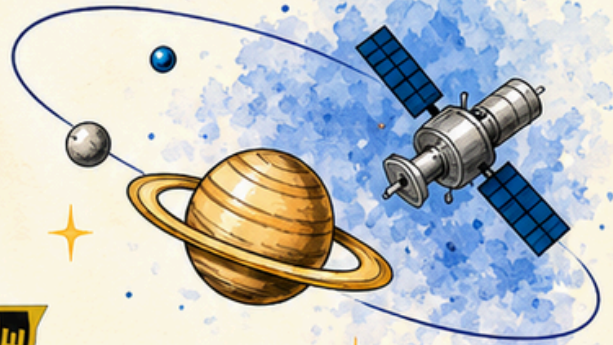
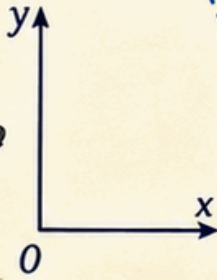
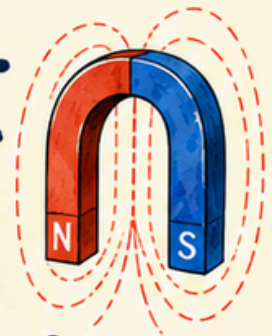
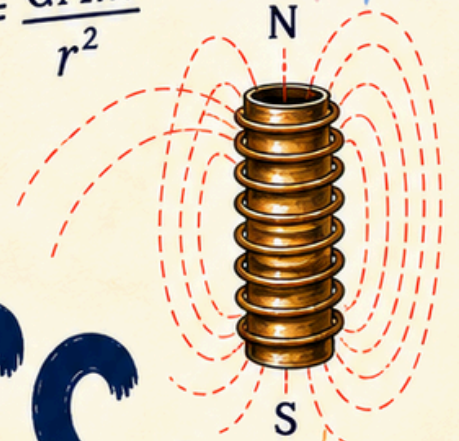


$$F = ma$$



$$F = \frac{GMm}{r^2}$$

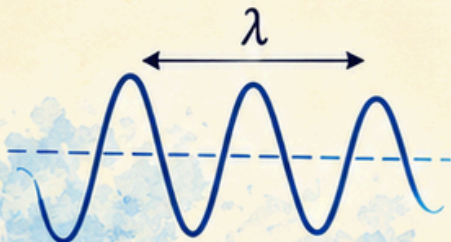


$$\tau = rF \sin \theta$$

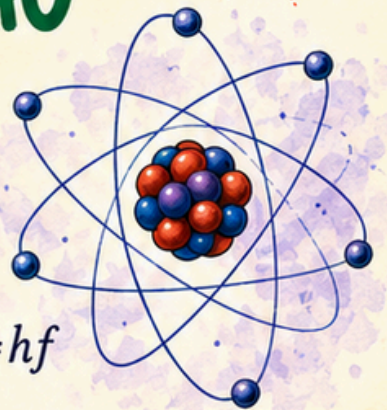
PHYSICS

MĀTAI AHUPŪNGAO

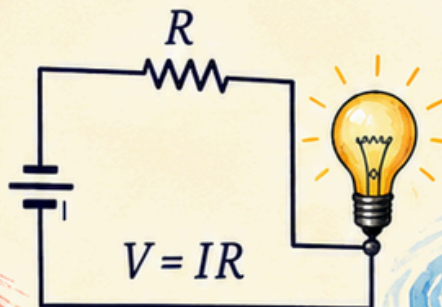
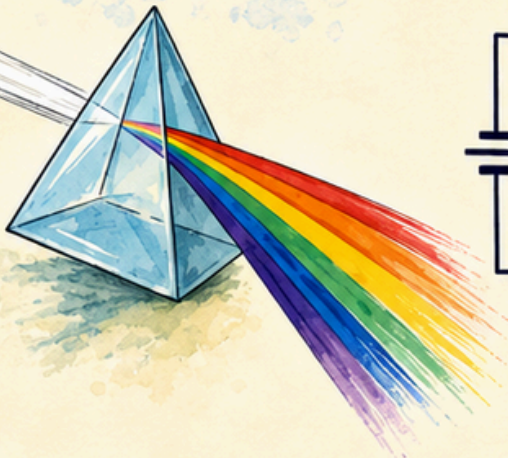
YEARS 12–13
CURRICULUM PROGRAMME



