



Aging and the Human Body

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Everybody will experience aging



... but it is poorly understood

Left: https://pixabay.com/static/uploads/photo/2012/02/23/10/40/concentration-16032_960_720.jpg

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Outline

- I. How and why scientists study aging
- II. How what we've learned applies to humans

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Studying aging will help people



- There are lots of elderly people
 - 2 billion people over age 60 by 2050, according to the UN
- Aging is expensive
 - Alzheimer's disease patients cost Medicare 60% more than unaffected people
- Aging is fully prevalent, penetrant and incurable

Top: <https://upload.wikimedia.org/wikipedia/commons/e/ee/Habibaadansalat.jpg> By Trocaire (Flickr) [CC BY 2.0 (<http://creativecommons.org/licenses/by/2.0>)], via Wikimedia Commons

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Studying aging is cool



- Fundamental and universal?
- Links to metabolism, repair and maintenance, inflammation

Human aging takes many forms



- Frailty
- Diminished mental capacity
- Wrinkles and cosmetic changes
- More things break
- Increased risk of death with time

(Almost) everything ages

Yes

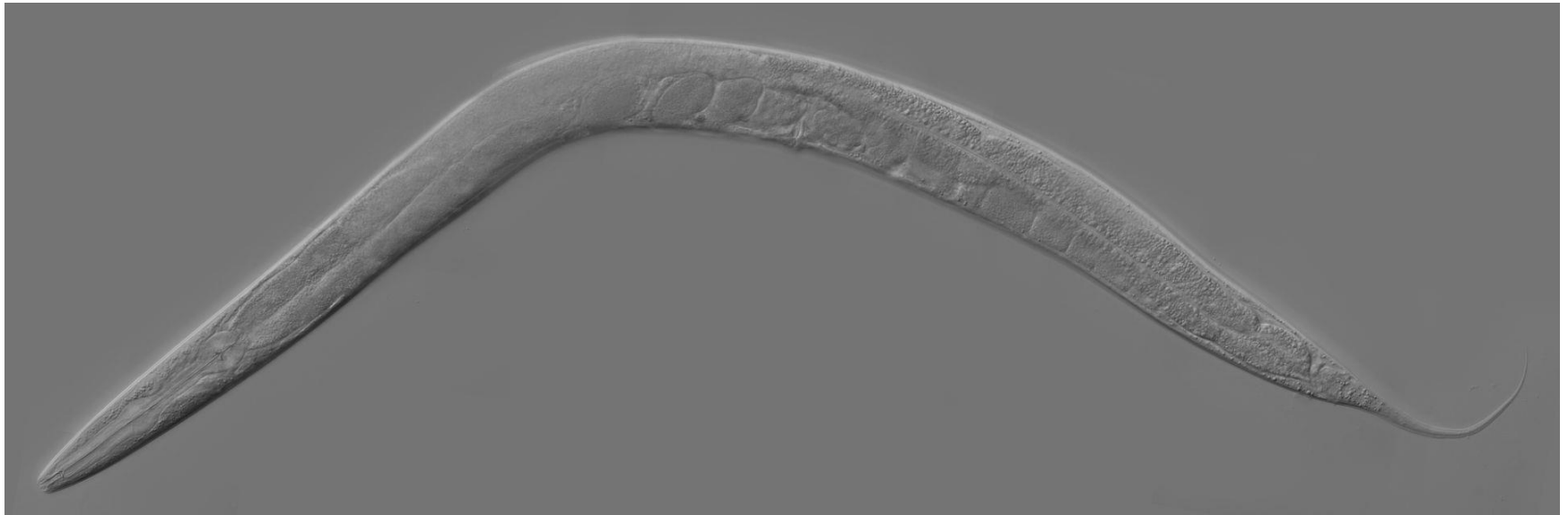
- Humans
- Mice
- Worms & flies

Maybe not

- Planaria
- Turtles
- Bacteria

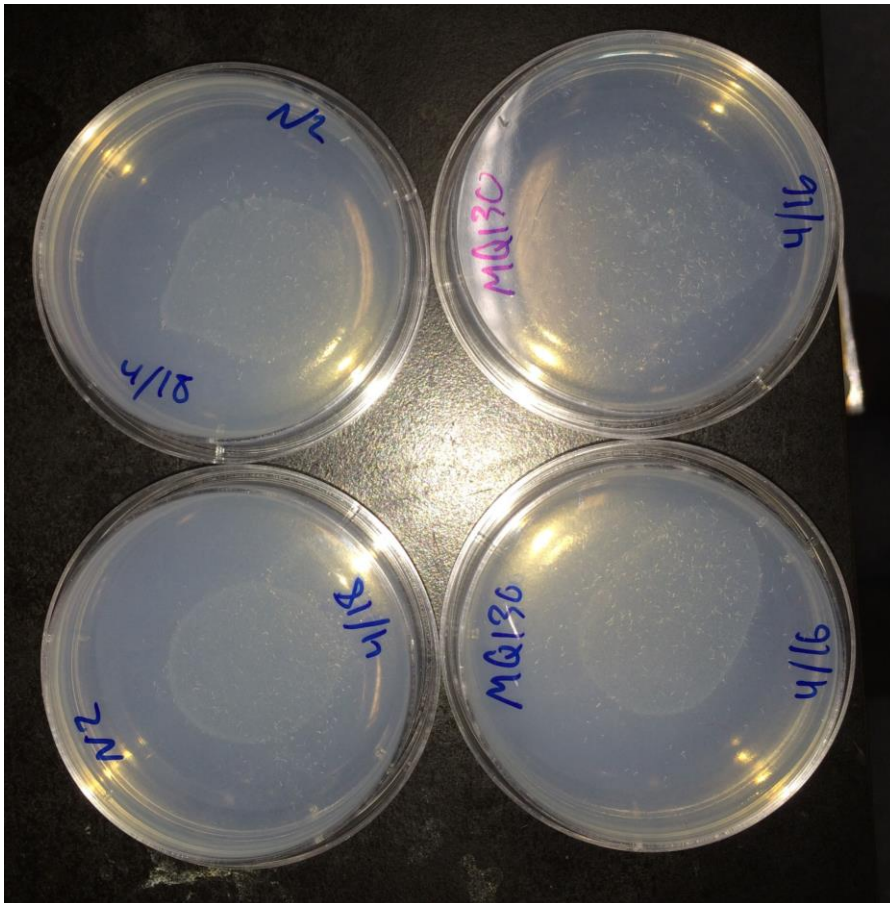


We study aging using model organisms



- Short lifespan
- Simpler than humans

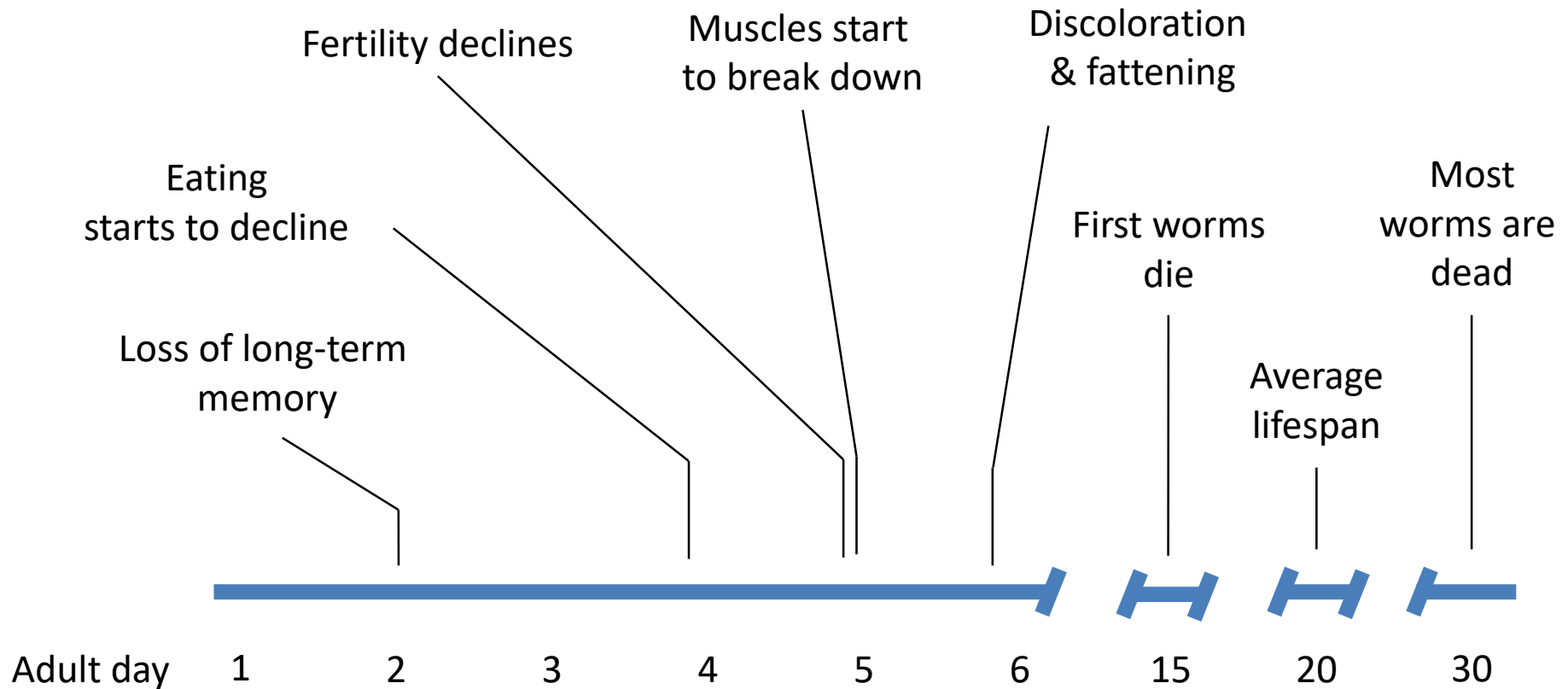
We keep worms on plates and watch them crawl with a microscope



