



AP Bio FRQ Fridays

2023 #3
Keystone Species
& Experimental Design



FRQ Friday #24

2023 #3

Sand lances of the genus *Ammodytes* are small fish that function as keystone organisms in several coastal ecosystems. These sand lances are prey fish that support organisms at higher trophic levels. Scientists performed experiments to examine how sand lance populations are likely to be affected by the rising temperatures and CO_2 levels associated with climate change.

Sand lance embryos typically develop and mature into adult fish at low temperatures (approximately 5°C) and stable, low CO_2 levels (approximately $400 \mu\text{atm}$). Over the course of two years, the scientists measured the survival rate of sand lance embryos allowed to develop and mature in a laboratory at three different temperatures, 5°C , 7°C , and 10°C , with the level of CO_2 maintained at $400 \mu\text{atm}$, $1,000 \mu\text{atm}$, and $2,100 \mu\text{atm}$ for each temperature.



FRQ Friday #24

2023 #3

(a) **Describe** the effect of increased biodiversity on the resilience of an ecosystem in a changing environment.

Describe the effect of increased biodiversity on the resilience of an ecosystem in a changing environment.

- (Ecosystem) resilience/it will be greater (with increased biodiversity).

Increasing biodiversity will also increase the resilience of an ecosystem in a changing environment because if there was a change, a small group of the ecosystem will only be the one affected and not the majority.



FRQ Friday #24

2023 #3

(b) **Justify** the scientists' selecting 5°C as the lowest temperature and $400\ \mu\text{atm}$ as the lowest CO_2 level in their study of sand lance embryo survival.

Justify the scientists' selecting 5°C as the lowest temperature and $400\ \mu\text{atm}$ as the lowest CO_2 level in their study of sand lance embryo survival.

Accept one of the following:

- These are the normal/current conditions at which the embryos develop and were used as a basis for comparison.
- These (current) conditions were used as a basis to compare the effects of changes in environmental conditions/increases in temperature and CO_2 .

The scientists selected 5°C and $400\ \mu\text{atm}$ as their lowest CO_2 levels as the control group since sand lances normally develop and mature in those conditions. The scientists can use this control group to compare with other experimental groups to observe the changes to sand lances in response to changes



FRQ Friday #24

2023 #3

(c) **State** a null hypothesis for the experiment.

Sand lances of the genus *Ammodytes* are small fish that function as keystone organisms in several coastal ecosystems. These sand lances are prey fish that support organisms at higher trophic levels. Scientists performed experiments to examine how sand lance populations are likely to be affected by the rising temperatures and CO₂ levels associated with climate change.

Sand lance embryos typically develop and mature into adult fish at low temperatures (approximately 5°C) and stable, low CO₂ levels (approximately 400 μatm). Over the course of two years, the scientists measured the survival rate of sand lance embryos allowed to develop and mature in a laboratory at three different temperatures, 5°C, 7°C, and 10°C, with the level of CO₂ maintained at 400 μatm, 1,000 μatm, and 2,100 μatm for each temperature.



FRQ Friday #24

2023 #3

(c) **State** a null hypothesis for the experiment.

State a null hypothesis for the experiment.

Accept one of the following:

- Climate change will have no effect on sand lance (embryo) survival/sand lance development/the size of sand lance populations.
- (Increases in) temperature/CO₂ levels will have no effect on sand lance (embryo) survival/sand lance development /the size of sand lance populations.
- There will be no difference in the sand lance (embryo) survival rates/sand lance development/the size of sand lance populations measured at all/different temperatures and CO₂ levels.

The null hypothesis is that the changes in CO₂ and temperature levels will have no affect on the sand lance population and their rate of survival.



FRQ Friday #24

2023 #3

(d) The scientists claim that a reduction in the population size of the *Ammodytes* sand lances will affect the stability of the entire coastal ecosystem. Provide reasoning to **support** the scientists' claim.

The scientists claim that a reduction in the population size of the *Ammodytes* sand lances will affect the stability of the entire coastal ecosystem. Provide reasoning to **support** the scientists' claim.

1 point

Accept one of the following:

- There will be a negative effect on other trophic levels because the sand lance provides food for many other species.
- There will be a negative effect on other trophic levels because there will be reduced energy to transfer (to higher trophic levels).

Because sand lances are classified as a keystone species, they are very important to control the environment/ecosystem. Reducing the sand lances can decrease the secondary & tertiary consumers that prey on it, while increasing the producer population. Ultimately, the population of sand lance predators would decrease because of the lack of food & competition, making the ecosystem unstable.