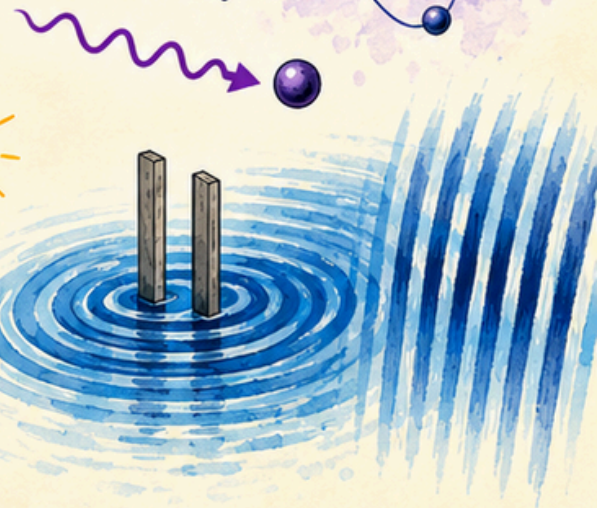
$$v = f\lambda$$

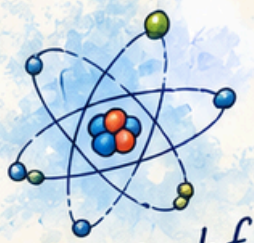


$$E = hf$$



$$V = IR$$





$$E = hf$$

CONTENTS

Physics | Mātai Ahupūngao

Years 12 – 13

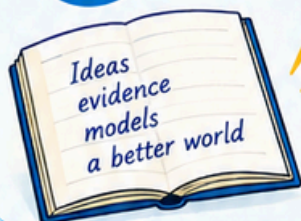


$$F = ma$$

1

Curriculum Foundations

WHY WE TEACH PHYSICS



- Purpose of Physics
- Physics Capabilities
- Physics Capabilities in Action
- Disciplinary Writing in Physics

Physics helps us make sense of the world and shape a better future.

2

Teaching & Learning

HOW WE SUPPORT STUDENTS



- Building a Physics Explanation
- Scaffolding Physics Writing
- Teaching Physics for Diverse Learners

Different learners. Different strengths. The same opportunities to succeed.

3

Curriculum Structure

HOW THE COURSE IS ORGANISED



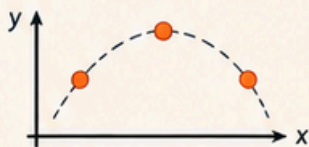
- Physics Course Structure
- How to Read This Curriculum

A clear structure to guide teaching, learning and progression.

4

Year 12 Physics

WHAT WE TEACH IN YEAR 12



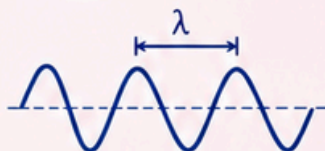
- Year 12 Physics Curriculum Map
- Year 12 Detailed Programme

Building knowledge, applying ideas, and developing key skills.

5

Year 13 Physics

WHAT WE TEACH IN YEAR 13



- Year 13 Physics Curriculum Map
- Year 13 Detailed Programme

Deepening understanding, analysing, and connecting Physics to the wider world.



$$E = mc^2$$

$$V = IR$$



PART 1

Physics | Mātai Ahupūngao

Years 12 – 13

CURRICULUM FOUNDATIONS

Ngā Tūāpapa o te Marautanga

$$E = mc^2$$



Purpose of Physics

Why we teach physics



Physics Capabilities

What our students will develop



Physics Capabilities in Action

How this looks in the classroom



Disciplinary Writing in Physics

Building clear and confident communication

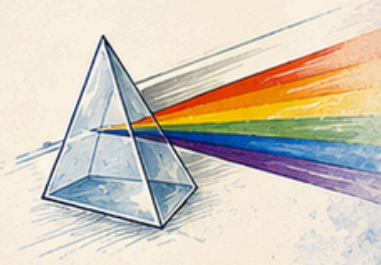
PURPOSE OF PHYSICS

TE PŪTAKE O TE MĀTAI AHUPŪNGAO

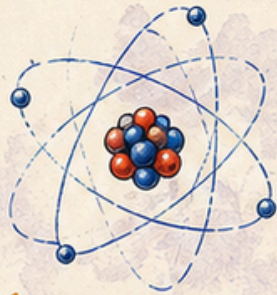


Physics enables students to **understand** and **explain** the physical world through **conceptual knowledge**, **mathematical reasoning**, **experimentation**, and **evidence-based thinking**.

Students develop knowledge of fundamental physical principles and models and learn to apply them to explain and predict physical phenomena. Through practical investigations, mathematical analysis, and problem-solving, students **collect and analyse data**, **test ideas**, **evaluate evidence**, and compare observations with **theoretical models**.



$$F = ma$$
$$E = hf$$

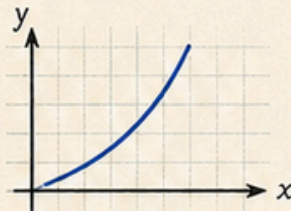


THE STUDY OF PHYSICS DEVELOPS STUDENTS' ABILITY TO:



1. UNDERSTAND & APPLY

physical concepts, principles, laws, and models.



2. USE MATHEMATICS

to represent relationships, make predictions, and solve physical problems.



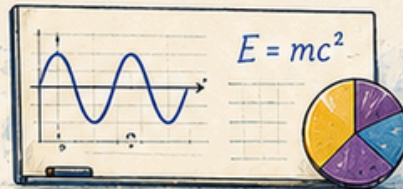
3. INVESTIGATE

physical phenomena through observation, measurement, experimentation, and analysis of data.



4. EVALUATE EVIDENCE

and models, including considering uncertainty, limitations, and the validity of conclusions.



5. REPRESENT & COMMUNICATE

physical ideas using appropriate scientific language, equations, graphs, diagrams, tables, and other representations.



6. APPLY PHYSICS

to technological, environmental, societal, and real-world contexts.

Physics develops the knowledge, practices, and capabilities students need to **explore**, **understand**, **explain**, and **predict** the physical world.

