

Grade 9 Natural Sciences Worksheet

Evolution

Here is an interesting story. In England, the pepper moth is well known. It gets its name from the light speckled colour of its wings – like sprinkled pepper. It survives during the day by sleeping on tree trunks covered in lichen. Its wings are the same colour as the mottled and blotchy lichen, so it is well hidden, or camouflaged. Birds cannot easily see it and so it has a good chance of surviving and reproducing many more moths like itself. Every now and again, something will go wrong in the genes of the pepper moth and instead of having pepper coloured wings, it will have black wings. You can understand that this would not really be a good thing for the moth. A black moth would stand out against the light speckled lichen and birds would see it and eat it. So black moths would not survive and reproduce. Now something interesting was noticed in a part of England called Manchester in the late 1800s where there was heavy industry and lots of sooty black smoke in the air. The number of black moths was getting higher and higher until almost all the moths in that area were black. Scientists asked why this was happening and looked for an explanation. Hypotheses (suggestions based on evidence and observation) were put forward. After investigations, the scientists came to the following conclusion. They said that the smoke and soot produced by heavy industry killed the lichens on the trees and turned the tree trunks black. They said that this would mean that the occasional black moths that were produced would have a better chance at survival and reproduction than the light coloured moths. So, over time, the black moths became the most common forms observed. This is a true story! Scientists often tell this story to support the theory of evolution.

Part One: Important words in science

This is a test your understanding of some important words in science. These words are:

observation, fact, opinion and theory.

Read each of the statements below and decide if the statement is an observation, a fact, an opinion or a theory.

- 1.1 The pepper moth is found in England.
- 1.2 The pepper moth's speckled colour makes it difficult to be seen against the lichen covered tree trunks.
- 1.3 People saw that black pepper moths became more predominant in the late 1800s.
- 1.4 Black pepper moths became more predominant because they were better adapted to black tree trunks.
- 1.5 Industry should have been stopped because of the pollution they were making.

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Now try these – they are based on the theory of evolution.

- 1.6 People who believe in evolution are wrong, because it goes against religious teachings.
- 1.7 Dinosaurs went extinct about 70 million years ago.
- 1.8 Dinosaurs became extinct because of a sudden ice age, most likely brought on by an asteroid crashing into earth.
- 1.9 Studying dinosaurs is a waste of money.
- 1.10 Natural selection is also called 'survival of the fittest'.

[20 marks]

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Part Two: Natural selection

1. Using the example of the pepper moths, explain in a paragraph what is meant by “natural selection”. [10 marks]
2. In this activity you must complete a paragraph by supplying the missing words. The

useful, competition, offspring, harmful, resources, fittest, natural selection, better adapted
words in the clue-box will help you.

Natural selection

Natural selection states that _____ individuals in a population are more likely to survive for a longer period of time and produce more _____. Characteristics that are _____ are selected for. Characteristics that are _____ are selected against. Natural selection results in the fit organisms dying out. A key element of natural selection is _____. Each species produces more offspring than can survive. Only a limited number actually do survive and produce further offspring of their own. The reason for this is that _____ in the environment are limited and there is competition between organisms for the resources. The individuals that have the genes that allow it to compete successfully and therefore have more offspring (who will inherit its successful genes) are the _____ individuals in the population. Those individuals less fit to adapt in the environment will die, or have less offspring.

Survivors pass on more genes because they have more offspring. Thus, there is “survival of the fittest” or _____.

[8 marks]

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Part Three: Artificial selection

‘Artificial selection’ is the process used by farmers and breeders to improve the characteristics of their livestock and crops. Although it is called ‘artificial’ it works on the exact same principles as natural selection, except that the farmer is controlling the selective pressures. Only individuals displaying certain characteristics that the farmer wants in his livestock will be allowed to breed.

Through artificial selection, the farmer produces a livestock population with only the characteristics he wants.

In groups, you are going to go through magazines and find pictures of examples of artificial selection. Look in farming magazines in particular. Remember to look for plants as well as animals.

Paste your pictures onto a chart.

Under each picture, say what characteristic the farmer is selecting for.

[16 marks]

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Rubric to assess chart

Criteria	Level 4 [8]	Level 3 [6]	Level 2 [4]	Level 1 [2]
Presentation	Chart is neat, extremely well organised and presents the information in a professional, easy to read format.	Chart is generally neat, well organised and presents the information well.	Chart could be neater; more attention should be paid to organisation of information.	Chart is untidy; little attention was paid to organisation of information.
Choice of pictures	Pictures clearly represent examples of artificial selection; learner is able to accurately name the characteristic being selected for.	Pictures generally represent examples of artificial selection; learner is able to mostly name the characteristic being selected for.	Most of the pictures represent examples of artificial selection; learner is able to satisfactorily name the characteristic being selected for.	Pictures do not always represent examples of artificial selection; learner is unable to accurately name the characteristic being selected for.

