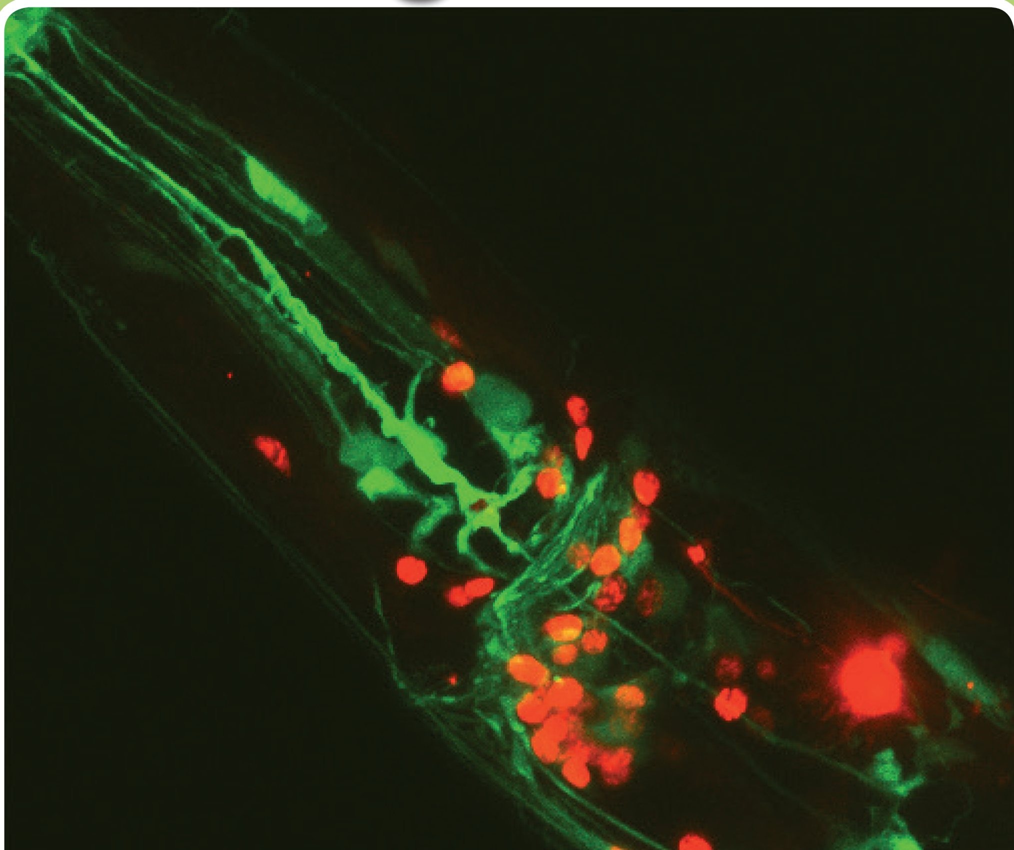
MRC Laboratory of Molecular Biology

Name:

Worms are Cleverer than you think!



Credit: Yee Lian Chew, MRC LMB

Collect a sticker for each activity

Meet our worms!

Using senses to find food

What happens when worms get old?

Safety

*Our worms, and the bacteria they grow on, are harmless. But you should always **WASH YOUR HANDS** when you finish doing experiments.*

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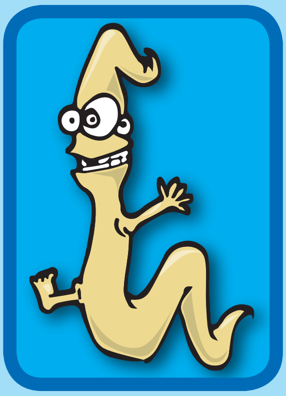
Meet our worms!



Our worms have a long name:
***Caenorhabditis elegans*.**
They can normally be found on compost heaps, where they eat bacteria and fungi. They are 1mm long, so we need a microscope to see them.

- **Look at the worms labelled "wild type" first. These are normal worms.**
- **How do they move?**
- **Can you see different sizes (adults and larvae), and eggs?**

We grow them on a sort of jelly, covered with a layer of bacteria for them to eat.

Photo credits: John Sulston, LMB

We use worms to help us understand how our own bodies work

Worms live for about 17 days, and have about 300 babies!

The detail

Caenorhabditis elegans is a free-living nematode worm. Despite its simplicity, many of its genes are very similar to ours, so many cellular processes are conserved. As a result, it is a powerful model organism for understanding our own bodies, and what goes wrong in human diseases.

