4D CELL Biology Laboratory

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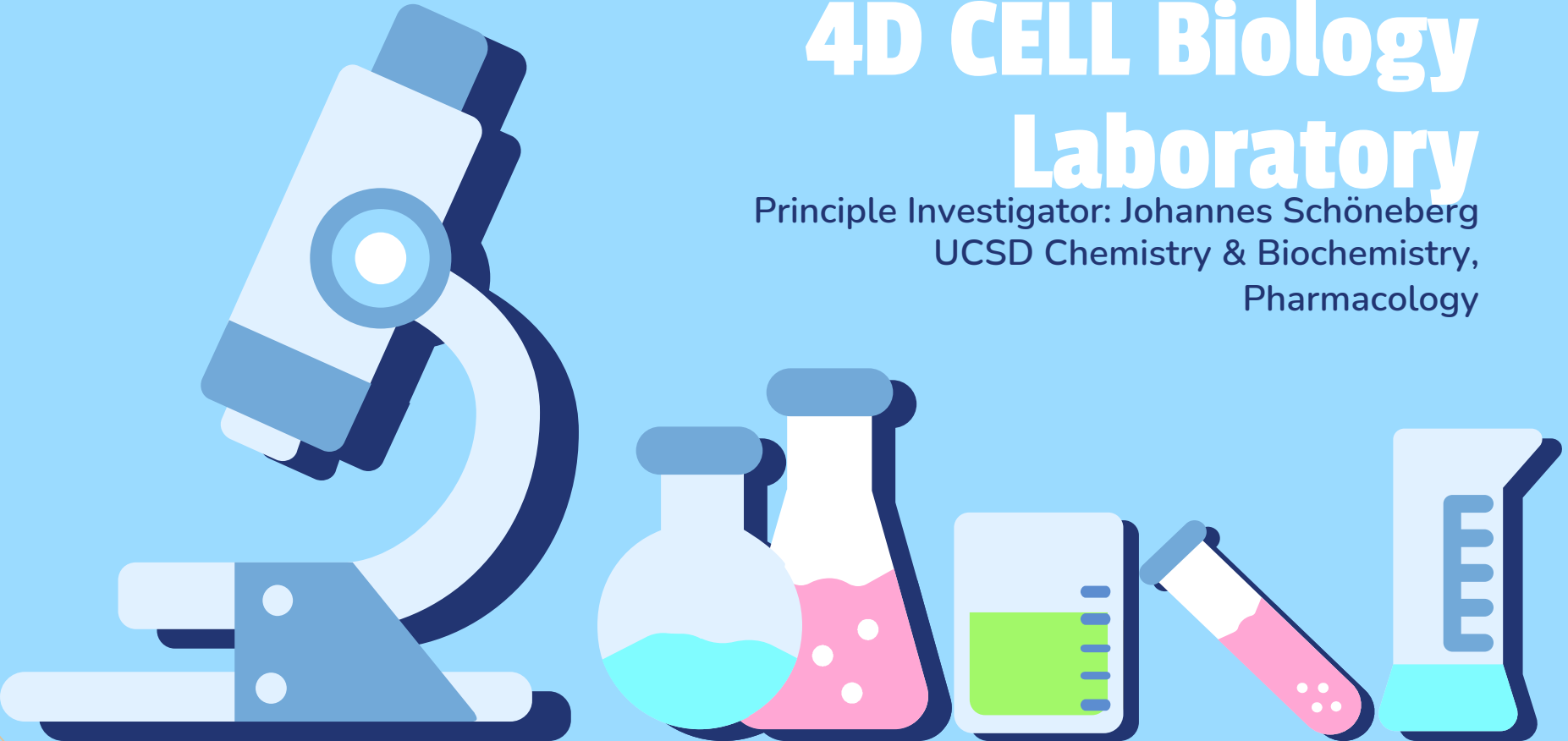
UCSD Chemistry & Biochemistry, Pharmacology



REC

This meeting is being recorded!

Recordings will only be available to members of the Big Sister STEM organization.

Please do not:

Say
Do
Or Type

What you don't want others to:

See
Hear
Or Read

Who are we?