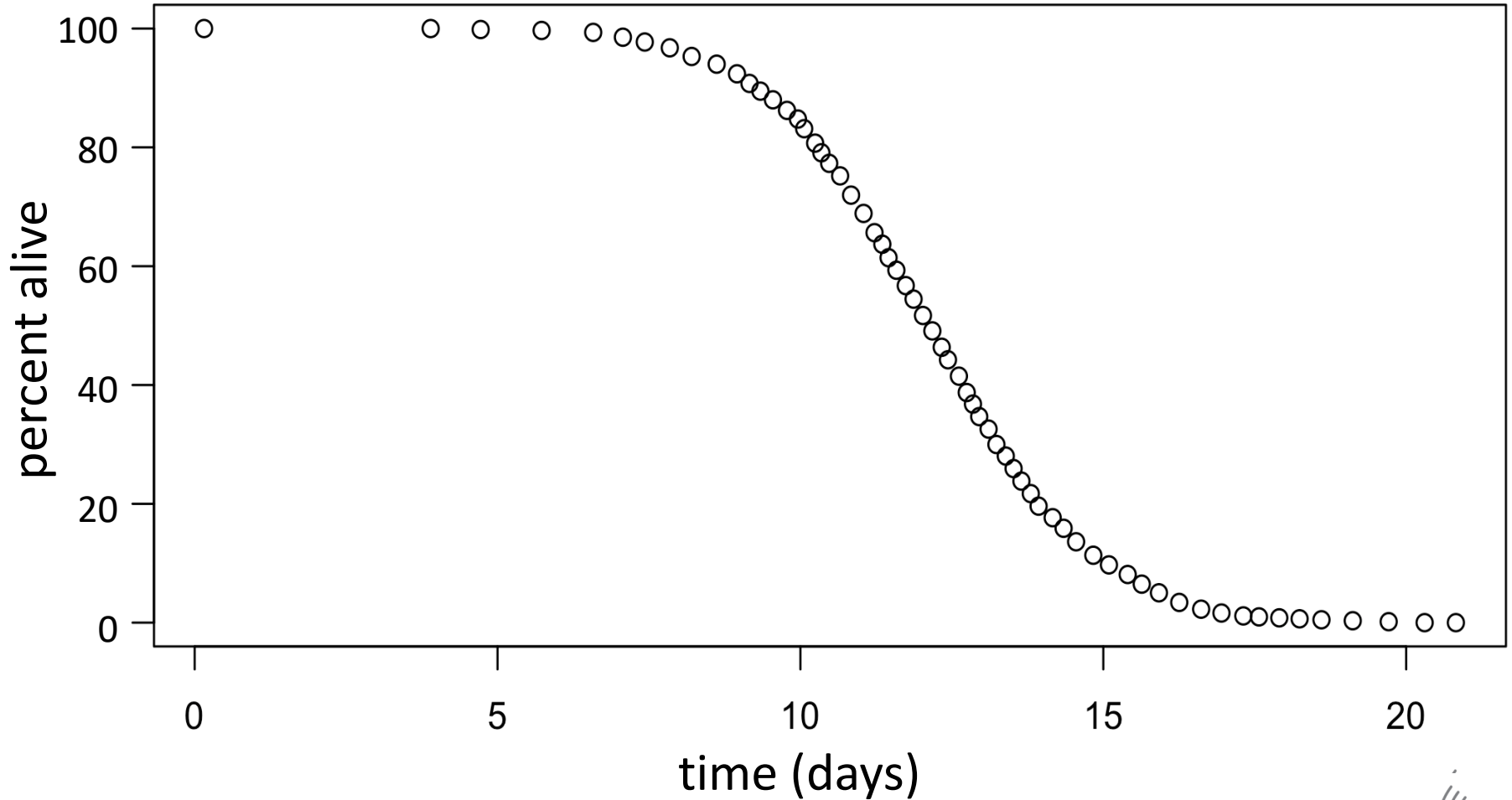
Worms look like this

They live on these plates
& eat bacteria

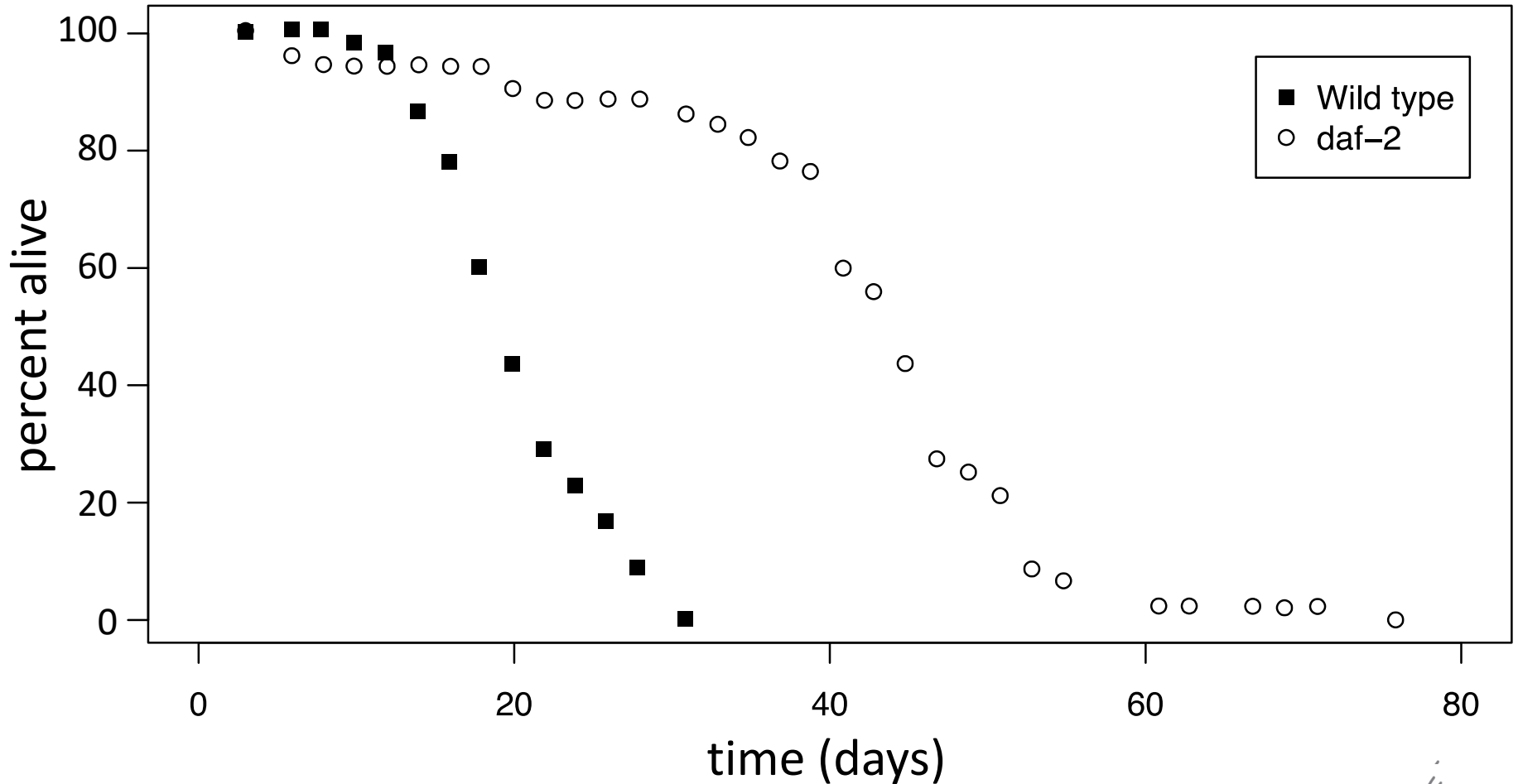
Worms get old, too



Scientists commonly measure lifespan curves

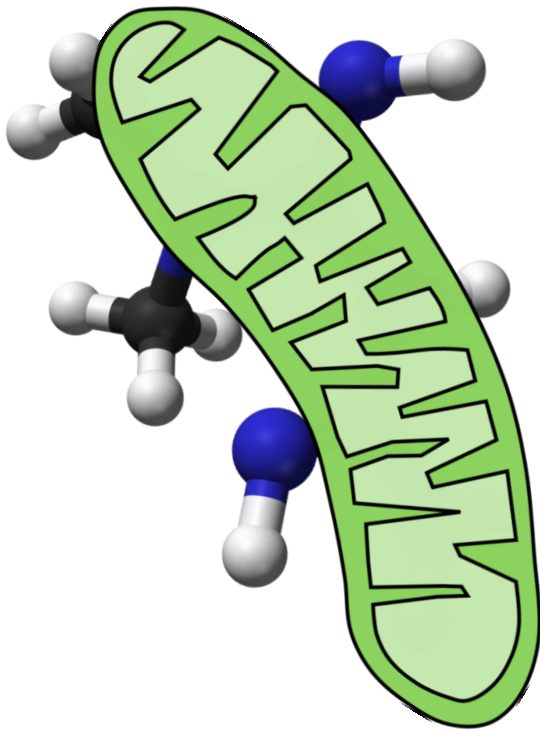


Some genetic changes prolong life (in worms)



Data digitized from Kenyon, C., Chang, J., Gensch, E., Rudner, a & Tabtiang, R. A *C. elegans* mutant that lives twice as long as wild type. *Nature* **366**, 461–464 (1993).

There are many ways to extend a worm's lifespan



- Energy and metabolism
 - Insulin
 - Mitochondria (the cell's "power plant")
 - Calorie restriction
- Pharmaceutical drugs such as metformin

A close-up photograph of a man's face, heavily covered in blood and gore. His eyes are wide and staring, and his mouth is open, showing teeth and more blood. The background is blurred, showing a woman's face with red hair. The overall tone is dark and horror-themed.

