Fukushima Butterflies Released Item Set
Constructed Response Anchor Papers

6 **Use evidence to support the claim that the nuclear accident at the nuclear power plant caused changes that resulted in the abnormalities seen in the pale grass blue butterfly population for the next several generations.**

Type your answer in the space provided.

Score Level 0 Anchor Paper

an accident at the nuclear powe plant releaed a larg amount of nuclear radiation into the surrounding area the pale grass blue butterflies were a model organism to evaluate the evironmental and biological effects of the radiation

This response demonstrates that the student has no understanding of the question. The response contains only information provided in the stimulus which does not support a claim of mutations being caused by the power plant accident (*the pale grass blue butterflies were a model organism to evaluate the evironmental andbiological effects of the radiation*). The student response is irrelevant.

Score Level 0 Anchor Paper

The blue butterfly population started to live longer and have a greater population due to their shortened wing size

This response demonstrates that the student has no understanding of the question. The data presented is misinterpreted and fails to address the prompt (*started to live longer and have a greater population due to their shortened wing size*). The student response is irrelevant to the question and incorrect.

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Score Level 0 Anchor Paper

The nuclear accident effected many things in the butterflys including the eclosion time and the span of wings, these are the results of genetic changes. Genetic changes occur when the DNA is damaged and the wrong protiens are placed in the DNA strands that are being copied. These protien changes cause the DNA to be changed and a mutation ocurrs in this case the proteins that changed controlled the eclosion process and the span of wings.

This response demonstrates that the student has no understanding of the question. The response identifies changes in eclosion times and forewing size as resulting from radiation exposure but the explanation of the process that caused this is incorrect (*DNA is damaged and the wrong protiens are placed in the DNA strands that are being copied*). Without an accurate discussion or appropriate data to support these ideas it is assumed that the first statement is just extracted from the stimulus (*The nuclear accident effected many things in the butterflys including the eclosion time and the span of wings*). The student response is too vague and incorrect.

Score Level 1 Anchor Paper

As the parent butterflies were exposed, their genes mutated and they started creating offspring with the genes they had mutated. Those offspring then carry the abnormalities in the mutated genes and allow them to carry those abnormal genes to their offspring and so on.

This response demonstrates a minimal understanding and constructs a minimal explanation of the question. The explanation is based on disciplinary core ideas when it describes the mechanism of passing the abnormalities to the offspring (*their genes mutated and they started creating offspring with the genes they had mutated*). The student demonstrates no integration of the science and engineering practices by not providing any evidence to support the claim in the response. The response reflects little synthesis of complex ideas or crosscutting concepts related to cause and effect by linking the mutated genes to the abnormalities (*Those offspring then carry the abnormalities in the mutated genes*). The student response demonstrates a minimal understanding of the three dimensions.

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Score Level 1 Anchor Paper

More abnormalities developed in pale grass blue butterflies that were closer to the nucear accident than those who were farther away. By feeding on the plants that were more affected, they were exposed to more harmful chemicals which were then passed onto future generations. Some abnormalities include the eclosion time, appendages, forewing size, and their eyes. According to the data table given, the closer a butterfly was to the nucear accident, the more likely their offspring will have a longer eclosion time. The farther away a butterfly was from the nuclear power plant, the less likely their offspring are ot have abnormal appendages. The more radiation that a butterfly was exposed to, their future generation had a smaller forewing size.

This response demonstrates a minimal understanding and constructs a minimal explanation of the question. The explanation lacks disciplinary core ideas by identifying the wrong material from the parents that is passed on to future generations that causes the abnormalities (*harmful chemicals which were then passed onto future generations*). The student demonstrates little integration of the science and engineering practices by using the data from the graphs to show the relationship between radiation exposure and abnormalities (*More abnormalities developed in pale grass blue butterflies that were closer to the nucear accident than those who were farther away)*. The response reflects little synthesis of the crosscutting concept of cause and effect by identifying the relationship between radiation exposure and the abnormalities in the butterfly offspring but lacks evidence to support this statement. (*The farther away a butterfly was from the nuclear power plant, the less likely their offspring are ot have abnormal appendages*). The student response demonstrates a minimal understanding of the three dimensions.

Score Level 1 Anchor Paper

The nuclear accident at the nuclear plant did cause abnormalies as seen in the pale blue grass butterfly for the next generations. The graphs shown as the butterflies were closer to the NPP, the anamoly rate percentage for the appendages increased from 0. 9% 120 km away to 7.9% 20 km away. Also the anomaly is shown through the forewing size. As the butterflies were exposed to more ground radiation, the size of their forewing decresed. When as 0.01 at ground radiation exposure, the forewing size was normal at around 1.4 em. When at 2.95 at ground radiation exposure, the forewing size decreased to 1.31 em showing how radiation causes abnomalties in the wing. The data was taken from the graph Butterfly Forewing Size and Rate of Abnormal Appendages. In the graph Abnormalties in Several Generations of Butterflies, it shows how after exposure to radiation, the abnormalties percentage increased

This response demonstrates a minimal understanding and constructs a minimal explanation of the question. The explanation lacks disciplinary core ideas by failing to link the data from the stimulus to a genetic process that would cause these changes to be passed on to future generations (*The nuclear accident at the nuclear plant did cause abnormalies as seen in the pale blue grass butterfly for the next generations*). The student demonstrates an integration of the science and engineering practices by correctly using data from the graphs to show how increased radiation exposure could have resulted in changes to appendages and forewing size (*When as 0.01 at ground radiation exposure, the forewing size was normal at around 1.4 em. When at 2.95 at ground radiation exposure, the forewing size decreased to 1.31 em*). The response reflects no synthesis of the crosscutting concept of cause and effect by not completing the argument as to the cause for the increase in the abnormalities in future generations. The student response demonstrates a minimal understanding of the three dimensions.

