Transcript of 2021 3MT® presentation by Michael Lim, PhD Integrative Biology candidate at the University of Guelph

Mother knows best. This saying has been passed on for generations, and for good reason. It may provide a clue to understanding how animals around the world can cope with climate change.

For decades, researchers have known that if you expose a mother to a stressful environment, she can alter the development of her offspring, so they're better adapted to living with that stress. For example, as shown on the left, mothers who grew up in times of famine had children and grandchildren with bodies more adapted to living with little food. Likewise, as shown on the right, exposure of stressors linked with climate change such as high temperatures and low dissolved oxygen levels could affect aquatic offspring changing their tolerance to those stressors.

Unfortunately, if and how this occurs is still unclear. My research aims to better understand how mothers are teaching their children about stressful environments even before they are born. To do this, I am using a fantastic model, zebra fish. Zebra fish are particularly well suited for this work as their genome is fully sequenced. This means I can target specific gene sequences used to respond to stress.

As a tropical species, zebra fish develop rapidly, hatching within a mere three days after being fertilized compared three to four weeks for mice models, or nine months for humans. Zebra fish respond to stress very similarly to other species such as through the production of heat shock proteins. Unlike the name implies, heat shock proteins are produced in response to a wide variety of stressors to help protect and repair the proteins in your cells from damage.

To test the ability for zebra fish to communicate information about stressful environments, I expose them either to daily cycling high temperatures, low dissolved oxygen levels, or combination of the two. The levels and cycles chosen represent the extremes of their natural habitat today are likely to become more frequent, and severe as climate change progresses. Following exposure, male and female zebra fish were pooled together in lab to spot. I collected the resulting eggs and adult tissues to analyze them for signs of stress transfer.

The results are clear. Stressed mothers are producing more heat shock proteins, especially when exposed to high temperatures. These levels are especially high in their ovaries and are transferred into their eggs. In other words, into their offspring.

This stress transfer may not only increase early stressor tolerance but could change many other aspects of their offspring, such as decreasing anxiety or increasing brain development, all of which I am currently investigating.

As climate change progresses, it's becoming increasingly clear that more work needs to be put forward across a wide variety of disciplines and species to better understand this phenomenon. Through this work, we may not only better understand how future generations maybe able to cope with climate change, but truly show that mothers know what's best.

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