Long-lived ≠ healthy

**(We don't want to be like
this sad zombie)**

Quick recap

- Most animals age
- Scientists study aging in model organisms
- Some things can drastically increase the lifespan of these model organisms

Questions?



Outline

I. How and why scientists study aging

II. How what we've learned applies to humans

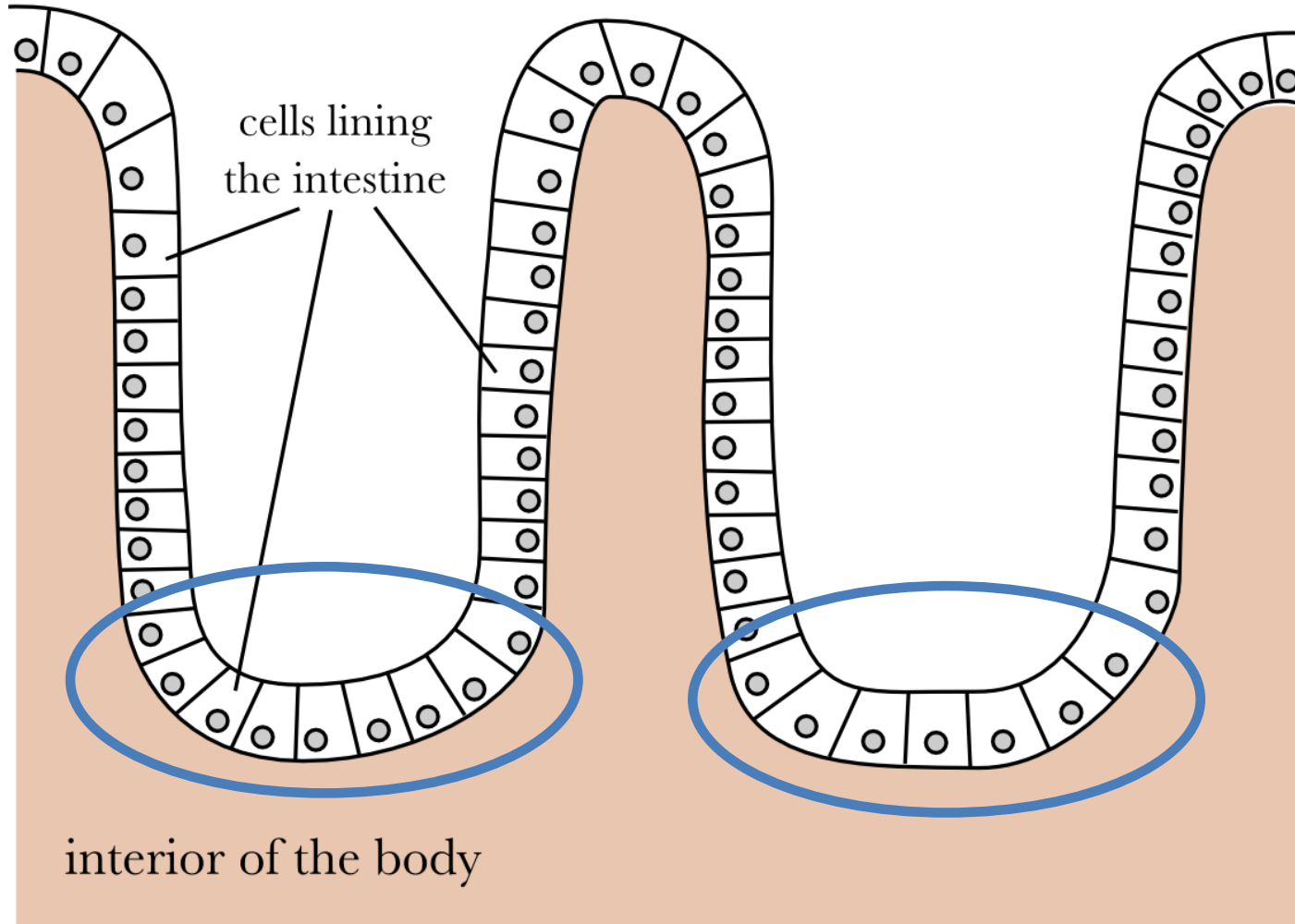
Aging humans have advantages – and challenges – that worms don't have



