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INSIDE JEB

Zebrafish parents pass on resistance to oil spills

Zerafish (*Danio rerio*). Photo credit: Pogrebnoj-Alexandroff [CC BY-SA 3.0 (https://creativecommons.org/licenses/by-sa/3.0)].

Evolution can be utterly ruthless. Under the wrong circumstances you and your genes could find yourselves quickly heading the way of the dodo if your genetic pack of cards is stacked against you. But Naim Bautista and Warren Burggren from the University of North Texas, USA, explain that there is another form of inheritance that could help animals adapt swiftly if conditions become challenging. Instead of directly altering the DNA sequence of genes, epigenetic inheritance changes the pattern and timing of when genes are switched off and on, allowing animals to respond rapidly to environmental change. More importantly, these gene-activating changes can be passed on to the next generation when the future would otherwise look dicey. '[But] we still have only a poor understanding of the role of transgenerational epigenetic inheritance during exposure to environmental stressors', say Bautista and Burggren.
As oil spills are among the worst environmental disasters any sea creature can face, the pair decided to find out how zebrafish – a commonly used model species – cope on a toxic crude oil-laced diet and, more importantly, whether they pass on any of the adaptations that help them to survive to the next generation.

'We prepared three different oil-spiked diets by spraying commercial flake food with various concentrations of oil-containing water', say Bautista and Burggren, who fed the oily flakes to adult zebrafish twice a day for 3 weeks. 'Despite the oil content of the flake, the zebrafish were voracious feeders, gobbling down all available food in less than 5 minutes', they recall. Then the duo checked the fish's health. Fortunately, none of the adults seemed to suffer any ill effects. So all was well with the Ma and Pop generation, but what about the kids? How would they be affected by their parents' unhealthy diet?

First, Bautista and Burggren compared the fertility of the fish parents that had been provided with a heavily polluted diet with that of fish that had been fed cleaner meals. The oil dramatically affected the fish's fertility, reducing the males' sperm count, the number of eggs produced by the females and their fertilisation rate. Things weren't looking great for the next generation, so the scientists monitored the developing youngsters, which they raised in fresh water and water with three different levels of increasing pollution. 'We expected that the larvae in oil-polluted water would not fare well, since oil and larval fish generally don't mix', the duo says. However, it seemed that the offspring of the parents that had dined on crude oil had an advantage over the youngsters whose parents had consumed an uncontaminated diet; they had much higher survival rates (30%) in the polluted conditions. However, it turned out, remarkably, that clean water did not agree with these toxic-diet descendants; their survival rate plummeted by 55%.
And when the scientists checked the youngsters' health, it seemed that their parents' diet had affected their hearts, with the offspring of the oil-fed parents having a slower heart rate than the hatchlings of parents that had consumed an oil-free diet.

So, it seems that epigenetic inheritance can be a double-edged sword, simultaneously passing on protective and harmful characteristics to the next generation. Bautista and Burggren also suspect that epigenetic inheritance could mean that the effects of many stressors are passed on down the generations.

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