Its small size, short lifetime, and abundant offspring make it easy (and cheap) to grow in the lab. Thanks to 50 years of research, we have a wide array tools at our disposal. For example, we can introduce new DNA (i.e. make transgenic animals), to express fluorescent proteins in our cells of interest, or we can silence genes to find out what they do.

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Match the mutant worms to their names

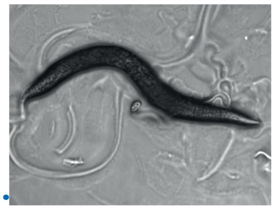
- **Now look at the mutants. These each have a mistake (mutation) in a gene, making them look different.**
- **See if you can match the mutants to their names.**

....

***rol-6*, roller**
These worms roll in circles while they crawl.

....

***unc-7*, uncoordinated**
These worms cannot move normally.



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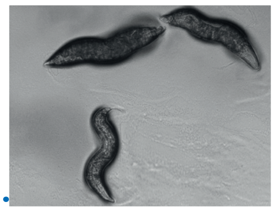
***egl-1*, egg laying defective**
These have problems laying eggs, so the eggs get stuck.



....

***dpy-2*, dumpy**
These worms are shorter and fatter than normal.

....

***lon-2*, long**
These worms are longer and thinner than normal.

Photo credits: Kristin Webster, LMB

The detail

Worms with mutations in their genes (genotype) that have visible effects on the worms (phenotype) are often the first clue that specific genes are important in particular cellular process. Studying mutations in *C. elegans* has helped scientists better understand human biology and disease. For example, the elucidation of the role of *egl-1* in cancer signalling pathways won a Nobel prize! The phenotypes that we study are often much more subtle than these, for example, defects in sensing a specific type of touch, taste or odour, or learning less well.

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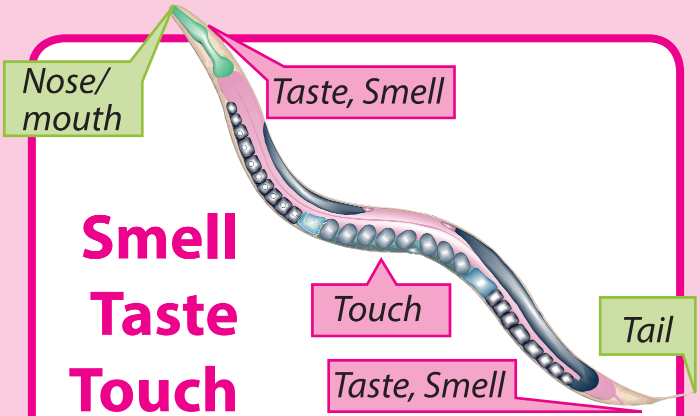
Using senses to find food

All animals use senses. We use them to react to our surroundings, to find food and avoid danger.

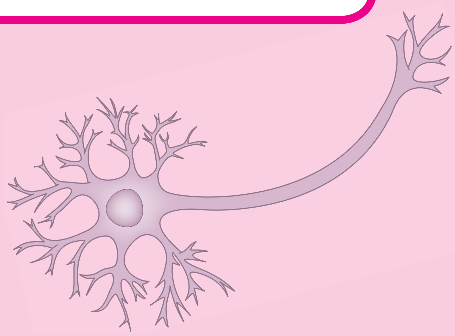
Mammals like us have 5 senses. **Our worms have 3.**

Sight
Hearing
Smell
Taste
Touch



Smell
Taste
Touch

To sense things, we need neurons



Neurons are special cells in our body that receive and send messages.

Sensory neurons sense the world around us.

Interneurons act as connectors, passing on the message.

Motor neurons tell muscles how to move, controlling how we react to sensory information.

Worm neurons are amazingly similar to ours, so they help us understand how our neurons work. Worms only have 302 neurons, while we have 100 billion!

The detail

When you compare worm and human genes, they are remarkably similar, so studying a worm gene (and the protein it encodes) helps us to understand its human homologue.

For example, we are interested in human deafness genes. Some of these are needed for sensing touch in worms. By studying the cellular and molecular details of their role in touch, we can understand more about their role in deafness (which is a form of touch sensation) in humans.