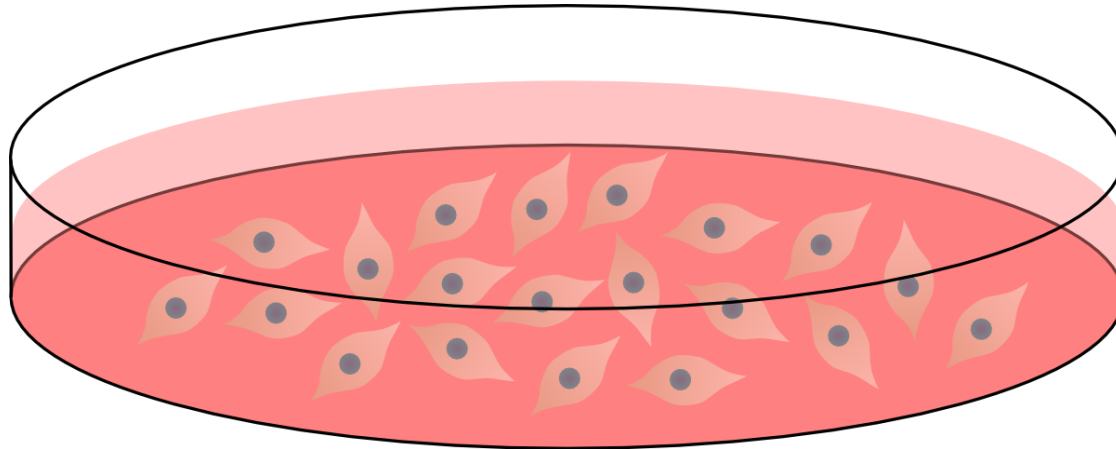
- Every *C. elegans* worm has 959 cells
- Humans have about 30 trillion
- Humans replace cells and can devote resources to maintenance

