1,600 MUSSELS, 10 CAL POLY STUDENTS, 5 DAYS

The heat tolerance of the humble California mussel was the subject of a highly complex biological experiment, one of the first of its kind. A team of 10 undergraduates worked around the clock for a week at the Cal Poly Pier to collect thousands of data points on intertidal mussels at the cellular, tissue and organismal levels. This experiment is one of the first to explore what's happening at multiple levels within an organism at the same time.

With oceans warming due to climate change, mussels' reaction to heat stress could be a key factor in the resiliency of California intertidal ecosystems. These bivalves increase diversity in the intertidal zone and are an important food source for marine mammals, lobsters, crabs and humans.

Below, three members of the research team describe their role in the experiment and how it helped them discover what it means to be a scientist. The illustration on the facing page explains the experiment in more detail.

SAWYER RANDLES, *BIOLOGY SENIOR*

I worked on the ciliary activity portion of the experiment (see facing page). At each time point, we cracked open the mussel, dissected the gill and recorded video of cilia beating at different segments of the gill. The footage will be used to calculate ciliary beat frequency in response to food level, temperature and sirtuin inhibition.

Being involved with such a grand experiment and seeing different teams of scientists come together really showed me the exciting potential of integrating multiple fields of biology.

MAYA FEEZELL, *MARINE SCIENCES JUNIOR*

I gave the mussels two different concentrations of food, which is essentially algae and phytoplankton, depending on whether they were supposed to receive a low-food or high-food diet. I then recorded the mussels for 30 minutes and analyzed the videos to see how long their shells were open during that 30 minutes. This tells us whether there was a difference in feeding depending on the temperature and food concentrations.

The most exciting part of this experiment for me was being able to apply the skills I had learned in class to real-life research and seeing the results of that hard work.

JAMES OWENS, *BIOLOGY SENIOR*

I placed the gill tissue on a slide and then introduced green fluorescent beads along with some filtered seawater to help control for the environment of the gill tissue, and took 30 second recordings at 100X magnification. I will be using computer software to study particle transport by measuring the velocity of the fluorescent beads as they move across the surface of the gill.

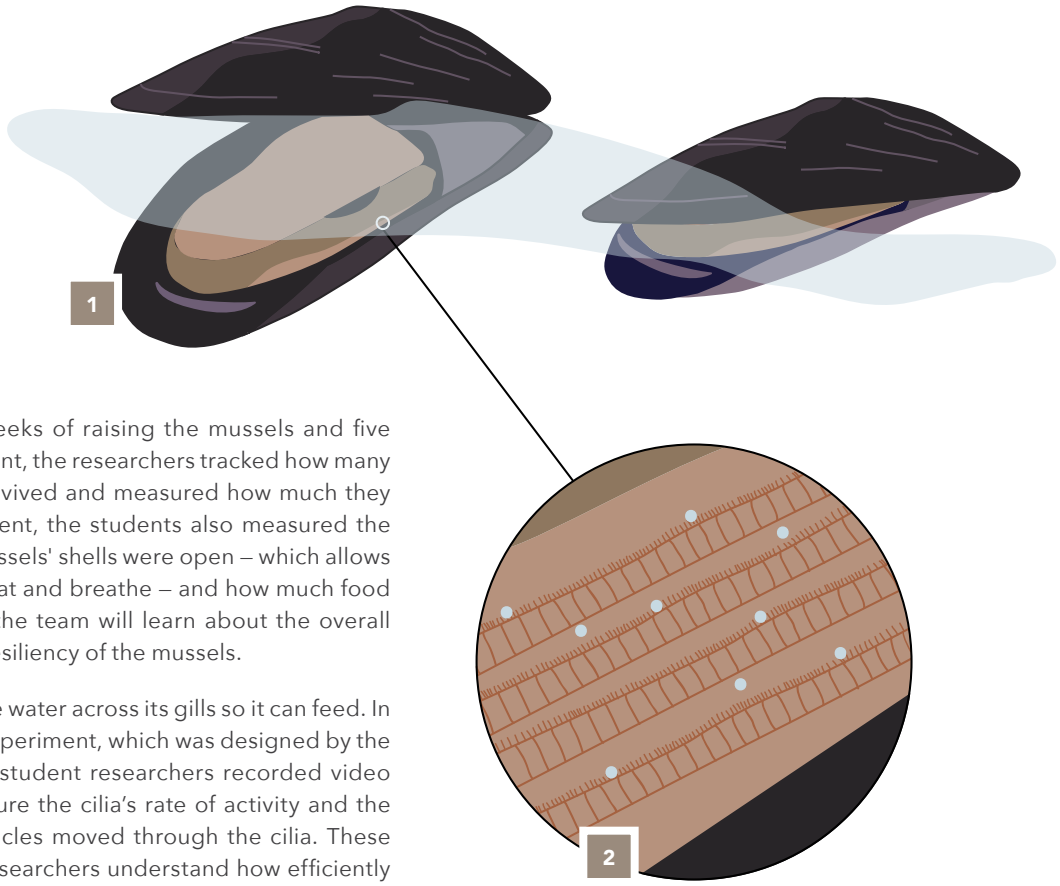
The most exciting part of this experiment was being around people who are interested in science and curious about the world at the same level as I am. It's invigorating. Working with Dr. Tomanek, Dr. May and Dr. Vasquez was probably the best part because they are so knowledgeable about physiology.

Photo Credit: *Lars Tomanek*

HOW THEY DID IT

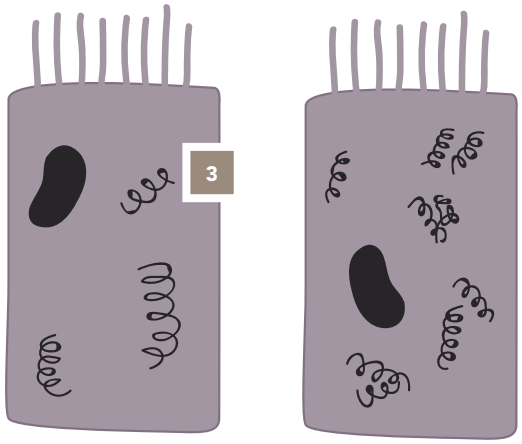
Led by biological sciences Professor Lars Tomanek, the student research team raised groups of mussels under distinct food and temperature conditions, such as a little food in warm water or a lot of food in cold water. Then they exposed all the groups to the same extremely high temperature. The results may help scientists understand how the processes in an organism's cells and tissues relate to each other and to the health of the whole organism when it experiences heat stress.

The illustrations below describe how the student-faculty research team investigated each level of the organism.



1 During the three weeks of raising the mussels and five days of the experiment, the researchers tracked how many mussels in each group survived and measured how much they grew. During the experiment, the students also measured the percentage of time the mussels' shells were open – which allows them to draw in water to eat and breathe – and how much food they ate. From this data, the team will learn about the overall health and therefore the resiliency of the mussels.

2 A mussel's cilia move water across its gills so it can feed. In this portion of the experiment, which was designed by the undergraduate team, the student researchers recorded video that they will use to measure the cilia's rate of activity and the speed at which food particles moved through the cilia. These measurements will help researchers understand how efficiently mussels eat under different conditions.



3 To investigate what happens at a cellular level, the research team is studying how genes, proteins and metabolites – small particles that are a byproduct of metabolism – change during stress and how all three are affected by sirtuins, a type of protein that regulates other proteins. Tissue samples collected at the same time as the other measurements were taken will be analyzed to determine the number and kind of proteins present in the cell when the mussels are exposed to stress.