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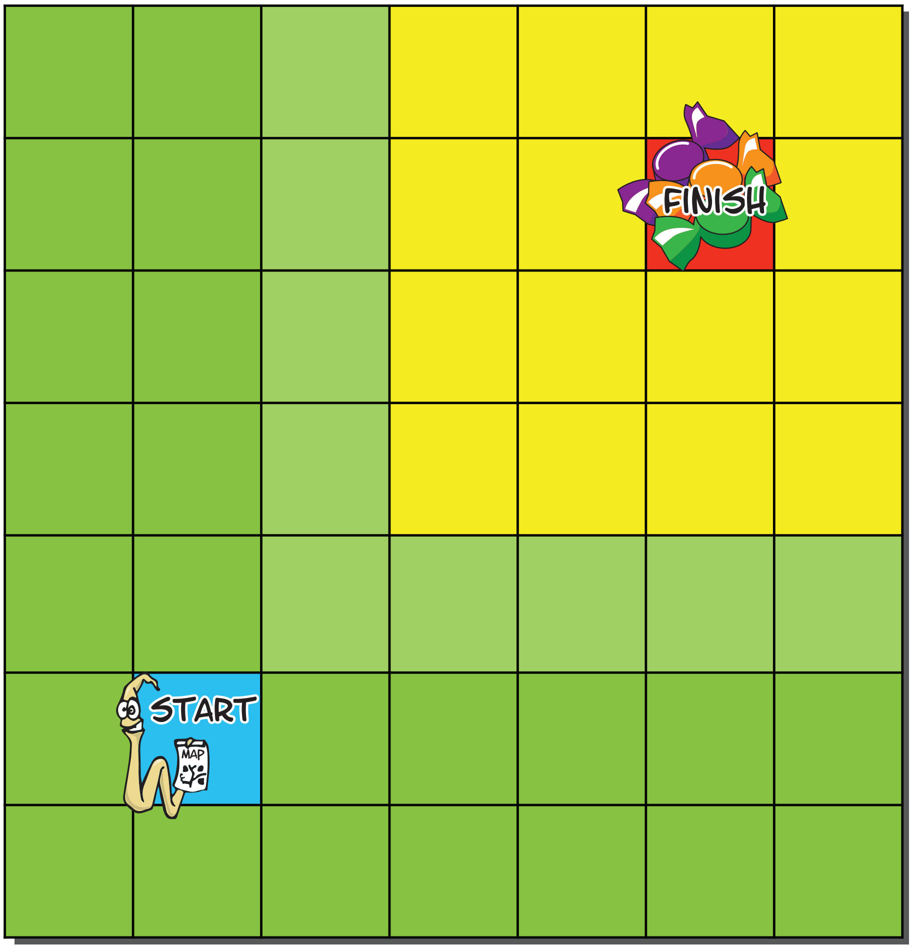
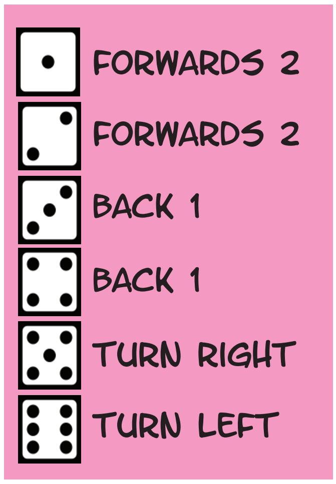
Using senses to find food - the game!

Imagine you are a hungry worm. You need to find food, without using too much energy. What if you couldn't use your senses? You would need to use random search.





Roll to decide how to move

- Keep rolling until you reach the yellow zone.
- Now you can use your **senses** (you can smell the sweets).
  Each turn, **you decide** how to move without rolling the die *(forwards, backwards, turn right, turn left)*.

Can you reach the sweets in less than 30 turns?

- Now imagine your sense of smell is better. You can smell the sweets in the light green zone.

Does this help you to find the sweets quicker?

You can play this game at home. You'll need counters with a "head" and "tail" (so you know which way they are facing).

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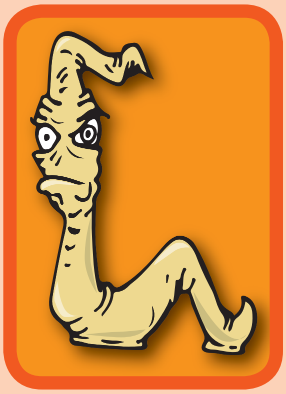
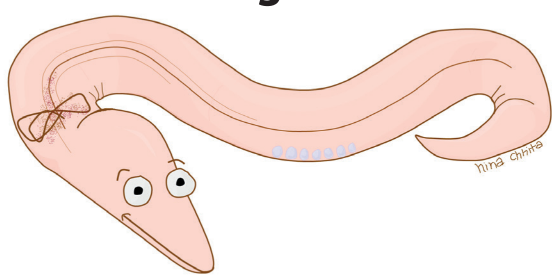
What happens when worms get old?