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Score Level 2 Anchor Paper

The nuclear accident likely caused changes, resulting in abnormalities, in the pale grass blue butterflies near the Fukushima Nuclear. This is evident due to how the average eclosion time for radiation-exposed butterflies decreases the further away the population is from the accident, suggesting the radiation likely caused the butterflies to take abnormally long to develop from egg to adult.

This is also evident by how the rate of abnormalities increases from the parental to second generation produced--from 13.2 in the parentals to 33.5 in the second generation. Likely, litters produced by parent butterflies are more susceptible to radiation damage. Not only that, but the mutations from the parents are probably passed along to their offspring, and have an accumulation effect over time.

This response demonstrates that the student has a complete understanding and constructs a complete explanation of the question. The response coherently uses disciplinary core ideas to describe the process that causes abnormalities in the offspring (*the mutations from the parents are probably passed along to their offspring*). The student demonstrates a complete integration of the science and engineering practices by including evidence and data from the stimulus to support the claim and their reasoning (*rate of abnormalities increases from the parental to second generation produced--from 13.2 in the parentals to 33.5 in the second generation*). The response reflects synthesis of the crosscutting concept of cause and effect by correctly relating increases in eclosion times to increased radiation exposure (*how the average eclosion time for radiation-exposed butterflies decreases the further away the population is from the accident, suggesting the radiation likely caused the butterflies to take abnormally long to develop from egg to adult*). The student response demonstrates an understanding of the three dimensions.

Score Level 2 Anchor Paper

As seen in the Abnormalities in Several Generations of Butterflies graph, the amount of abnormalities increased in the following generations. After 6 months, there was a 51.9% abnormalies in the F1 generation, which is the highest out of all the data. The radiation left by the nuclear accident caused mutations in the DNA of the butterflies and they were passed down to its offspring. In each generation, there are more mutations, which cause abnormalities, being produced and being passed down to offspring. We know that the plant caused the abnormalities because the butterflies closest to the power plant experienced the most abnormalities. About 7% of the butterflies experienced abnormalities from 20 km from the plant. which was the most out of the butterflies. This shows that the radiation from the nuclear power plant caused the abnormalities in the butterflies.

This response demonstrates that the student has a complete understanding and constructs a complete explanation of the question. The response coherently uses disciplinary core ideas to describe how mutations in the parent's is passed along to their offspring (*nuclear accident caused mutations in the DNA of the butterflies and they were passed down to its offspring. In each generation, there are more mutations, which cause abnormalities*). The student demonstrates a complete integration of the science and engineering practices by including evidence and data from the stimulus to support the claim and their reasoning (*the amount of abnormalities increased in the following generations. After 6 months, there was a 51.9% abnormalies in the F1 generation*). The response reflects synthesis of the crosscutting concept of cause and effect by identifying the radiation as the cause of the abnormalities in the original butterfly population (*We know that the plant caused the abnormalities because the butterflies closest to the power plant experienced the most abnormalities.*). The student response demonstrates an understanding of the three dimensions.

Score Level 2 Anchor Paper

As we see with the data regarding abnormality percentages, the abnormality rate 6 months after the accident for the F1 generation is absurdly above the normal rate, which should be close to zero. And since the parent generation had only 28.1 percent abnormality and the F1 generation had 51.9, we know that the abnormalities are being passed down by the parents and inherited by the next generation. We also know that these abnormalities are being caused by the increased radiation from the Fukishima plant accident because butterflys collected less than 40 kilometers away from the accident yeilded over 6% abnormality rate, while those collected over 120 kilometers away had an abnormality rate of about 1%. I both the abnormal appendage graph and the forewing size graph, the trend lines show that as you get closer to the site of the Fukishima accident, the butterflys have more mutations abnormalities.

This response demonstrates that the student has a complete understanding and constructs a complete explanation of the question. The response coherently uses disciplinary core ideas to describe the inheritance of mutations from one generation to the next (*we know that the abnormalities are being passed down by the parents and inherited by the next generation*). The student demonstrates a complete integration of the science and engineering practices by including evidence and data from the stimulus to support the claim and their reasoning (*And since the parent generation had only 28.1 percent abnormality and the F1 generation had 51.9*). The response reflects synthesis of the crosscutting concept of cause and effect by identifying the correlation between the abnormalities in the parents and the F1 generation (*both the abnormal appendage graph and the forewing size graph, the trend lines show that as you get closer to the site of the Fukishima accident, the butterflys have more mutations abnormalities*). The student response demonstrates an understanding of the three dimensions.