



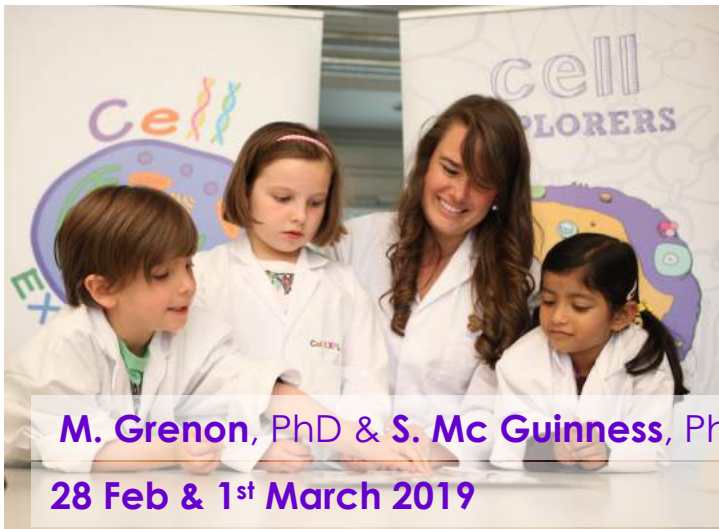
cell
EXPLORERS



Cell EXPLORERS

Cellular and molecular biology in the primary school classroom

Scientix Estonia, Tartu, Tamme Gymnasium



M. Grenon, PhD & S. Mc Guinness, PhD, NUI Galway

28 Feb & 1st March 2019

Content of this workshop

- Introduction
 - Cell EXPLORERS
 - Modern Biology
- Hands on Activities
 - Little Cells - Cellular Biology
 - Fantastic DNA – Molecular Biology
- Conclusion
 - Activity suggestions
 - Resources

Inform, Inspire, Involve



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YouTube

@cellexplorers



www.cellexplorers.com

Cell EXPLORERS

Public engagement objectives

1. To promote modern biology, biomedical sciences and research in both
2. To combat stereotypical images of scientists
3. To change perceptions of science and inform on scientific careers
4. To contribute to addressing the national shortfall of science graduates in Ireland