Just like people, worms change as they get older. But worms live for a much shorter time than we do – only 17 days!

Young worm



Old worm

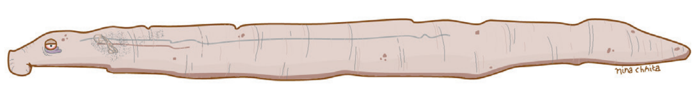


Illustration credits: Jennina Chhita **www.scienceunhinged.com**

- Look at the video of the **young** worms, then the video of the **old** worms. What differences can you see?

  Do the old worms move differently?

  Are they a different size or shape?

- Now look at the third video. **What do you notice about these old worms?**

We can change genes in the worm to make them age faster or slower. Some of these gene changes can make animals live for a very long time. A worm with a change in a gene called *daf-2* can live more than twice as long as wild type.

That's like a human living to over 170 years old!!!

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Disease experiment

When people get old, they are more likely to get ill. Some of these illnesses affect our brains. We can make worms that get sick when they're old, so we can study why it happens, and how to help people stay healthy as they get older.

Our cells are built of proteins, and some of these proteins can cause illness as we get older. We can make these disease proteins green so we can study them in our worms! Can you see them in the video?

What is different about the green protein in young and old worms? Can you draw it?

Young

Old

Watch the third video. **Does the *daf-2* mutant gene make the sick worms move differently?**

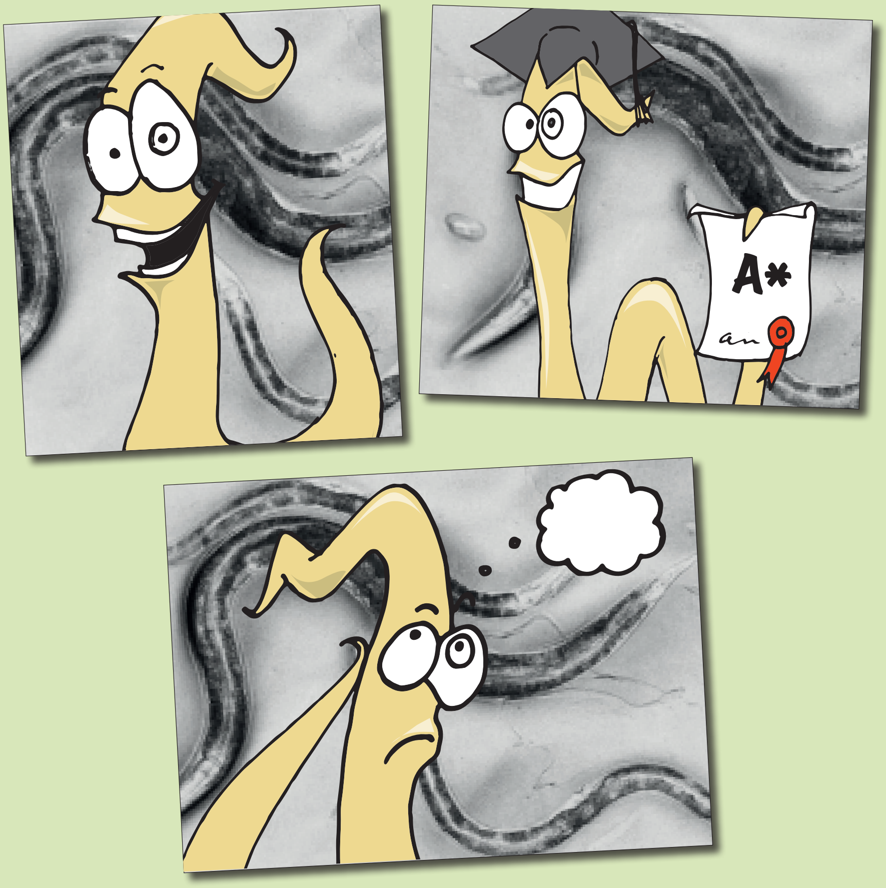
The detail

Worm cells change in similar ways to human cells as they get older. This means that we can put genes and proteins that cause human age-associated illnesses into worms, including those that cause Alzheimer's, Huntington's and Parkinson's diseases, and study why they lead to disease as animals get older. We can also genetically manipulate worms so that they become less susceptible to illness, and then investigate the reasons why. For example, studies of disease proteins in worms have shown that changing the action of insulin in the body, through mutations in the worm's *daf-2* gene, can influence how we age, and how likely we are to develop diseases of ageing.

If you enjoyed our activity, share your thoughts and pictures with us on:

@MRC_LMB **(MRC.LMB)**

using #LMBworms



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