PHYSICS CAPABILITIES

1

KNOWING AND UNDERSTANDING



GUIDING QUESTION

Do students understand the physics?

FOCUS

Demonstrating conceptual understanding of physical principles, laws, models and relationships.

2

ANALYSING AND APPLYING



GUIDING QUESTION

Can students use the physics?

FOCUS

Applying concepts, mathematical models and scientific reasoning to solve problems and explain physical situations.

3

EVALUATING AND SYNTHESISING



GUIDING QUESTION

Can students judge the physics?

FOCUS

Critically evaluating evidence, models and conclusions, and integrating knowledge to justify scientific decisions.

REPRESENTING AND COMMUNICATING

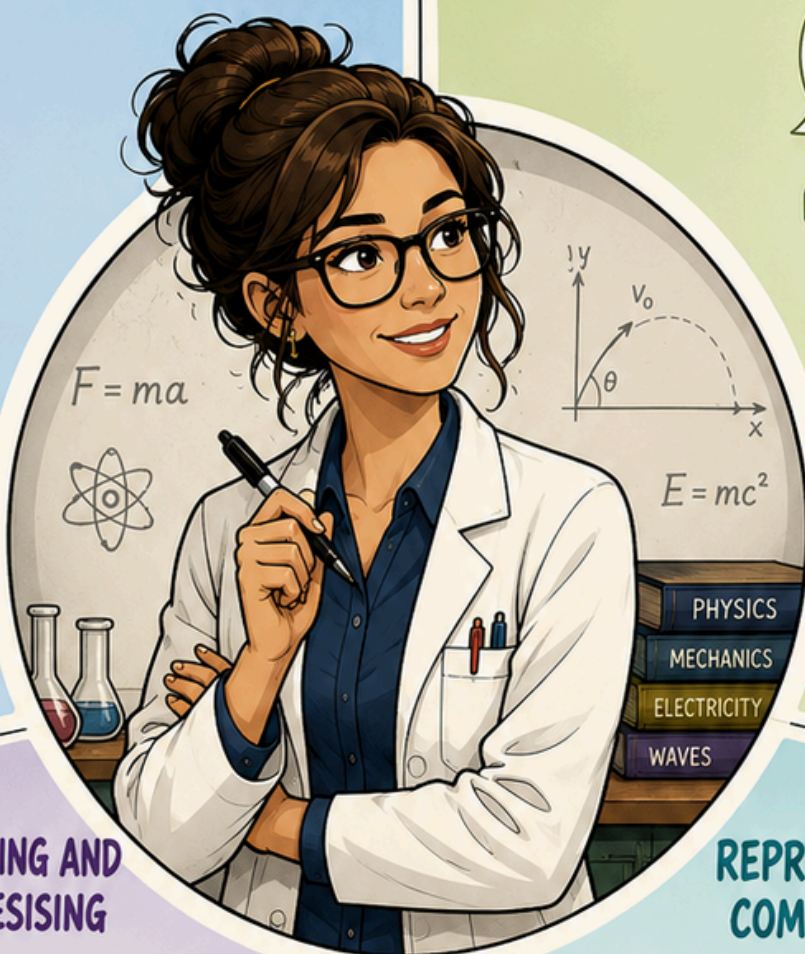


GUIDING QUESTION

Can students communicate like physicists?

FOCUS

Communicating scientific thinking using appropriate disciplinary language, diagrams, graphs, equations, symbols and conventions.



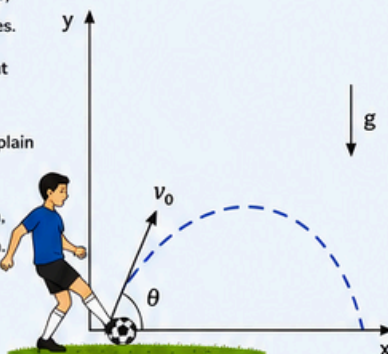
PHYSICS CAPABILITIES

IN ACTION

1 KNOWING AND UNDERSTANDING

What students do:

- Explain the situation using ideas, physics vocabulary and principles.
- Identify what is known and what needs to be found.
- Recognise the key ideas that explain why the path is parabolic.
- Connect ideas: projectile motion, gravity and components of motion.



STUDENT UNDERSTANDING (EXAMPLE)

When the ball is kicked, it has an initial velocity v_0 at an angle θ above the horizontal. Gravity acts downward, so the ball slows as it goes up, stops momentarily at the highest point, then speeds up as it falls. The horizontal motion continues at a constant speed. This combination produces a parabolic path.



FOCUS

- Key physics ideas (gravity, components of velocity, projectile motion).
- Vocabulary and definitions.
- Diagrams and representations.

EVIDENCE WE LOOK FOR

- ✓ Correct use of physics terms.
- ✓ Clear explanation of how gravity and velocity affect the motion.
- ✓ Correct identification of variables and assumptions.
- ✓ Links between concepts.
- ✓ Logical reasoning.

PARABOLIC MOTION

A football kicked into the air follows a curved (parabolic) path due to gravity. Air resistance is small and can be neglected.

2 ANALYSING AND APPLYING

What students do:

- ✓ Use models and equations to solve problems.
- ✓ Break motion into horizontal and vertical components.
- ✓ Calculate time of flight, maximum height and range.
- ✓ Interpret results in context.

