# 2022 Year 10 ACARA Physics – Science A Unit 3: MOTION

## Science Content Descriptions

## Science Understanding

**Physical sciences**

Energy conservation in a system can be explained by describing energy transfers and transformations (ACSSU190)

1. Recognising that the Law of Conservation of Energy explains that total energy is maintained in energy transfer and transformation.
2. Recognising that in energy transfer and transformation, a variety of processes can occur, so that the usable energy is reduced and the system is not 100% efficient.
3. Comparing energy changes in interactions such as car crashes, pendulums, lifting and dropping.
4. Using models to describe how energy is transferred and transformed within systems.

The motion of objects can be described and predicted using the laws of physics(ACSSU229)Outlining processes involved in natural selection including variation, isolation and selection.

1. Gathering data to analyse everyday motions produced by forces, such as measurements of distance and time, speed, force, mass and acceleration
2. Recognising that a stationary object, or a moving object with constant motion, has balanced forces acting on it.
3. Using Newton's Second Law to predict how a force affects the movement of an object.
4. Recognising and applying Newton's Third Law to describe the effect of interactions between two objects.

## Science as a Human Endeavour

**Use and influence of science**

People can use scientific knowledge to evaluate whether they should accept claims, explanations or predictions (ACSHE194)

1. Using knowledge of science to test claims made in advertising.

The values and needs of contemporary society can influence the focus of scientific research (ACSHE230)

1. Considering innovative energy transfer devices, including those used in transport and communication.

## Science Inquiry Skills

**Questioning and predicting**

Formulate questions or hypotheses that can be investigated scientifically (ACSIS198)

1. Developing hypotheses based on well-developed models and theories.
2. Using internet research to identify problems that can be investigated.
3. Formulating questions that can be investigated within the scope of the classroom or field with available resources.
4. Developing ideas from students own or others' investigations and experiences to investigate further.
5. Evaluating information from secondary sources as part of the research process

**Planning and conducting**

Plan, select and use appropriate investigation methods, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS199)

1. Combining research using primary and secondary sources with a student's own experimental investigation.
2. Using modelling and simulations, including using digital technology, to investigate situations and events.
3. Deciding how much data are needed to produce reliable measurements.
4. Considering possible confounding variables or effects and ensuring these are controlled.

Select and use appropriate equipment, including digital technologies, to systematically and accurately collect and record data (ACSIS200)

1. Applying specific skills for the use of scientific instruments.
2. Identifying where human error can influence the reliability of data.

**Processing and analysing data and information**

Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies (ACSIS203)

1. Using spreadsheets to present data in tables and graphical forms and to carry out mathematical analyses on data.
2. Exploring relationships between variables using spreadsheets, databases, tables, charts, graphs and statistics.

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS204)

1. Using primary or secondary scientific evidence to support or refute a conclusion.
2. Constructing a scientific argument showing how their evidence supports their claim.

**Evaluating**

Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data (ACSIS205)

1. Evaluating the strength of a conclusion that can be inferred from a particular data set
2. Distinguishing between random and systematic errors and how these can affect investigation results
3. Identifying alternative explanations that are also consistent with the evidence.

**Communicating**

Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations (ACSIS208)

1. Constructing evidence based arguments and engaging in debate about scientific ideas.
2. Presenting results and ideas using formal experimental reports, oral presentations, slide shows, poster presentations and contributing to group discussions.
3. Using a range of representations, including mathematical and symbolic forms, to communicate science ideas.

# LINKS TO SENIOR PHYSICS COURSE

1. Understand that Newton's Laws of Motion describe the relationship between the forces acting on an object and its motion
2. Understand how scientific models and theories have developed and are applied to improve existing, and develop new, technologies
3. Use science inquiry skills to design, conduct and analyse safe and effective investigations into linear motion and wave phenomena, and to communicate methods and findings
4. Use algebraic and graphical representations to calculate, analyse and predict measurable quantities associated with linear motion.
5. Communicate physics understanding using qualitative and quantitative representations in appropriate modes and genres.