Cells are replaced in the human intestine all the time

interior of the intestine

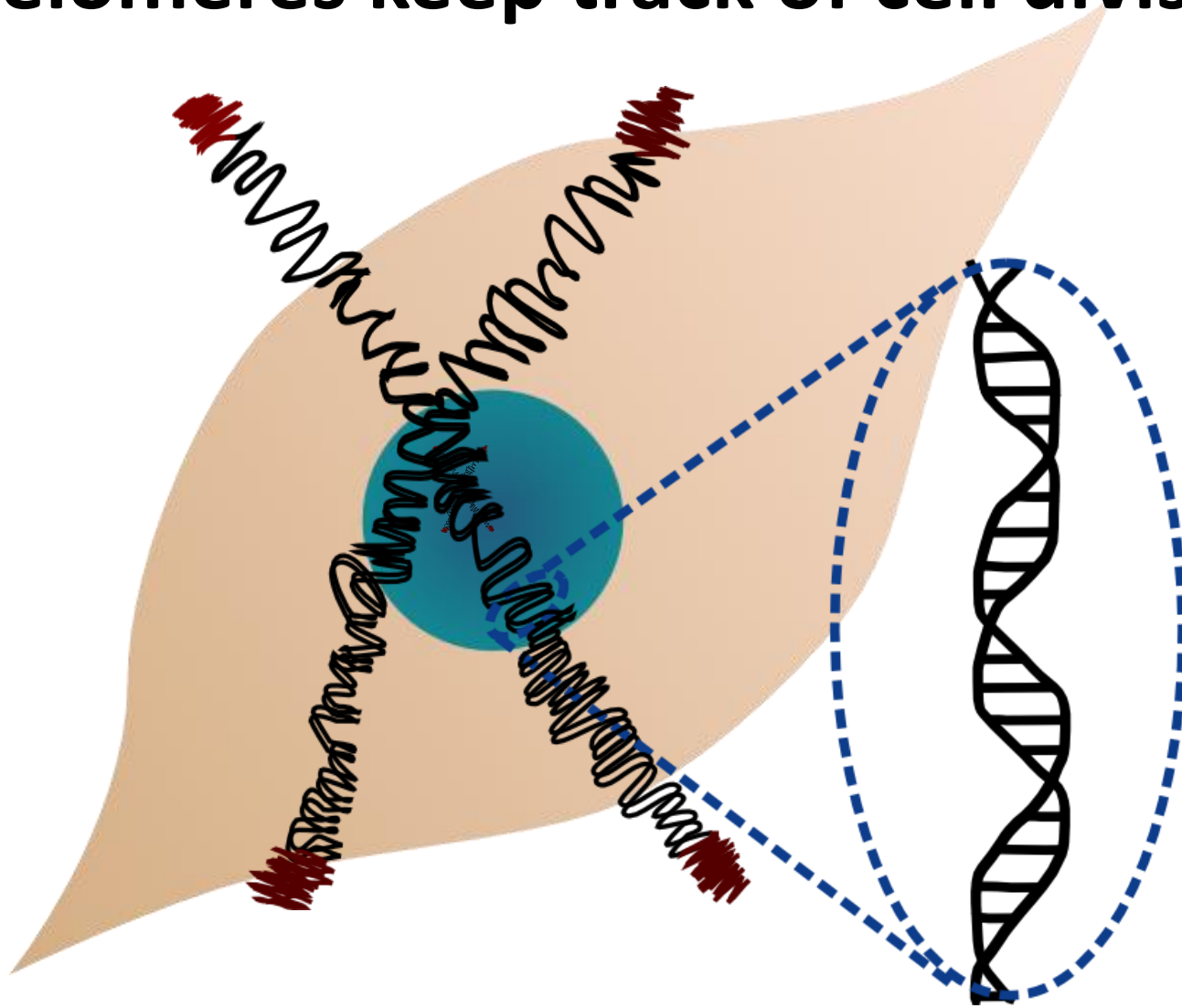


Cells don't divide forever

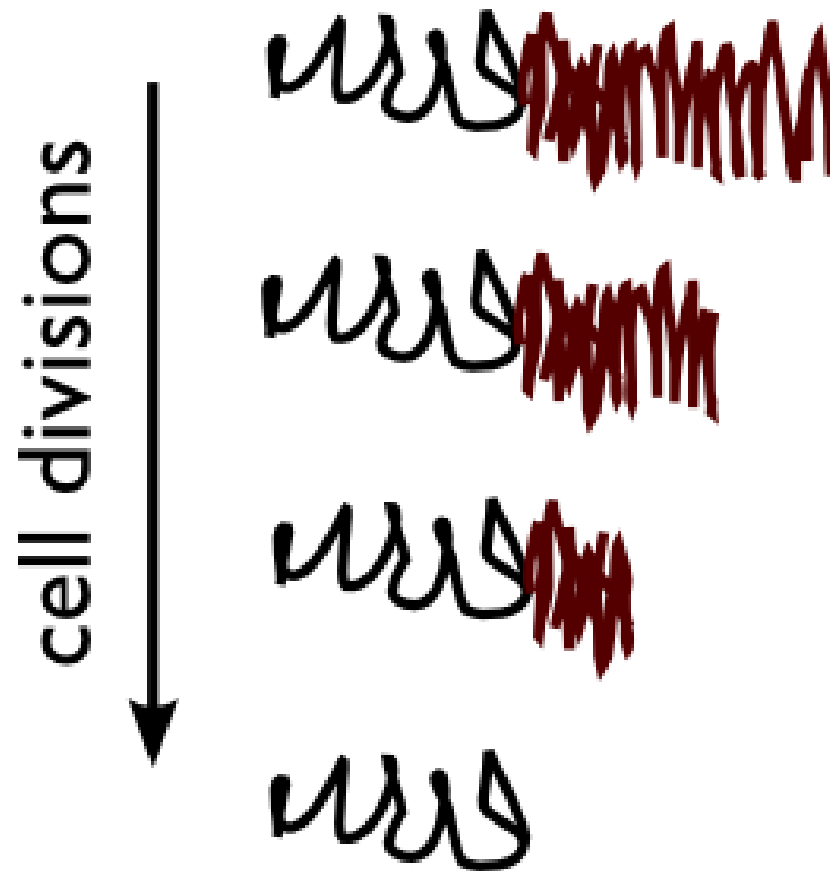


- Scientists can grow some types of cells in dishes
- Early 1960s, Leonard Hayflick noticed they weren't immortal
- Stopped dividing – “senescence”

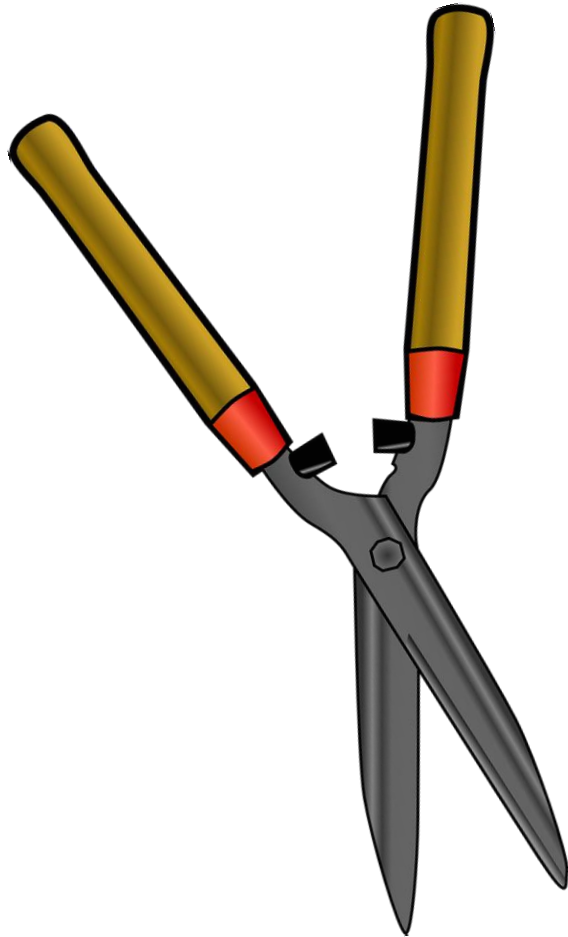
Telomeres keep track of cell divisions



Telomeres shorten with each cell division

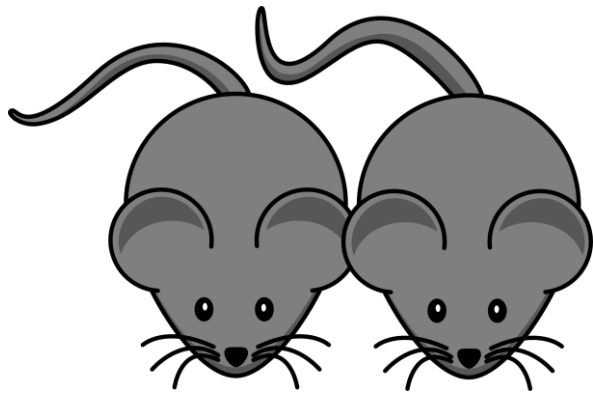


Should we remove senescent cells?