Gillian

When I was a kid I wanted to be...

A princess scientist cheerleader

Today I am...

A bioengineer (fancy scientist)

IN SCHOOL

Math
Biology
Engineering
Crafts

IN THE LAB

Grow organoids
Create sample chips
Understand mitochondria

AFTER WORK

Dancing
Hiking/Skiing
Legos
Mystery movies

Anna

When I was a kid I wanted to be...

ballerina, chemist, and actress

Today I am...

Cognitive and Machine Learning Research Scientist

IN SCHOOL

Geometry
Literature

IN THE LAB

Process Data from the Microscope
Make pictures look sharp and clean

AFTER WORK

Dancing
Reading
Hiking
Fashion and Art

Pham

When I was a kid I wanted to be...

singer and teacher

Today I am...

Biologist studying cancer

IN SCHOOL

Biology
Chemistry
Music

IN THE LAB

Grow cell lines
Learn microscopy
Understand how drugs preventing cancer works

AFTER WORK

Hiking
Baking
Watching movies

Ashley

When I was a kid I wanted to be...

vet / teacher / singer / philosopher / food critic (and more ;))

Today I am...

Biochemist in the making!

IN SCHOOL

Science(Chemistry! and Biochem!)
Computer Science
Psychology
Arts/Music/Design/ Languages

IN THE LAB

Learn about and use CRISPR and fluorescence!

AFTER WORK

Reading! Eating!
Watching shows!
Exploring!
Solving puzzles!
Snuggling my dog!

Soha Khan

When I was a kid I wanted to be...

Many things, including a firefighter,doctor, president, etc...

Today I am...

A 4th year Biochemistry Major studying to maybe go into Medicine!

IN SCHOOL

I love all subjects! Mainly STEM, History, Political Science

IN THE LAB

I am a research assistant helping design plasmid sequences and tagging cells.

AFTER WORK

Archery
Poetry
Sightseeing
Netflix

McKenna

When I was a kid I wanted to be...

Artist/ Chef/ Doctor/ Scientist/ and so many more

Today I am... Future Chemist, Researcher and Lab Manager!

IN SCHOOL

Art
Science
Math
English

IN THE LAB

Lab Management
Fluorescent Tagging (CRISPR)
Grow Organoids
Microscopy

AFTER WORK

Sailing
Arts and Crafts
Horseback Riding
Reading

What do we do?

Use an advanced microscope to understand how changes in mitochondria lead to disease

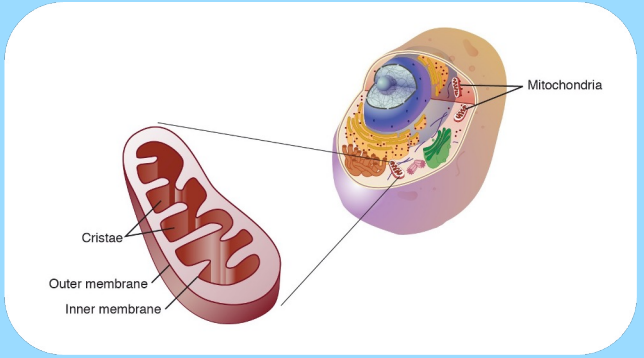
Use an advanced microscope to understand how changes in mitochondria lead to disease

What is mitochondria?

Mitochondria

- Creates energy for the cell to function
- Found all over the cell
- Always moving around

- Mitochondrion (beans) -> mitochondria networks (noodles)
- Combine and separate depending on what happens in the cell

