 Evolution of paper planes

Stage 5 Living world

Outcomes

Values and attitudes

SC5-1VA appreciates the importance of science in their lives and the role of scientific inquiry in increasing understanding of the world around them

Working Scientifically

SC5-4WS develops questions or hypotheses to be investigated scientifically

* WS4 Students question and predict by:

b. predicting outcomes based on observations and scientific knowledge

SC5-5WS produces a plan to investigate identified questions, hypotheses or problems, individually and collaboratively

* WS5.1 Students identify data to be collected for an investigation by:

a. describing the purpose of an investigation

* WS5.2 Student plan first-hand investigations by:

b. describing a logical procedure for undertaking a range of investigation types

* WS5.3 Students choose equipment or resources for an investigation by:

b. identifying the appropriate units to be used in collecting data

c. selecting equipment to collect and record reliable data or information, using digital technologies as appropriate, e.g. data loggers

SC5-6WS undertakes first-hand investigations to collect valid and reliable data and information, individually and collaboratively

* WS6 Students conduct investigations by:

e. reporting data and information, evidence and findings, with accuracy and honesty

SC5-7WS processes, analyses and evaluates data from first-hand investigations and secondary sources to develop evidence-based arguments and conclusions

* WS7.1 Students process data and information by:

e. identifying data which supports or discounts a question or hypothesis being investigated or a proposed solution to a problem

* WS7.2 Analyse data and information by:

a. analysing patterns and trends, including identifying inconsistencies in data and information (ACSIS169, ACSIS203)

d. using knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170, ACSIS204)

SC5-8WS applies scientific understanding and critical thinking skills to suggest possible solutions to identified problems

* WS8 Students solve problems by:

c. applying the processes of Working Scientifically in developing creative solutions to problems

e. using models to explain phenomena and make predictions

SC5-9WS presents science ideas and evidence for a particular purpose and to a specific audience, using appropriate scientific language, conventions and representations

* WS9 Students communicate by:

a. selecting and using in presentations, for different purposes and contexts, appropriate text types including discussions, explanations, expositions, procedures, recounts or reports 

b. selecting and constructing an appropriate table, type of diagram, table or graph (histogram or sector, column or line graph) to present information and show relationships clearly and succinctly using digital technologies as appropriate

Knowledge and understanding

SC5-15LW explains how biological understanding has advanced through scientific discoveries, technological developments and the needs of society

LW4 The theory of evolution by natural selection explains the diversity of living things and is supported by a range of scientific evidence. (ACSSU185)

Students:

a. describe scientific evidence that present-day organisms have evolved from organisms in the past

c. explain, using examples, how natural selection relates to changes in a population, eg in the development of resistance of bacteria to antibiotics and insects to pesticides 

Learning across the curriculum

Cross-curriculum priorities

[ ]  Aboriginal and Torres Strait Islander histories and cultures

[ ]  Asia and Australia's engagement with Asia

[ ]  Sustainability

General capabilities

[x]  Critical and creative thinking

[x]  Ethical understanding

[x]  Information and communication technology capability

[ ]  Intercultural understanding

[x]  Literacy

[x]  Numeracy

[x]  Personal and social capability

Other areas of learning

[ ]  Civics and citizenship

[ ]  Difference and diversity

[ ]  Work and enterprise

Teacher notes

This task combines a traditional first-hand investigation with the process of modelling evolution by artificial selection. The outcomes of the task focus on the Working Scientifically skills as students are actively involved in the predicting, planning and conducting of the investigation.

To assess an understanding of content, students could be asked to compare their method to the mechanism proposed by Charles Darwin if the content had been covered.

This task may potentially be used as the Student Research Project in Stage 5, whereby students are given the option of developing a similar test using original or creative ideas.

The marking criteria is holistic and essentially amalgamates communication, investigation and problem solving. This is different from an analytical rubric which assesses individual components of the scientific method and information presented.

The task can be performed in class across a minimum of two periods to allow for investigation time and research and writing.

Prior reading

[The Power of Evolution](http://www.diplomacy.edu/blog/171-%E2%80%93-power-evolution) this web resource is blog article which discusses the process of ‘evolution’ in a place other than nature. It can be used to set the scene to model evolution using firsthand information without having to use secondary sources or use organisms.