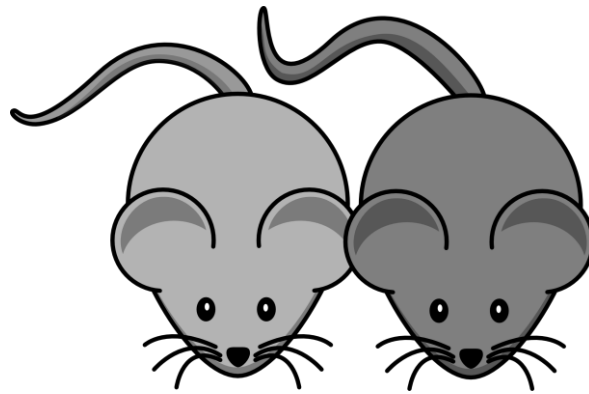
- Can't just cut the brakes
- Eliminating senescent cells helps in mice
- More work needs to be done

Some things help youthfulness in multiple tissues



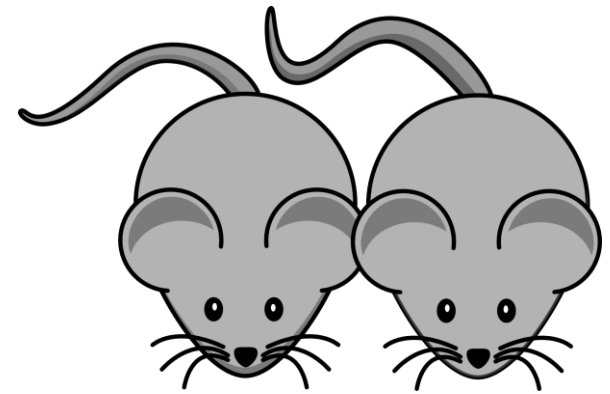
old

old



young

old



young

young

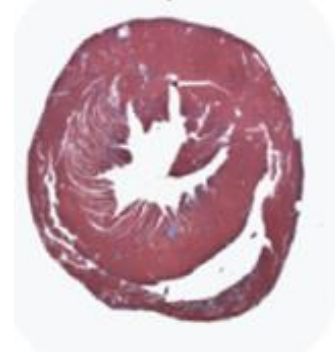
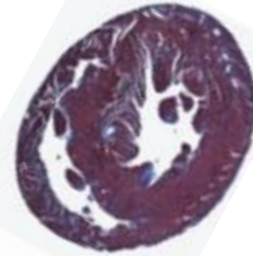
The effects of young blood can be drastic

Young (2 months)

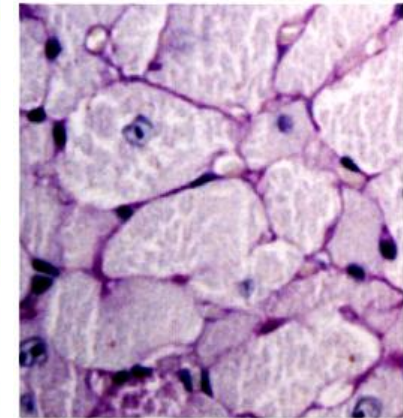
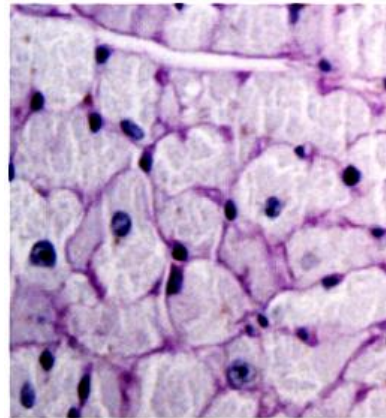
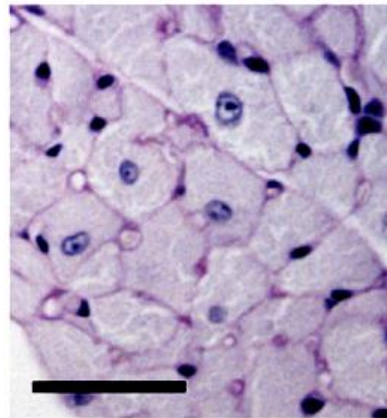
“Rejuvenated”

Old (23 months)

Heart cross section



Heart cells



- Scientists are still studying what is causing these effects

Clinical trials are underway



- Alkahest is giving blood from young donors to patients with Alzheimer's disease
- It's a long shot
- The results are expected later this month

Scientists are making progress, but there's still lots of work to be done!

- We know of interventions that help worms and mice – people, not so much
- We still have much to learn about why and how aging occurs
- A handful of clinical trials are underway
- Lifespan is not the same as healthy life
- A healthy diet and exercise are the best bet

Thank you!

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