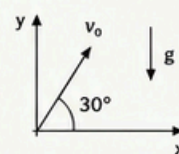


KNOWN

$$v_0 = 20 \text{ m/s}$$

$$\theta = 30^\circ$$

$$g = 9.8 \text{ m/s}^2$$



EXAMPLE PROBLEM

A football is kicked with a speed of 20 m/s at an angle of 30° above the horizontal.

Find: (a) time of flight (b) maximum height (c) range (horizontal distance)

SOLUTION

a) Time of flight

$$T = \frac{2v_0 \sin \theta}{g}$$

$$= \frac{2(20) \sin 30^\circ}{9.8}$$

$$= 2.04 \text{ s}$$

b) Maximum height

$$H_{\max} = \frac{v_0^2 \sin^2 \theta}{2g}$$

$$= \frac{(20)^2 \sin^2 30^\circ}{2(9.8)}$$

$$= 5.10 \text{ m}$$

c) Range (horizontal distance)

$$R = \frac{v_0^2 \sin 2\theta}{g}$$

$$= \frac{20^2 \sin 60^\circ}{9.8}$$

$$= 35.3 \text{ m}$$



FOCUS

Applying formulas and mathematical models to real situations.

EVIDENCE WE LOOK FOR

- ✓ Correct calculations and substitutions.
- ✓ Logical working and units.
- ✓ Solutions make sense in context.

3 EVALUATING AND SYNTHESISING

What students do:

- Evaluate the quality of data and methods.
- Consider uncertainties and reliability.
- Suggest improvements to increase accuracy.
- Draw justified conclusions and generalisations.

CLASS INVESTIGATION EXAMPLE

We kick the ball 5 times with the same angle (30°) and measure the range.

Total	Range (m)	Mean (m)	Theoretical (m)	% Difference	Uncertainty (1m)
1	34.6	34.0	35.3	3.7%	1.1
2	33.2				
3	34.8				
4	33.4				
5	34.1				

IMPROVING ACCURACY

- Keep the same release height.
- Measure from the same reinit to point.
- Repeat trials and take the mean.
- Use video analysis to reduce human reaction error.
- Calibrate equipment before use.



STUDENT EVALUATION (EXAMPLE)

Our mean range (34.0 m) is close to the theoretical value (35.3 m). The 3.7% difference is within our uncertainty (± 1.1 m), so our result is reliable. Using video analysis and more trials improved the accuracy.

EVIDENCE WE LOOK FOR

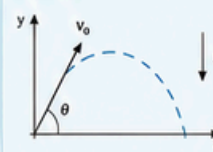
- ✓ Considers reliability and uncertainty.
- ✓ Justifies conclusions with evidence.
- ✓ Compares with theory.
- ✓ Proposes realistic improvements.

4 REPRESENTING AND COMMUNICATING

What students do:

- Use multiple representations (diagrams, graphs, tables, equations).
- Communicate reasoning clearly and coherently.
- Use correct symbols, units and terminology.
- Explain results and what they mean.

DIAGRAM



STUDENT COMMUNICATION (EXAMPLE)

The initial velocity is 20 m/s at 30° . The graph shows the range increases as the angle increases up to 45° , then decreases. The maximum range occurs at 45° because $\sin 2\theta$ is maximum.

KEY EQUATIONS USED

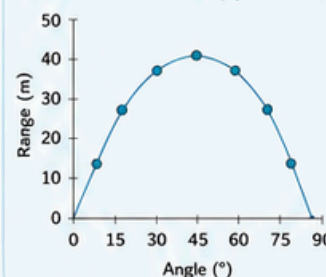
$$v_x = v_0 \cos \theta$$

$$v_y = v_0 \sin \theta - gt$$

$$y = v_0 \sin \theta t - \frac{1}{2}gt^2$$

$$R = \frac{v_0^2 \sin 2\theta}{g}$$

GRAPH: RANGE vs ANGLE ($v_0 = 20 \text{ m/s}$)



FOCUS

Communicating scientific thinking using appropriate language, diagrams, graphs, equations and conventions.

EVIDENCE WE LOOK FOR

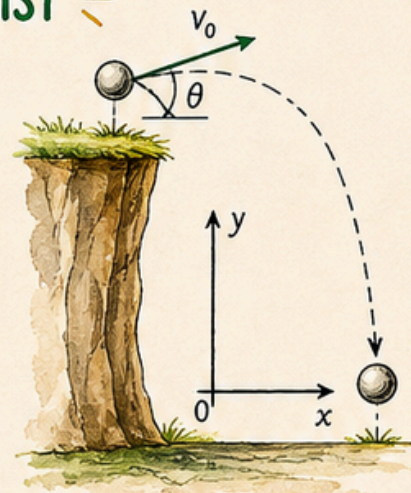
- ✓ Clear, accurate diagrams and graphs.
- ✓ Correct use of symbols, units and equations.
- ✓ Well-structured explanations.
- ✓ Links between representations and ideas.

DISCIPLINARY WRITING IN PHYSICS

COMMUNICATING LIKE A PHYSICIST

Physics students communicate their understanding by connecting **physical principles**, **evidence**, **mathematical representations**, and **scientific reasoning**.