| Wk | **Theme,** Concepts / Content | **Student objectives** | **21CLD**<br>**Study Skills (SS)**<br>**Habits of Mind** | **RESOURCES /** ASSESSMENT/ PRACTICALS<br>GENERAL RESOURCES<br>Optional Text books Pearson 10, Human Perspectives Units 1 and 2 |
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| 1-2 | **Introduction of terms, Newton's First Law of Motion and review of equations.**<br>• Definitions of terms used to describe forces and motion.<br>• Vectors and Scalars.<br>• Journey Graphs.<br>• Velocity as gradient of s vs t graph<br>• (rate of change of displacement)<br>• $v = u + at$<br>• $v_{av} = s/t$<br>• v vs. t graphs. | Students will be able to –<br>1. Describe the work of Aristotle and Newton in understanding motion. (See simple mechanics and classical mechanics).<br>2. Define the terms: distance, displacement, speed, acceleration, velocity, force, and inertia.<br>3. Explain the difference between a scalar and a vector quantity and give examples of each.<br>4. Explain what gravity is and how this relates to mass.<br>5. Explain the difference between mass and weight.<br>6. Distinguish between speed and velocity when answering questions related to movement.<br>7. Understand the purpose of journey graphs and how to interpret them.<br>8. Plot s vs t and v vs t graphs from real life situations.<br><br>**Extension:**<br>1. Predict the outcome of certain journeys based on given information.<br>2. Create their own problems and can use equations and/or journey graphs to solve them.<br><br>**Enrichment**<br>Consider how the understanding of motion has changed over time. How has it informed us in terms of design of cars, roller coasters or something of their choice. | ICT LESSON<br>Students to complete the Stile lesson on Kinematics.<br>Two lessons<br>- Speed, distance and time.<br>- Velocity and displacement.<br><br>Online activities/resources.<br>• http://www.physicsclassroom.com/Physics-Tutorial/Newton-s-Laws<br>• http://en.wikipedia.org/wiki/Classical_mechanics<br>• http://www.bbc.co.uk/education/guides/z3bqtfr/revision<br>• http://www.explainthatstuff.com/motion.html<br>• http://www.bozemanscience.com/ap-physics (Big Idea 3: Forces) Great videos. | RESOURCES<br>• Pearson Science Ch 9<br>• Worksheets on Connect.<br>• Worksheets and notes in Resources folder:<br><br>PRACTICALS<br>- Time and displacement graph – retrieve data from slow medium fast runners 5 m intervals 0-50m. Timers at every 5m interval<br>• Measuring velocity, SA4, pg. 31-32.<br>• Graphing motion, SA4, pg. 32.<br>• Measuring time interval and distance: iSc10, Ch.7, Investigation 7.1, pg.218. |
| 2-3 | **Combined Equations of Motion**<br>• $s = ut + ½ at^2$<br>• $a = \Delta V/\Delta t$ gradient v | Students will be able to –<br>9. Define acceleration.<br>10. Draw graphs to solve acceleration problems.<br>11. Use equations to solve acceleration problems.<br>12. use equations to solve problems involving falling objects | ICT LESSON<br>Students to complete the Stile lesson on Kinematics.<br>One lesson<br>- Acceleration and gravity | RESOURCES<br>• Worksheets and resources on Connect.<br>• Worksheets and notes in Resources folder: 2. |