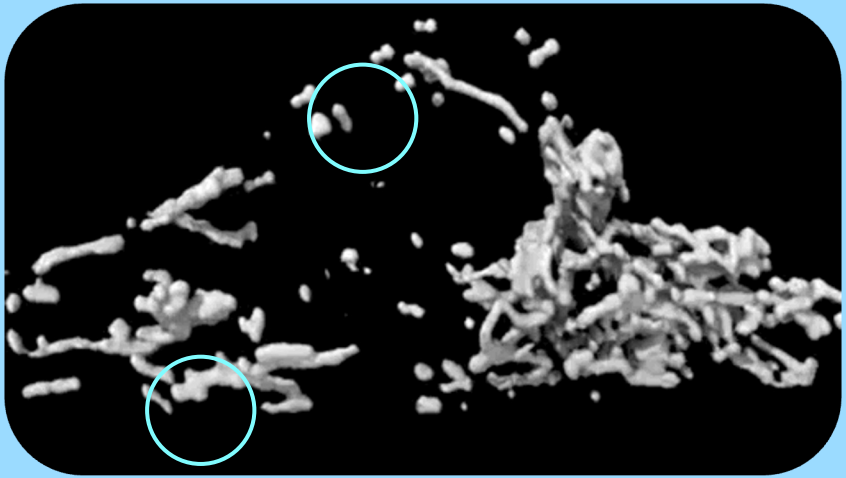


genome.gov


The Guardian


NPR

Mitochondria



Mitochondria move around the cell to provide energy for different processes
Fusion: Two pieces come together
Fission: Two pieces separate
Do you see any fusion or fission?

Use an advanced microscope to understand how changes in mitochondria lead to disease

What could go wrong?

If mitochondria don't work

Without energy, cells cannot do what they need to do

Changes in the mitochondria lead to many diseases

Brain

Trouble with remembering, moving around

Eye

Losing sight

Heart

Hard for the heart to pump blood around the body

Lung

Trouble with breathing, swallowing

Intestine

Very painful, hard to eat and move around

Muscles

Weak muscles, hard to exercise

Bones

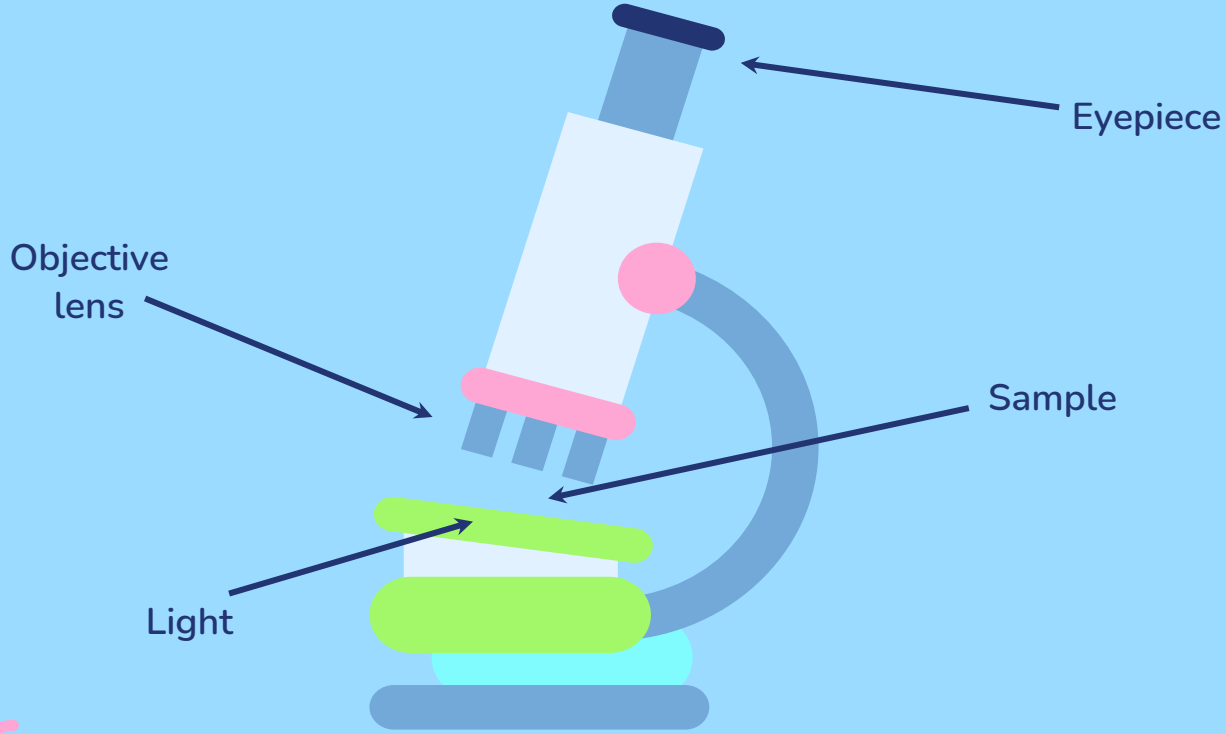
Weak bones might break easier

Use an advanced microscope to understand how changes in mitochondria lead to disease

What is a microscope?