Part Four:

Do some research to find out who Charles Darwin was and what his contribution was to science. Write up your findings as a profile for a book entitled "Famous Scientists".

[16 marks]

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Rubric to assess profile

Criteria	Level 4 [8]	Level 3 [6]	Level 2 [4]	Level 1 [2]
Content of profile	Profile contains at least 10 important facts about the life and works of Darwin; information clearly outlines his contribution to science.	Profile contains about 7 important facts about the life and works of Darwin; information outlines his contribution to science.	Profile contains about 5 important facts about the life and works of Darwin; information satisfactorily outlines his contribution to science.	Profile contains less than 4 important facts about the life and works of Darwin; information poorly outlines his contribution to science.
Writing style	Profile is extremely well written with excellent use of grammar and vocabulary; presentation is neat.	Profile is well written with good use of grammar and vocabulary; presentation is largely neat.	Profile is satisfactorily written; some grammar errors and limited vocabulary; presentation needs attention.	Profile is poorly written with weak grammar and vocabulary; presentation is untidy.

Part Five: Can you observe evolution happening?

Provide some evidence in the form of an argument that could be used in a debate FOR evolution.

[8 marks]

Part Six: A case study

This activity is a **case study**. You must read about a real life situation and then answer questions, using your knowledge of evolution and natural selection. You must act like a scientist. You must use the evidence to propose or put forward a possible explanation for something. This is called a **hypothesis**.

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The White Lions of Timbavati.

Timbavati is an area bordering on the Kruger National Park and is a private game reserve. Animals roam freely between the Kruger Park and Timbavati. All over Africa, legends of White Lions exist in ancient oral traditions. Storytellers spoke of the existence of these legendary animals. The first photographic records of the White Lions date back to the 1970s when researcher Chris McBride recorded the existence of White Lions in more than one pride in the Timbavati region. Further sightings were then recorded in the neighbouring Kruger Park.

The White lions were captured from this area and relocated to zoos and special farms where they are being bred. What exactly are the White lions? They resemble normal tawny coloured lions in every way, except that they have a very pale fur colour – almost pure white. They are not albinos. Rather, their fur colour is the result of a genetic mutation.

Do you think that over time, a new species of white lions will evolve from the original tawny coloured lions? Give reasons for your thinking.

[7 marks]

[Total: 85 marks]

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Suggested Solutions

Question number	Possible marks	Solution
1	20	<p>1.1 The pepper moth is found in England. <i>This is a fact. It can be proven by observation and evidence that everyone will agree on.</i></p> <p>1.2 The pepper moth's speckled colour makes it difficult to be seen against the lichen covered tree trunks. <i>This is an observation. It draws no conclusion; it is simply a statement of what has been noticed.</i></p> <p>1.3 People saw that black pepper moths became more predominant in the late 1800s. <i>This is another observation. No conclusions are drawn.</i></p> <p>1.4 Black pepper moths became more predominant because they were better adapted to black tree trunks. <i>This statement is a theory. It provides an explanation for something based on evidence.</i></p> <p>1.5 Industry should have been stopped because of the pollution they were making. <i>This is an opinion. It is a personal belief based on a value system.</i></p> <p>1.6 People who believe in evolution are wrong, because it goes against religious teachings. <i>This is an opinion based on a personal belief and a value system.</i></p> <p>1.7 Dinosaurs went extinct about 70 million years ago. <i>Fact. Evidence of fossils and dating of rocks proves this as a fact. Scientists agree on the evidence.</i></p> <p>1.8 Dinosaurs became extinct because of a sudden ice age, most likely brought on by an asteroid crashing into earth. <i>This is a theory. It is an explanation supported by evidence.</i></p> <p>1.9 Studying dinosaurs is a waste of money. <i>Opinion. Personal beliefs and values lie at the bottom of this statement.</i></p> <p>1.10 Natural selection is also called 'survival of the fittest'. <i>Fact. Charles Darwin wrote these words and the statement has become part of factual evidence to support the theory of evolution.</i></p>
2.1	10	<p>Learner paragraphs will differ, but this can be used as a guideline:</p> <p>A population is a group of individuals of the same species living in one particular area. The members of a population are able to breed with each other. So all the pepper moths living around Manchester were a population. ✓ Remember from the story that the moths originally were light coloured and it was only with industrialisation and the darkening of tree trunks that the moth population became black winged. ✓ Answer these questions: Would a light coloured moth be able to survive on the dark tree trunk? ✓ Would the black winged moth be able to survive on the dark coloured tree trunk? ✓ You should have no problem in</p>