Specific activity setup



Hands-on: every child does each activity



Small demonstrator to pupil ratios



Real science role models



Real science: provide an authentic scientific experience



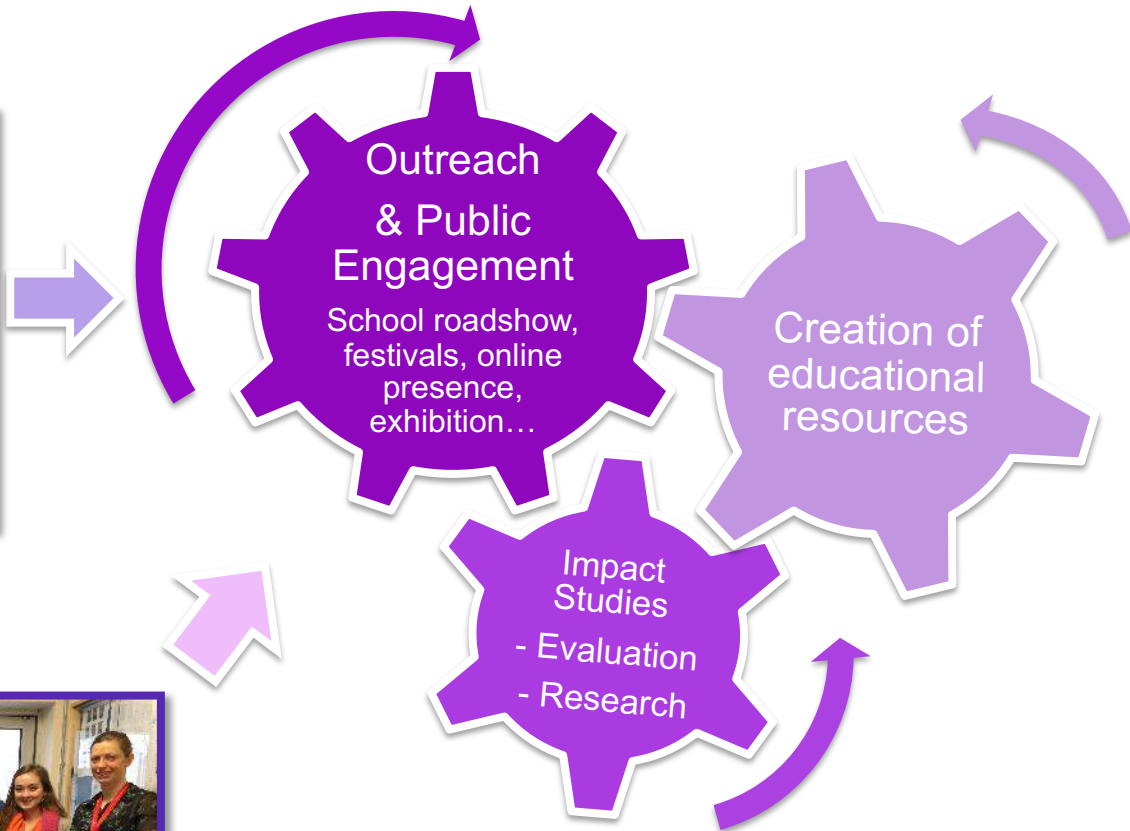
Involve the whole family



Remain informal, engaging & fun

Cell EXPLORERS working model

Volunteers
Students / Staff



Project students
Curriculum-based



Benefits




- Society
- University
- Students

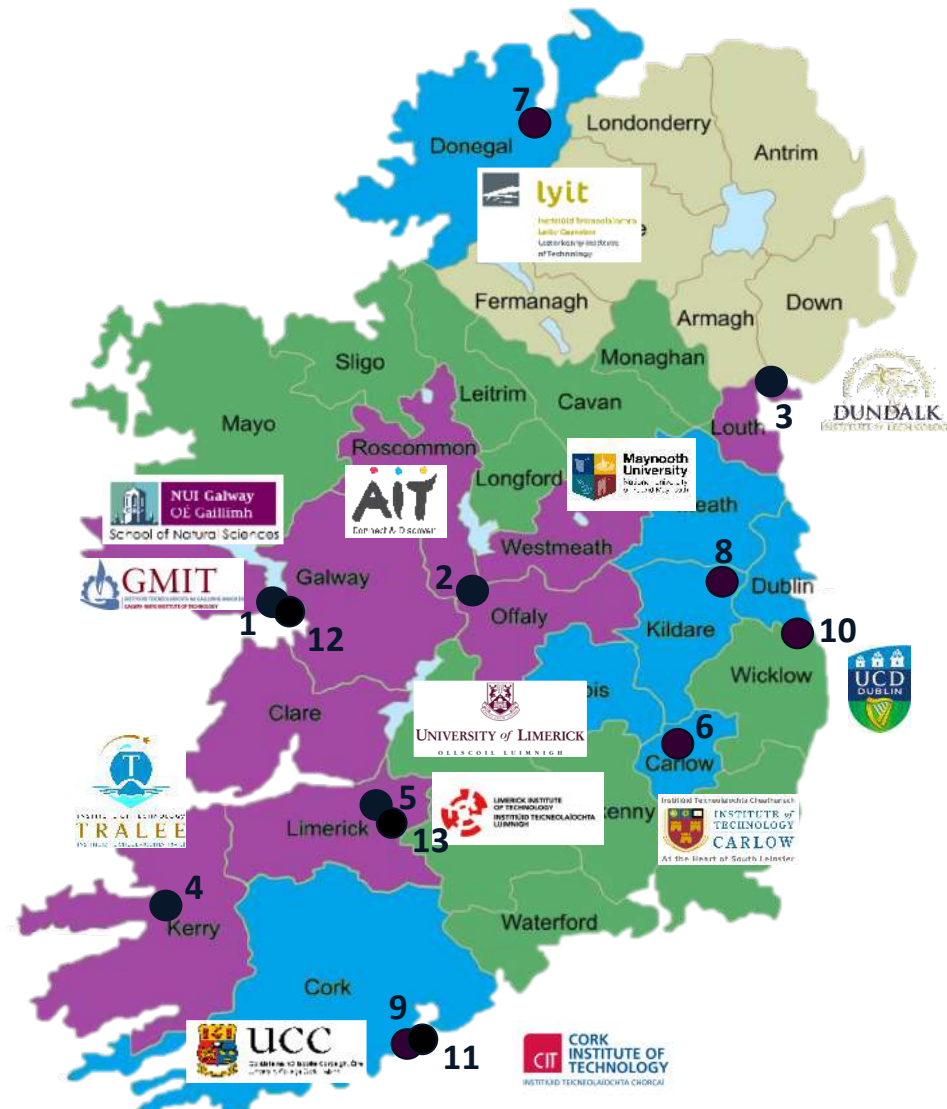
**Double
Educational
benefit**

Cell EXPLORERS National Network

13 teams based in 3rd level higher education institutions



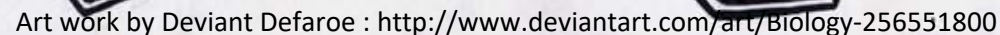
-  Counties Reached 2015-16
-  Reach added in 2017
-  Team Locations



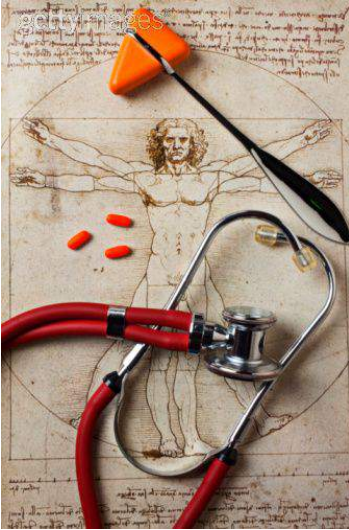
Workshop objectives

After this workshop you will be able to:

- Understand and explain the basic concepts of cellular and molecular biology in lay term
- Run hands-on activities on these topics in your classroom

Cellu
Biolo

Why is it important?



