Use worked examples or partially solved examples that take pupils through each step of a process (reduce the use of examples are pupils’ expertise increases)**.**

4b. Memory: Revisit knowledge after a gap to help pupils retain it in their long-term memory. (‘Spaced review’) [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=26)

4c. Memory: Provide opportunities for pupils to retrieve knowledge they previously learnt [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=26)

* ‘Retrieval practice’ (frequent, short, low-stakes tests/using flashcards/completing practice questions/making concept maps)
* Research shows that longer (at least a week) intervals are more effective
* Highly durable effect: research has found effects can last for years

4d. Memory: Encourage pupils to elaborate on what they have learnt [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=27)

* Elaboration involves describing and explaining in detail something you have learnt
* This approach supports learning by integrating new information with existing prior knowledge, helping to embed it in the long-term memory**.**

5a. Practical work: Know the purpose of each practical activity [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=28)

* Think through the best approach to developing these things
* Make sure your pupils know the purpose too

5b. Practical work: Sequence practical activities with other learning [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=29)

* You need to plan how their practical skills develop in the same way as you plan the development of their knowledge.
* For practical activities that aim to improve understanding of scientific theory, you may have to help pupils to make links between the practical activity and the underlying scientific ideas.

5c. Practical work: Use practical work to develop scientific reasoning [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=30)

* Even if the main purpose of the experiment is to develop a particular scientific theory or a scientific skill, you can point out how you are using scientific methodology.
* Every time you do an experiment, you can model some aspect of scientific reasoning.
* Pay close attention to teaching the control of variables: performance on these tasks predicts attainment

5d. Practical work: Use a variety of approaches to practical science [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=31)

6a. Language of science: Carefully select the vocabulary to teach and focus on the most tricky words – often it is words that have alternative meanings in everyday language that cause the most problems [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=33)

6b. Language of science: Show the links between words and their composite parts [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=34)

6c. Language of science: Use activities to engage pupils with reading scientific text and help them to comprehend it. – Pupils should have the opportunity to engage with authentic scientific books and texts. [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=35)

6d. Language of science: Support pupils to develop their scientific writing skills – The writing process involves several components and is iterative. [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=36)

7a. Feedback: Find out what your pupils understand - It is important that you build up an accurate picture of the current understanding of all your pupils [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=38)

7b. Feedback: Think about what you’re providing feedback on [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=39)

* Feedback at the task level is likely to be difficult for pupils to transfer
* Feedback at the level of self-evaluation could promote a fixed mindset
* The most useful feedback is at the ‘subject’ and ‘self-regulation’ levels

7c. Feedback: Provide feedback and comments rather than marks [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=40)

* They don’t have to be written
* Prioritise quality over quantity

7d. Feedback: Make sure pupils can respond to your feedback [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=41)

* Try to make it clear and easy to act on
* Phrase feedback as a question, and direct pupils where to go for help
* Ensure pupils have enough time to respond

EEF Teaching and Learning Toolkit, Feedback strand: [Link](https://educationendowmentfoundation.org.uk/evidence-summaries/teaching-learning-toolkit/feedback/)

Effective feedback tends to:

* Be specific, accurate and clear (e.g. “It was good because you...” rather than just “correct”);
* Compare what a learner is doing right now with what they have done wrong before (e.g. “I can see you were focused on improving X as it is much better than last time’s Y…”);
* Encourage and support further effort;
* Be given sparingly so that it is meaningful;
* Provide specific guidance on how to improve and not just tell students when they are wrong.

EEF Teaching and Learning Toolkit, Peer Tutoring strand: The introduction of peer tutoring approaches appears to have a positive impact on learning. [Link](https://educationendowmentfoundation.org.uk/evidence-summaries/teaching-learning-toolkit/peer-tutoring/)