Development of DNA Microarrays for Environmental Monitoring

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Daphnia magna adults in various stages of development

Key messages

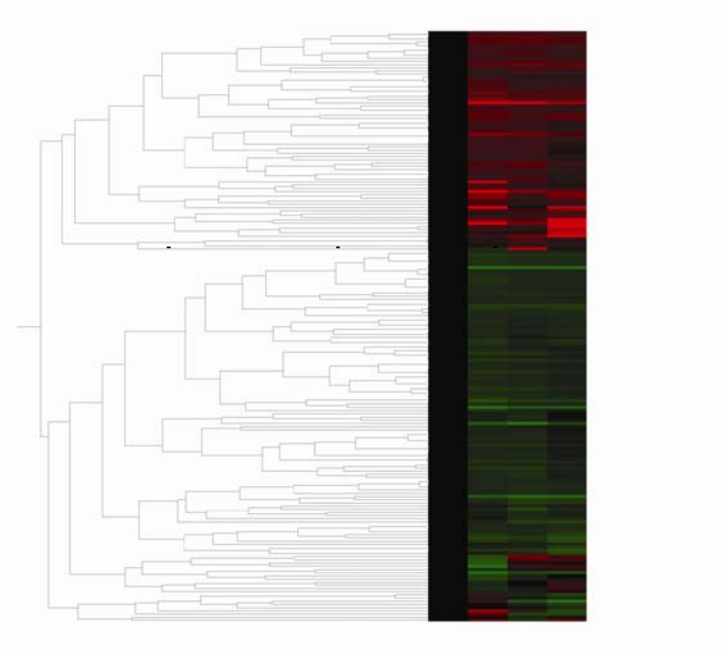
- The world's first *Daphnia magna* DNA microarray has been developed by Reading scientists.
- It simultaneously measures the responses of thousands of genes to changes in environmental stress.
- Such DNA microarrays offer a novel tool for environmental diagnosis and risk assessment for chemical discharges to aquatic environments

What are DNA microarrays

A DNA microarray is a glass slide to which a collection of DNA fragments has been attached.

Ideally, the DNA microarray has fragments of every gene in the organism's genome, so there can be 20,000 DNA fragments attached to individual locations on a small glass slide measuring only 2 × 7 cm.

Microarray gene tree of expression similarity *(Pearson's correlation)*



The tree shows clustering of similar responses. Red represents genes that are down-regulated and green represents genes that are up-regulated

Making & using DNA microarrays

- We have made a microarray containing some 3000 genes for *Daphnia magna* here at Reading.
- We are using it to investigate responses to environmental stress.
- We have already looked at the effects of five stressors, including pH and a range of chemicals commonly discharged to waters.
- *Daphnia magna* is the organism most widely used to test the effects of environmental chemicals.
- Our research is revealing how chemical discharges affect the health of aquatic animals.

How are they used?

The microarray is used to measure the expression of genes in test organisms.

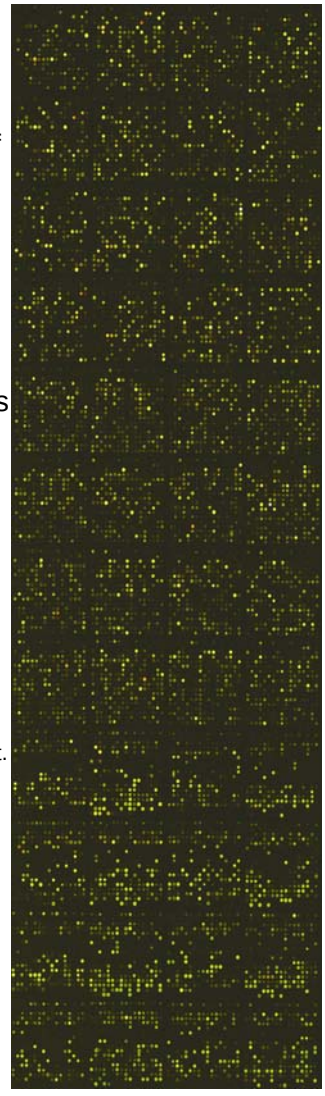
Genes control the production of proteins by generating copies of themselves, called RNA molecules, which move into the cell and make proteins using cellular equipment.

At the time of measurement, some genes will be turned on to make RNA copies of themselves and manufacture proteins and other genes will be turned off.

The microarray measures how many of these RNA molecules have bonded to their corresponding genes (DNA fragments) on the microarray.

- An experiment is carried out with two treatments, where one set of Daphnia is exposed to a stressor and the other is not.
- Following RNA extraction, the RNA molecules are made visible by the attachment of a fluorescent dye.
- One treatment is labelled with a red dye and the other with a green dye.
- When the labelled RNA attaches to their corresponding gene on the chip, a coloured dot is seen.
- Therefore if a gene is expressed more in the green treatment, the dot appears to be more green.

A two colour DNA microarray



Find out more…

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