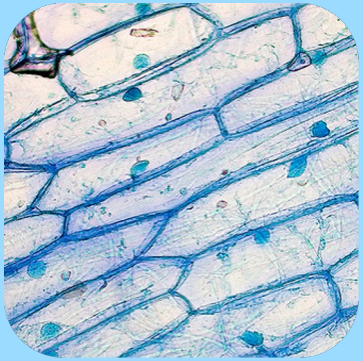
What does it do?

What is a microscope?

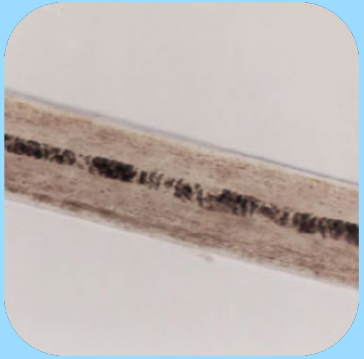


What does a microscope do?

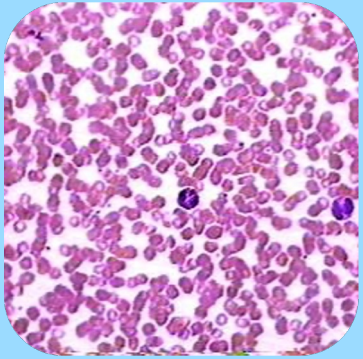
Leaf



Onion



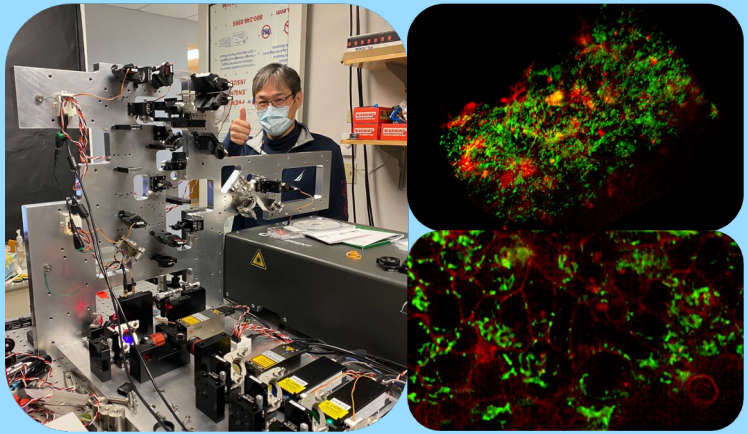
Hair



Blood

Advanced microscope

Basic Light Microscope



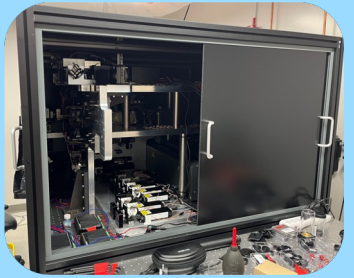
Our Advanced Microscope

Adaptive optics lattice light-sheet microscope

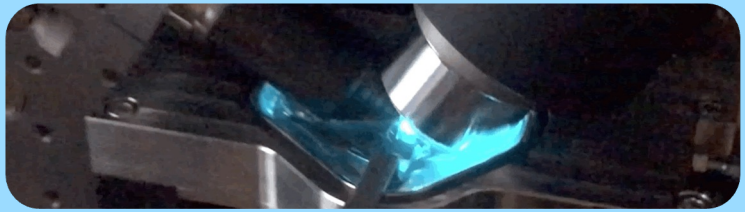
Our microscope is much bigger... and can do much more!