Strong Physics responses do more than state what happened or provide a calculation. Students should be able to **explain why** a phenomenon occurs, support their reasoning with appropriate **evidence or representations**, and communicate a **justified conclusion**.



A STRONG PHYSICS EXPLANATION CONNECTS:



PHYSICS PRINCIPLE

What Physics applies?

Identify the relevant concept, law, model, or relationship.

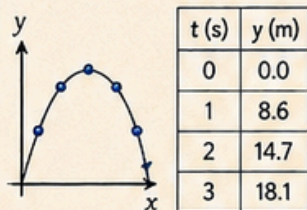
$$F_{net} = ma$$



EVIDENCE / REPRESENTATION

What supports the explanation?

Use appropriate equations, calculations, data, graphs, diagrams, observations, or experimental evidence.

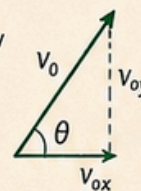


REASONING

Why does this happen?

Connect the Physics principle to the evidence and explain the relationship between the quantities involved.

As time increases, the vertical velocity decreases due to gravity, so the object rises less and then falls.



CONCLUSION

What can we conclude?

Use the Physics and evidence to answer the question clearly and justify the conclusion.

The object follows a projectile motion because gravity acts downwards, causing the vertical velocity to change.

STUDENTS COMMUNICATE PHYSICS THROUGH



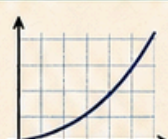
Scientific language

$$E = hf$$

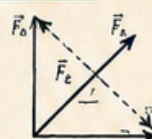
Equations



Calculations



Graphs



Diagrams



Data



Written explanations



Don't just state what happens –
use **Physics** to explain why it happens.

PART 2

Physics | Mātai Ahupūngao

Years 12 – 13

TEACHING & LEARNING

Ako me te Whakaako

HOW WE SUPPORT STUDENTS

Explain
Justify
Support
Connect



**Building a
Physics Explanation**



**Scaffolding
Physics Writing**



**Teaching Physics
for Diverse Learners**



$$F = ma$$



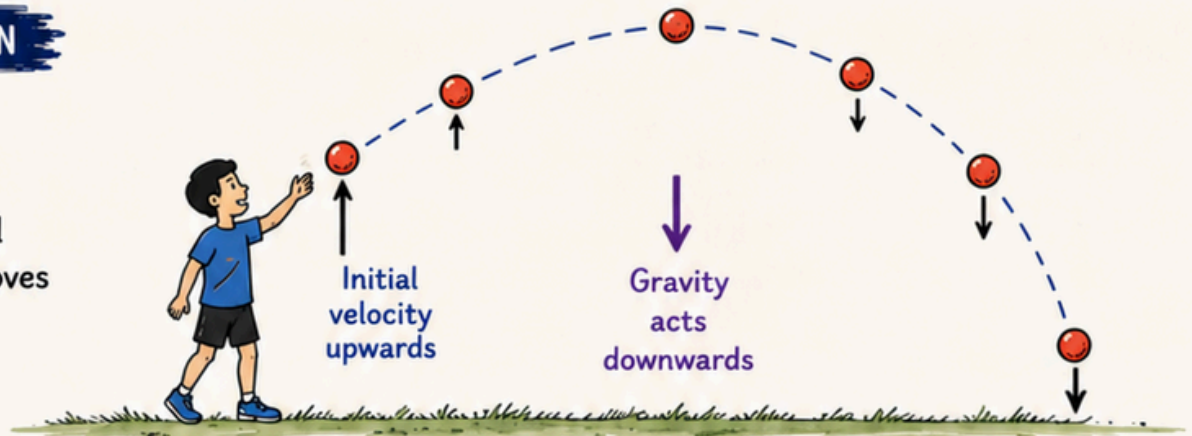
BUILDING A PHYSICS EXPLANATION

Simple steps to clear answers



EXAMPLE QUESTION

A ball is thrown vertically upwards.
Explain why the ball slows down as it moves upwards.



1 WHAT HAPPENS?

Describe



What happens or changes?

Use words to describe the observation.

As the ball moves upwards, its speed decreases.

2 WHY?

Explain with Physics



What Physics explains it and why?

Use the correct Physics idea and explain why it causes what happens.

This is because the gravitational force acts **downwards**, opposite to the direction of the ball's velocity.

3 THEREFORE?

Conclude



So what happens as a result?

State the result or conclusion.

Therefore, the ball has a downward acceleration, causing its upward velocity to decrease until it reaches zero at the highest point.

PUTTING IT ALL TOGETHER – A COMPLETE EXPLANATION

As the ball moves upwards, its speed decreases. This is because the gravitational force acts downwards, opposite to the direction of the ball's velocity. Therefore, the ball has a downward acceleration, causing its upward velocity to decrease until it reaches zero at the highest point.