Task

Using the scientific method, students model the process of evolution by artificial selection to test and select the most efficient paper plane in controlled conditions.

Students make 10 random paper planes and assess the “best” design. They will then make 10 variations on this design and repeat the process. Students can repeat this process as many times as they like to create the ideal paper plane using the paper provided. Some students will need to be guided to decide what parameter they are going to judge the best paper plane on: time of flight, distance travelled, or any other logical measurement.

Students will present their finding as an extended response (answering the question below) which will outline the process of the investigation and the results, including what evolution is and what was learnt about creating artificial representations to model evolution. They need to analyse how theiur activity models the process of evolution.

Possible questions to be answered

* Explain/discuss how this activity modelled the process of evolution.
* A challenging question would be to assess its effectiveness in modelling the process of evolution.
* A question may be posed using stimulus. Discuss the statement below which was made by a publisher of the year 10 Science textbook: ‘Relatives of Charles Darwin do not believe the paper plane modelling activity should be included ion our recent publication of Year 10 Science thus I want it removed immediately from our books.’ Mr R Briggs, Clayton Publishing.

Marking guideline/rubric

| Grade | Holistic criteria |
| --- | --- |
| A | * Communication is convincing through clear and meaningful use of language, extensive and correct use of precise scientific terms about their topic, and appropriate to the audience.
* Design is valid and reliable, method clearly demonstrates understanding of variables using correct experimental terminology.
* Variables are assessed and risk assessment is completed.
* Relevant observations over an appropriate number of trials have been made and recorded in an organised, sequential and logical manner using correct units.
* Evidence of a thorough testing process is presented.
* A range of possible procedures have been identified and assessed with convincing arguments provided for the procedure selected.
* Scientific principles and ideas were correctly used to show a deep understanding of the science content relevant to this investigation.
* Appropriate critical thinking is evident to synthesise experimental data to discuss conclusions.
* Trends, patterns and relationships in the results or data collected have been analysed and evaluated and clear and concise explanations given using scientific and/or mathematical models.
* Demonstrates a thorough understanding of the Theory of Evolution and how this activity models it through trial and error and survival of the fittest.
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| B | * There is effective use of language, appropriate to the purpose and audience.
* It includes the correct use of scientific terms about their topic.
* Variables have been controlled and a procedure selected.
* Relevant observations over a number of trials or through replication have been made and recorded in an organised manner using correct units.
* The entry provides substantial evidence that the student has conducted a valid scientific investigation over a period of time that includes a summary of current relevant information.
* Scientific principles or ideas were used to show an understanding of the science content relevant to this investigation.
* Critical thinking is evident in the conclusions.
* Trends, patterns and relationships in the results or data collected have been analysed and explanations given.
* Demonstrates a sound understanding of the Theory of Evolution and links it to the activity with basic understanding of how it is modelled.
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| C | * The use of language is adequate to communicate elements of the investigation to the appropriate audience
* Correct report format is used.
* Plan and conduct a first-hand investigation.
* Observations have been recorded using a standard procedure or appropriate technology.
* Uses identified strategies and problem solving skills to plan and conduct first hand investigations.
* Some ideas have been put forward for further investigation.
* Shows some understanding of relevant science content.
* Some trends, patterns or relationships in the results or data collected have been identified and an explanation has been given.
* Demonstrates a satisfactory understanding of the Theory of Evolution and describes how some features of the activity models it.
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| D | * The use of language is adequate to communicate elements of the investigation.
* Explanations are poorly expressed.
* Develops elementary plans and undertakes elementary first-hand investigation.
* Observations have been made with inappropriate procedures or technology.
* Shows little understanding of the science concepts relevant to the investigation.
* Generalisations show little evidence of critical thinking.
* Trends, patterns and relationships in the data collected are loosely identified.
* Demonstrates a limited understanding of the Theory of Evolution and does not link it to the modelling activity.
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| E | * The report communicates basic information to the audience.
* Undertakes an elementary investigation completed under guidance.
* Attempt at identifying simple trends.
* No attempt at applying the modelling activity to the Theory of Evolution and dos not demonstrate any understanding of the features of the theory.
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