We can look at

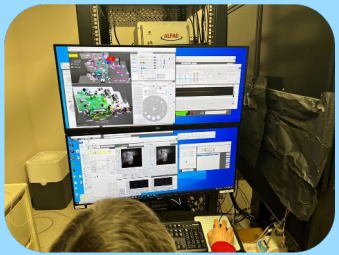
- Stuff in 3D
- Live cells
- Tiny parts of the cell moving



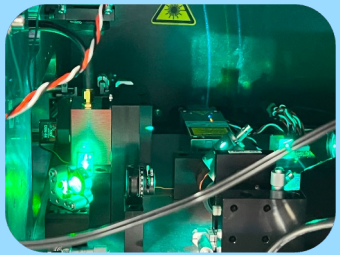
Objective lens



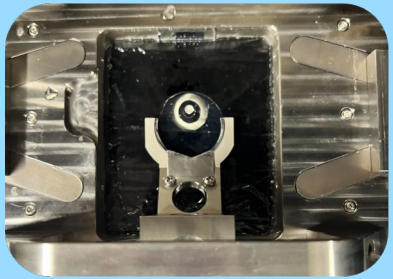
Eyepiece



Light

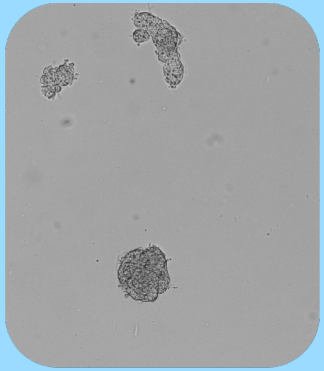


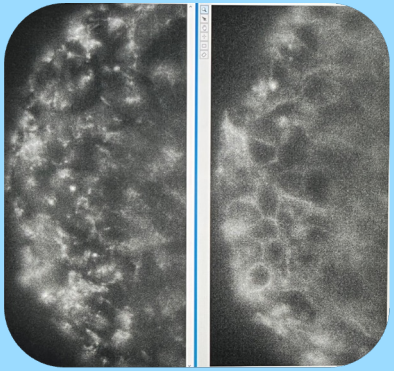
Sample



What does our microscope do?

Mitochondria Cell outline

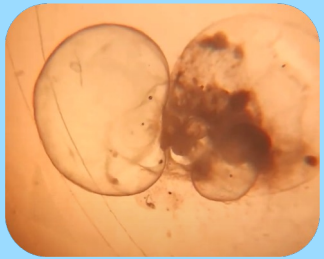


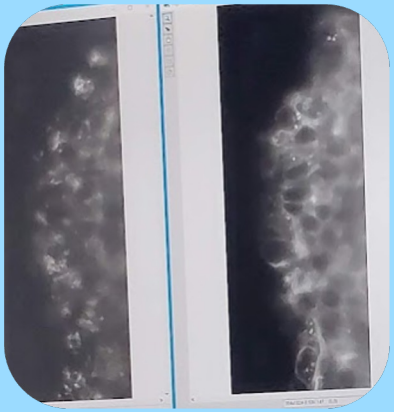


Intestines

What's the difference???

We don't know yet



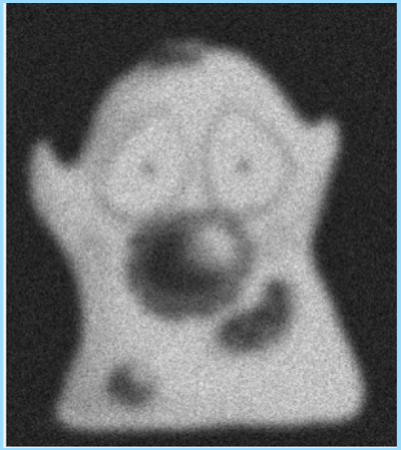


Brain

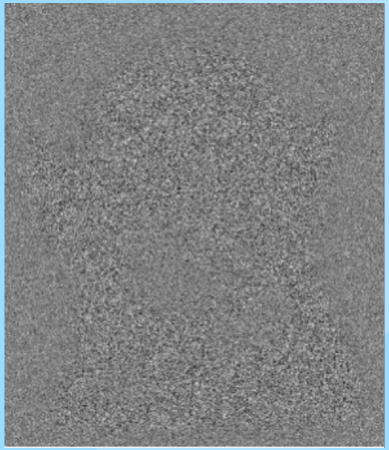
Use an advanced microscope to understand how changes in mitochondria lead to disease

How can we understand the pictures from the microscope?