COLOUR KEY

- What happens
- Why (Physics)
- Therefore

DESCRIBE

- increases
- decreases
- remains constant
- reaches zero
- reaches a maximum

EXPLAIN

- because
- this is because
- since
- due to
- as

PHYSICS IDEAS

- force
- gravity
- velocity
- acceleration
- opposite direction

CONCLUDE

- therefore
- as a result
- this means that
- consequently

EVIDENCE

- the graph shows
- the data shows
- from the equation
- this indicates



3 SIMPLE STEPS: WHAT HAPPENS → WHY → THEREFORE



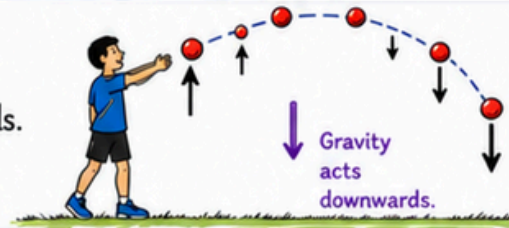
SCAFFOLDING PHYSICS WRITING

Same Physics. Different levels of language support.



THE SAME QUESTION

A ball is thrown vertically upwards.
Explain why the ball slows down as it moves upwards.



1 HIGH SUPPORT

Teacher provides the structure, key words and sentence frames.

WORD BANK

ball • speed • decreases • gravity
downwards • opposite • velocity
acceleration • zero

WHAT HAPPENS?

As the _____ moves
upwards, its _____.

WHY?

This is because _____
acts _____, in the
_____ direction to the
ball's _____.

THEREFORE?

Therefore, the ball has
a _____ acceleration.
Its upward velocity decreases
until it reaches _____.

2 DEVELOPING SUPPORT

Teacher provides sentence starters and key Physics vocabulary.

USEFUL PHYSICS WORDS

speed • gravitational force • downwards
opposite • velocity • acceleration • zero

WHAT HAPPENS?

As the ball moves upwards, ...

WHY?

This is because the gravitational
force _____.

THEREFORE?

Therefore, _____.

3 INDEPENDENT

Teacher provides only the thinking structure.

WHAT HAPPENS?

Describe the change.

WHY?

Explain it using Physics.

THEREFORE?

State the result.

MORE TEACHER SUPPORT

MORE STUDENT INDEPENDENCE



The Physics does not become easier. The language support is gradually removed.

A COMPLETED EXAMPLE

As the ball moves upwards, its speed decreases. This is because the gravitational force acts downwards, opposite to the direction of the ball's velocity. Therefore, the ball has a downward acceleration, causing its upward velocity to decrease until it reaches zero at the highest point.

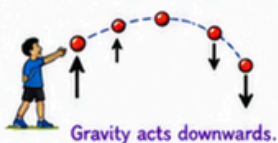
COLOUR KEY

- What happens
- Why (Physics)
- Therefore (result)

HOW TO TEACH THIS SKILL

1 SEE IT

Look at the diagram.



2 SAY IT

Teacher models.
Students say it together or with a partner.



BUILD IT

Students use the word bank and sentence frames to build the explanation.

gravity downwards
opposite velocity

4 WRITE IT

Students write the complete paragraph in their own words.



TOP TIP FOR TEACHERS

Use this scaffold in class, in homework, in tests and in every Physics topic. Model it often. Practice it together. Then remove the support. Repetition builds confidence and independence!





Teaching Physics for Diverse Learners

Same core Physics. Different levels of support and challenge.

Engage
Support
Challenge
All learners

What does Physics involve?

Physics is the study of the physical world. It helps us explain how and why things happen, using **models, evidence and mathematics**.



Motion and forces



Energy



Electricity and magnetism



Waves



Particles and modern physics.

Physics helps us understand the world around us and solve real problems.

Mathematics is a tool for Physics

We use mathematics to:

- ✓ represent physical situations with models.
- ✓ make calculations.
- ✓ identify patterns.
- ✓ analyse data.
- ✓ solve problems.
- ✓ test ideas and make predictions.



Mathematics helps us describe, model and make sense of the physical world.

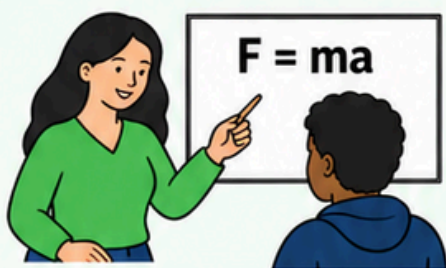
Levels of Support and the Teacher's Role

The same Physics for all students, with different levels of support and challenge.

1

High Support

Build understanding with strong teacher guidance.



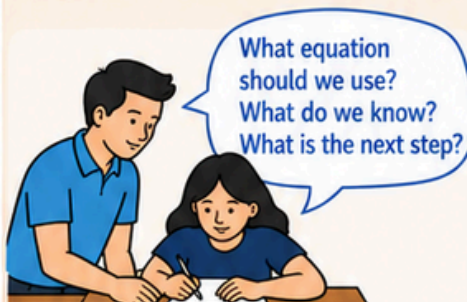
Teacher's role:

- Explicitly teach and model each step.
- Explain the physics and the mathematics.
- Use worked examples and clear diagrams.
- Provide sentence frames and key vocabulary.
- Check understanding frequently.
- Break tasks into smaller steps.
- Give guided practice.

2

Developing Independence

Gradually remove the support.