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| | vs. t graph<br>• Rate of change of acceleration<br>• Equivalence of s and area below v vs. t graph. | (falling as a result of gravity).<br>13. Combine acceleration and displacement equations to solve problems.<br>14. Interpret and formulate graphs to solve problems involving displacement, velocity and acceleration.<br><br>**Extension:**<br>1. Solve complex problems involving displacement, velocity and acceleration.<br>2. Apply an understanding of the suvat equations and graphs to solve some real-life problems of displacement, acceleration and velocity.<br><br>**Enrichment**<br>1. Design an experiment to investigate whether objects dropped at the same time hit the ground at the same time. | Online activities/resources.<br>• http://www.bbc.co.uk/education/topics/zbwdmp3<br>• https://www.khanacademy.org/science/physics/one-dimensional-motion | Acceleration.<br><br>ASSESSMENT<br>• Examination including content from Weeks 1-3 including SIS graphing. (100%)<br><br>PRACTICALS<br>• SA4, Focus 2.2, Page 37, "Lazy coins."<br>SA4, Focus 2.2, Pg. 37, "Crash test food." (The Egg drop). |
| 4-5 | **Newton's 2nd and 3rd Laws of Motion, FBDs**<br>• Newton's 1st Law of Motion.<br>• Inertia as a property of matter.<br>• (If $F_R = 0$ then a = 0)<br>• F = ma (Newton's Second Law of Motion)<br>• Action and reaction (Newton's third)<br>• Free body diagrams.<br>• Summarise vectors in 1D | Students will be able to –<br>15. State Newton's 1st Law of Motion.<br>16. Apply Newton's 1st Law of Motion to different situations.<br>17. Appreciate the impact of friction on moving objects.<br>18. Describe Newton's Second Law of Motion.<br>19. Can solve problems using F = ma.<br>20. Can distinguish between weight and mass.<br>21. State Newton's Third Law of Motion.<br>22. Can draw free body diagrams showing the reaction forces acting on the object.<br>23. Summarise vectors in one dimension.<br><br>**Extension**<br>1. Consider a range of different situations and draw free body diagrams to represent the forces acting on the object/subject in each case.<br><br>**Enrichment**<br>2. Investigate the impact of zero gravity on the body.<br>Consider the impact of forces such as friction and air resistance. How | Online activities/resources.<br>• http://www.grc.nasa.gov/WWW/k-12/BGA/Monroe/aircraft_motion_1_act.htm<br>• https://www.khanacademy.org/science/physics/one-dimensional-motion<br>• http://www.brightstorm.com/science/physics/newtons-laws-of-motion/free-body-force-diagrams/<br>• http://www.brightstorm.com/science/physics/newtons-laws-of-motion/<br>• http://www.bozemanscience.com/ap-physics/ (Big Ideas 3 and 4) | RESOURCES<br>• Worksheets and resources on Connect.<br><br>ASSESSMENT<br>• Worksheets and homework as part of teacher mark. (5%)<br>• Pendulum investigation (15%)<br><br>PRACTICALS<br>• Use Newton meters to pull blocks along surface.<br>SA4, Focus 2.4, pg. 49: "Water rockets. |

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| | | can these be reduced? | | |
| | **Taking Motion Further – Road Safety and Reaction Times**<br>• Displacement in 2D<br>• Sum vectors 2D<br>• Vector diagrams<br>• Road safety motion<br>Reaction times. | Students will be able to<br>24. State what a resultant force is.<br>25. Solve problems involving vectors in 2 dimensions.<br>26. Appreciate the importance of safety in a moving vehicle.<br>27. Work out the impact of velocity on reaction time and stopping times.<br>28. Evaluate how road conditions can affect reaction times and stopping times.<br><br>**Extension**<br>• Consider different vehicles and how they are adapted for their purpose. E.g. F1 car, motor vehicle, truck. How are reaction times and braking times affected? Use Newton's Laws to describe the effects.<br><br>**Enrichment**<br>1. Conduct a study into the history of cars in terms of safety. What features have been considered? Has safety changed? Present your findings in any form you choose.<br>2. Survey students to see what is important to them in terms of car design. Report on your findings using any format you choose.<br>Investigate road safety statistics in WA and select a key area that influences the number of fatalities, e.g. driver distraction, fatigue, speed, drug or alcohol use. Using the information design an advertising campaign to raise awareness of this issue. | Online activities/resources.<br>• http://www.physicsclassroom.com/class | RESOURCES<br>• iSc10, Ch.7. Pg. 224-244<br><br>ASSESSMENT<br>• Worksheets and homework as part of teacher mark. (5%)<br><br>PRACTICALS<br>• Investigating reaction times. iSc10, Ch. 7. Pg. 227-229, Act. 7.10. Investigating "Distraction and Stopping Distance." |

**Feedback | Teacher reflections**

Evaluate the information gathered from the formative assessment to inform teaching and learning strategies.

- What concepts do the students understand and/or not understand?
- Are there concepts that require more scaffolding?

Use feedback to respond to student work and identify possible strategies or lesson adjustments that may be appropriate to progress student understanding.

Specific feedback should include:

- areas where the student did well
- areas where improvement is required.

Areas to address in feedback include:

- did the student set working out clearly?
- were units written correctly?
- was a direction given when appropriate?

**Programs can be subject to change**