Noisy pictures



Noisy image



Noise

(Noisy image) - (Noise)
= Clear Image

Clear image

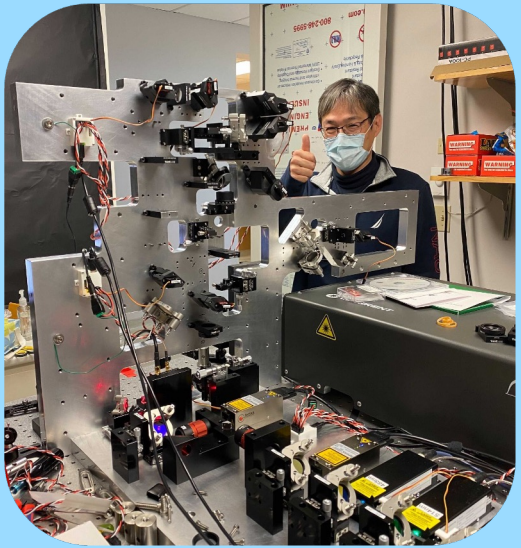
https://petebankhead.gitbooks.io/imagej-intro/content/chapters/formation_noise/formation_noise.html

But why are images noisy?

- Photon Noise
- Read Noise

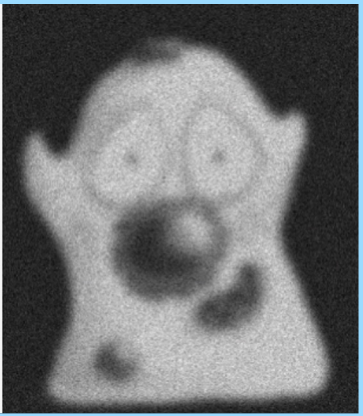
Photographing tiny mitochondria is difficult; even light particles can stand in the way

Camera electronics cause noise, too

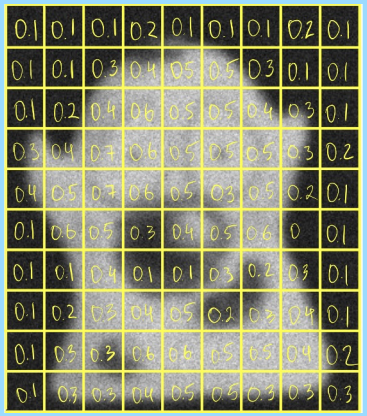


https://steemit.com/science/@shehzad/what-exactly-photon-is

How can we make the pictures better?

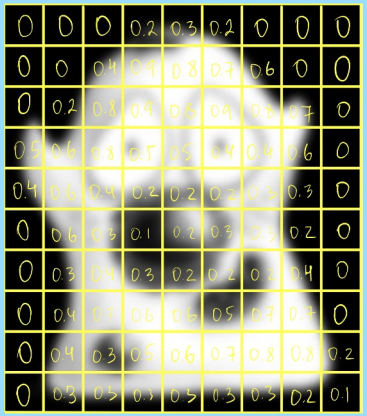


Noisy image
Human vision



Noisy image
Computer vision

Computer performs calculations
Learns to extract a clear image from a noisy one



Clear image
Computer vision

Clear image
Human vision

https://dribbble.com/shots/16318569-Cute-Computer-Cartoon
https://petebankhead.gitbooks.io/imagej-intro/content/chapters/formation_noise/formation_noise.html

What's actually happening?

- Computers are very smart
- If we tell them what to look for, they tell us what they find
- We tell them:
  - Look for where the mitochondria goes
  - Look for fusion
  - Look for fission

https://twitter.com/schoeneberglab/status/1560240646899859457

What do we do?

Use an advanced microscope to understand how changes in mitochondria lead to disease

1. Grow sample
2. Image sample
3. Analyze data

Let’s see how!