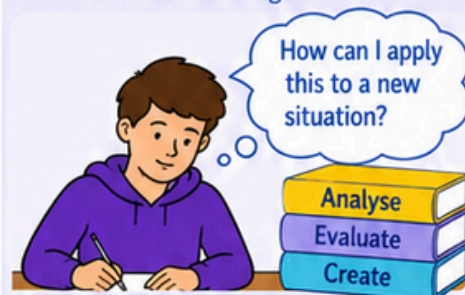
Teacher's role:

- Provide partially completed examples.
- Ask guiding questions.
- Encourage paired or small group discussion.
- Use scaffolded problems.
- Support students to explain their reasoning.
- Gradually reduce the amount of support.
- Give opportunities for practice and feedback.

3

Independent / Extension

Increase independence, depth and challenge.



Teacher's role:

- Set open-ended and complex problems.
- Provide minimal prompting.
- Ask for justification and evaluation.
- Encourage multiple representations.
- Use unfamiliar or real-world contexts.
- Support connections between concepts.
- Promote deeper analysis and synthesis.

PART 3

Physics | Mātai Ahupūngao

Years 12 – 13

CURRICULUM STRUCTURE

Te Hanganga o te Marautanga

PLAN

TEACH

LEARN



Physics Course
Structure



How to Read
This Curriculum

*A clear structure
to guide teaching,
learning and
progression.*



Mechanics

Electricity

Waves

Particles

Plan
Teach
Learn



1 FOUNDATIONS OF PHYSICS



FOCUS AREAS

- Physical quantities and units
- Measurement and uncertainty
- Vectors and mathematical tools
- Graphs and relationships
- Experimental methods

2 MECHANICS

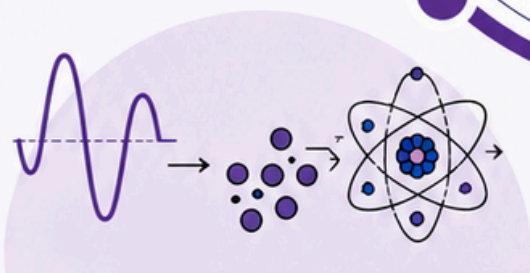


FOCUS AREAS

- Motion in one and two dimensions
- Forces and Newton's laws
- Energy and momentum
- Circular and rotational motion
- Gravitation and orbits

PHYSICS COURSE STRUCTURE

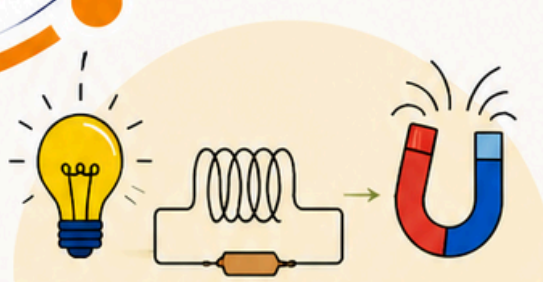
4 WAVES AND PARTICLES



FOCUS AREAS

- Wave properties and behaviour
- Light, sound and electromagnetic waves
- Atomic and nuclear models
- Radioactivity and particles
- The Big Bang and the universe

3 ELECTRICITY AND MAGNETISM



FOCUS AREAS

- Electric charge and fields
- Circuits and circuit components
- Magnetism and magnetic fields
- Electromagnetic induction
- AC electricity and applications



HOW TO READ THIS CURRICULUM



⇒ A simple guide for teachers ⇒

This curriculum is organised to help you plan, teach and assess Physics effectively.
Every unit and topic follows the **same clear structure**.

1



UNIT PURPOSE

Why are students learning this?
This sets the direction and gives meaning to the learning.

2



PHYSICS CAPABILITIES

What ways of thinking are students developing?
These are developed throughout the unit and across the course.



K&U Knowledge & Understanding



A&A Analysis & Application



E&S Experimental Skills



R&C Reasoning & Communication

3



WEEKLY TOPIC

What is the focus this week?
Each week has a specific topic or concept to build student learning.

4



LESSONS

How will we learn it?
Each topic is broken down into 5 lessons (approximately one week).

AT A GLANCE



5 lessons = approximately one teaching week.



Lessons build progressively from foundational to more sophisticated understanding and skills.



Concepts are connected within the topic, across the strand and across the course.



Use the structure to plan lessons, create resources, and assess student learning.

EXAMPLE: ONE TEACHING WEEK

Lesson	Topic What are we learning?	Knowledge Focus What students need to know and understand	Practice Focus What students need to do with that knowledge
1	The Physics of Projectiles	Define projectile motion. Identify key variables.	Describe the path of a projectile. Identify forces acting on the object.
2	Horizontal and Vertical Components	Resolve velocity into components. Understand independent motion.	Calculate time of flight. Calculate maximum height.
3	Range and Displacement	Understand horizontal range. Distinguish range from displacement.	Calculate horizontal range. Use kinematic equations.
4	Real-World Applications	Apply projectile ideas to real situations.	Solve contextual problems. Make links to sport and engineering.
5	Consolidation and Check	Review key ideas from the topic. Identify any gaps.	Complete mixed problems. Answer retrieval and reflection tasks.

KNOWLEDGE FOCUS = WHAT students learn



- Facts, definitions and ideas
- Concepts and principles
- Models, laws and theories
- Relationships and patterns

PRACTICE FOCUS = HOW students use the Physics



- Solve problems and apply ideas
- Analyse and interpret information
- Carry out investigations
- Communicate and evaluate

Both are essential for successful learning in Physics!