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		<p>answering confidently that the black winged moth is far better adapted to the dark tree trunk than the light winged moth. ✓ Light winged moths would have a greater chance of being seen by birds and being eaten. ✓ They would also not have a chance to reproduce as many offspring because their lives would be shorter. ✓ The black moths, however, would be better suited to the environment ✓ and they would also live longer and produce more offspring. ✓ Their offspring would look like them and slowly the population would change from being light coloured to being dark coloured. ✓ This is the process of natural selection. ✓ It is the survival ✓ of those individuals that are 'fitter' for the environment, ✓ or more suited to the environment. ✓</p>
2.2	8	<p>Natural selection states that <i>better adapted</i> individuals in a population are more likely to survive for a longer period of time and produce more <i>offspring</i>. Characteristics that are <i>useful</i> are selected for. Characteristics that are <i>harmful</i> are selected against. Natural selection results in the fit organisms dying out. A key element of natural selection is <i>competition</i>. Each species produces more offspring than can survive. Only a limited number actually do survive and produce further offspring of their own. The reason for this is that <i>resources</i> in the environment are limited and there is competition between organisms for the resources. The individuals that have the genes that allow it to compete successfully and therefore have more offspring (who will inherit its successful genes) are the <i>fittest</i> individuals in the population. Those individuals less fit to adapt in the environment will die, or have less offspring. Survivors pass on more genes because they have more offspring. Thus, there is "survival of the fittest" or <i>natural selection</i>.</p>
3	16	<p>See rubric in Appendix of Assessment Tools.</p> <p>Answers will differ according to the pictures selected by each group. However, the answers should highlight the fact that animals and plants are bred for favourable characteristics. Some cows are bred for their excellent milk producing ability, while others are bred for meat. Certain strains of corn might be bred for their colour or sweetness. Certain vegetables and fruit are bred for their size, etc.</p>
4	16	<p>See rubric in Appendix of Assessment Tools.</p> <p>Some guidelines for content of profile: Charles Darwin was the first person to come up with an acceptable explanation for the how evolution took place. Darwin was employed as a naturalist (someone who studies nature) on board the British survey ship HMS Beagle on a five year expedition to the southern hemisphere from 1831 and 1835. On this expedition, Darwin made notes on the geology, fossils, animals and plants he encountered.</p>

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		<p>He was especially interested in the animals and plants he observed on the Galapagos Islands, just off the coast of South America.</p> <p>Darwin kept very careful notes and records of his observations. When he returned to England, he spent the next 20 years reviewing his observations and slowly refining his theory of evolution.</p> <p>Darwin's grandfather had studied diversity in domestic animals such as dogs, cattle and pigeons. Charles Darwin drew on his grandfather's observations and made more observations of his own.</p> <p>Based on his studies, Darwin published his theory of evolution in a book called "On the Origin of Species by Natural Selection" in 1859. This book convinced many scientists that evolution was a fact and that the mechanism for evolution was natural selection. Darwin described natural selection as: The individuals that possess the genes that allow it to compete successfully and therefore have more offspring (who will inherit its successful genes) are the "fittest" individuals in the population. The theory of evolution is based on the concept of natural selection. What is so impressive about Darwin is that he made hundreds of observations while travelling around the southern hemisphere on a ship; then he made further observations when he returned home. It took him 20 years to finally publish his theory. Darwin was a very good scientist. His theory was based on observations, tests, evidence and investigation. He did not simply publish an opinion. It was a carefully researched theory.</p>
5	8	<p>To answer this question, all you have to do is go back to our story of the pepper moth. The pepper moth is evidence of evolution.</p> <p>But what about other examples of evolution happening right now? One example of evolution happening now is insects developing resistance to insecticides over a period of time.</p> <p>Insecticides are chemicals that interfere with the normal workings in the cells of insects and kill them. It has happened that a few individuals mutate by chance and have a different genetic characteristic which gives them resistance to the insecticide. They will survive when the insecticide is used. They will produce many offspring. Their offspring will also be resistant to the insecticide. The population will slowly have fewer individuals who are killed by the insecticide and more individuals with resistance to the insecticide. Eventually, the entire population is insecticide resistant. The population has evolved.</p> <p>Insects are not the only organisms to evolve resistance to a substance. Bacteria can become resistant to antibiotics too.</p>
6	7	<p>White lions would be easily spotted by their prey as their fur colour would not blend in well with the tawny background of the vegetation in which they hunt. It is also likely that the cubs would be more visible to other animals, such as leopards, which could kill them. Having white fur colour does not give the lions an advantage. They would not therefore be naturally selected for and a new species of White lions is unlikely to</p>

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	grammar and vocabulary; presentation is neat.	vocabulary; presentation is largely neat.	and limited vocabulary; presentation needs attention.	presentation is untidy.
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