This structure is used in every unit and every week.

It helps students build deep understanding, develop Physics capabilities, and apply their learning to new situations.



PART 4

Physics | Mātai Ahupūngao

Years 12 – 13

YEAR 12 PHYSICS

Te Mātai Ahupūngao o te Tau 12

WHAT WE TEACH IN YEAR 12

Build
knowledge
Apply ideas
Develop skills



**Year 12 Physics
Curriculum Map**



**Year 12 Detailed
Programme**

Building knowledge,
applying ideas,
and developing
key skills.



Mechanics

Electricity

Waves

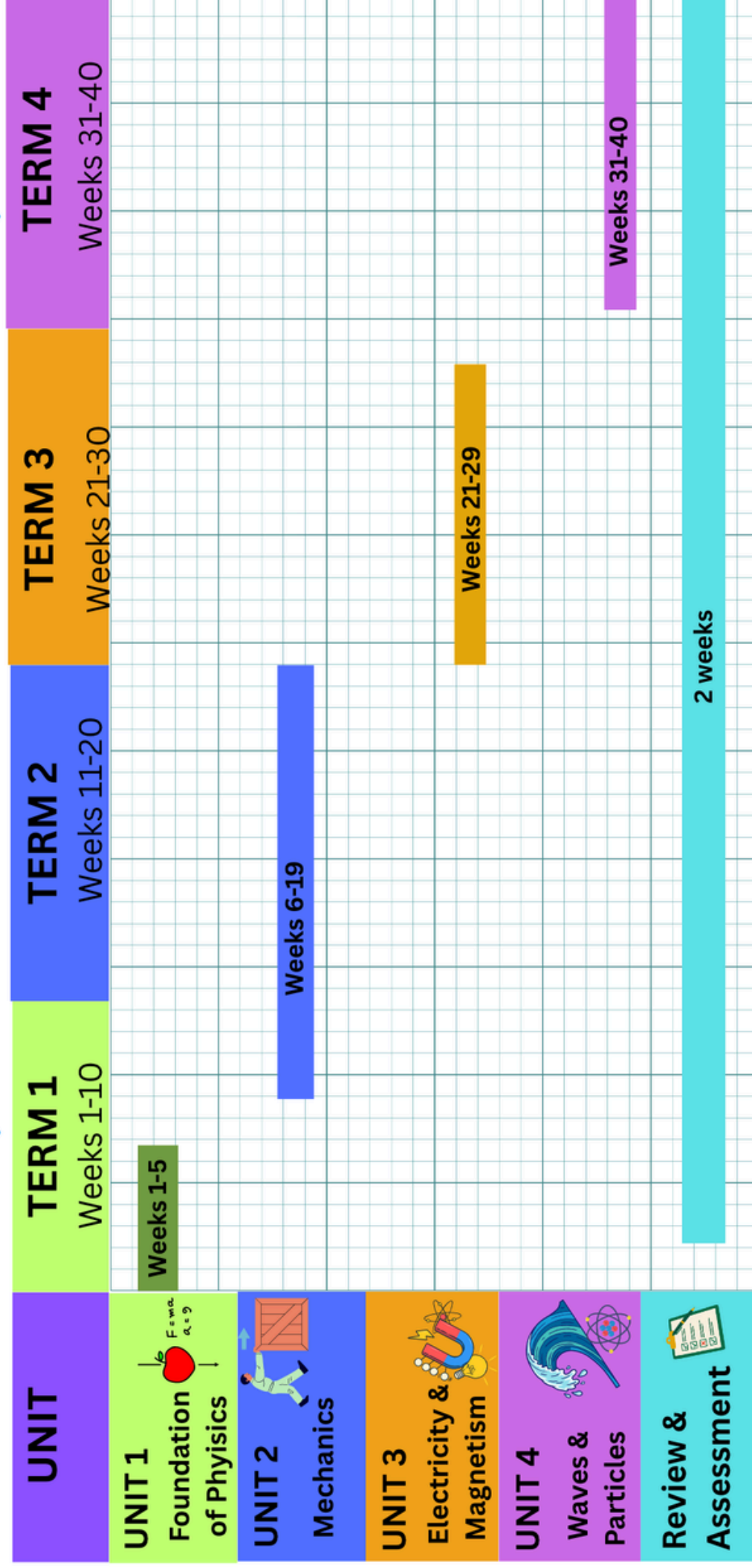
Particles

Same
ideas.
A brighter
future.



Year 12 Physics Curriculum Map

40 TEACHING WEEKS



PART 5

Physics | Mātai Ahupūngao

Years 12 – 13

YEAR 13 PHYSICS

Te Mātai Ahupūngao o te Tau 13

WHAT WE TEACH IN YEAR 13

Explore
Question
Analyse
Connect



Year 13 Physics
Curriculum Map



Year 13 Detailed
Programme

Mechanics

Electricity & Magnetism

Waves

Particles

$$E = mc^2$$



Deepening
understanding,
analysing, and
connecting Physics
to the wider world.

Same
principles.
Bigger questions.



Year 13 Physics Curriculum Map

40 TEACHING WEEKS