1. Medicine of the future:

- Personalised:
 - based on genomic information
 - Will reflect what your cells can or cannot do
- New technology to make medicine:
 - Preventative (Test)
 - Corrective (DNA)
 - Regenerative (organ, tissue)



2. Health & society implications:

- New professions
- New technological need
- New ethical impacts

How does this workshop work?

- This is a teacher presentation pitched at your level
- You will do activities as the children would
- **Resources** to run activities in the classroom are in the teacher section of our website

Little Cells

An introduction to Cellular Biology

5-8 years old



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The 'Little Cells' session

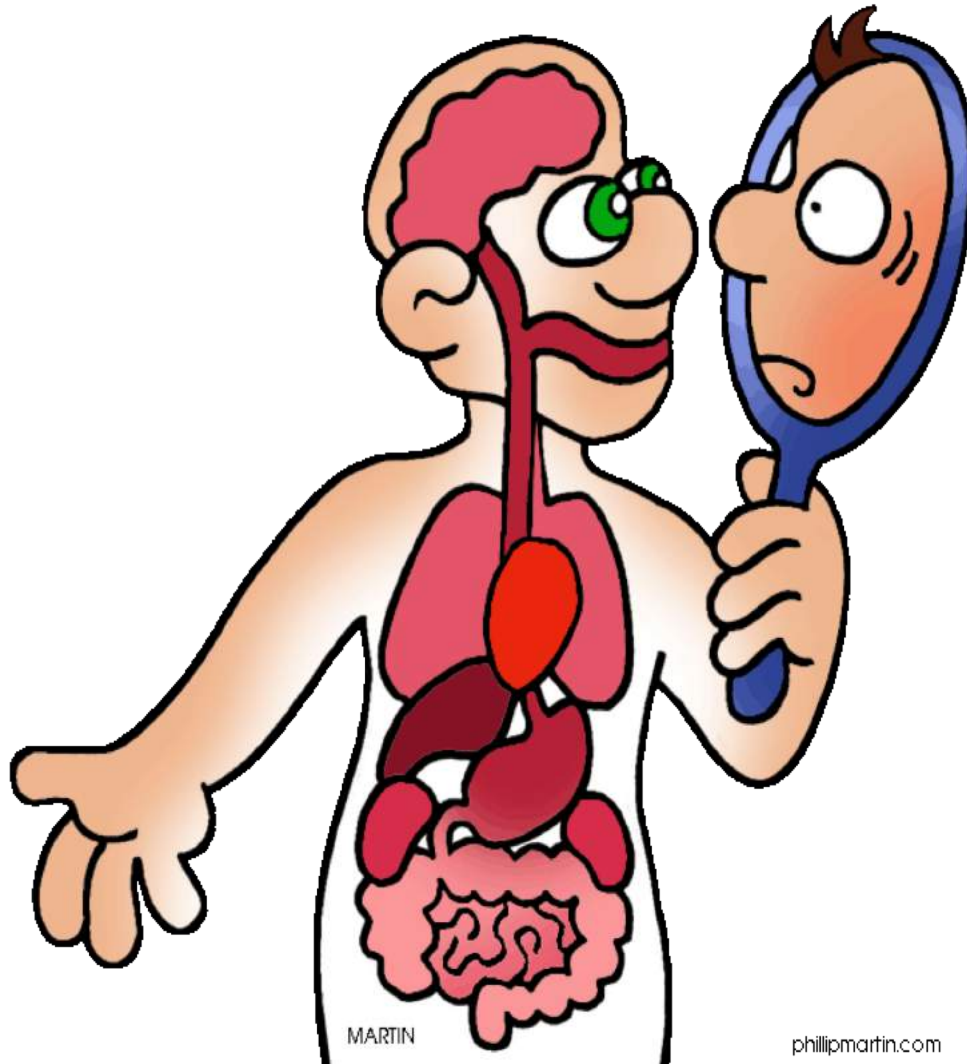


- **Public targeted:** 5-8 years old
 - First introduction to modern biology
 - First time meeting scientist
- **Engagement:**
 - Through games: matching/ordering Games, physical games, Art&Craft activity,
 - Team work and discussion
- **Curricular connection:** Literacy and numeracy, Science is extra-curricular
- **2 versions of games** to adapt to children ability

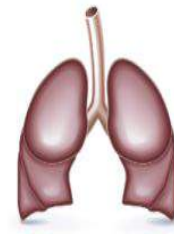
Key concepts

- Essential functions of body carried out by organs
- All body parts are made of cells
- Cells are the smallest unit of life
- Cells doing specific jobs have specific shapes
- Cells work together in our body

What are we made of?



Resources:
Little Cells Presentation
The Body Games



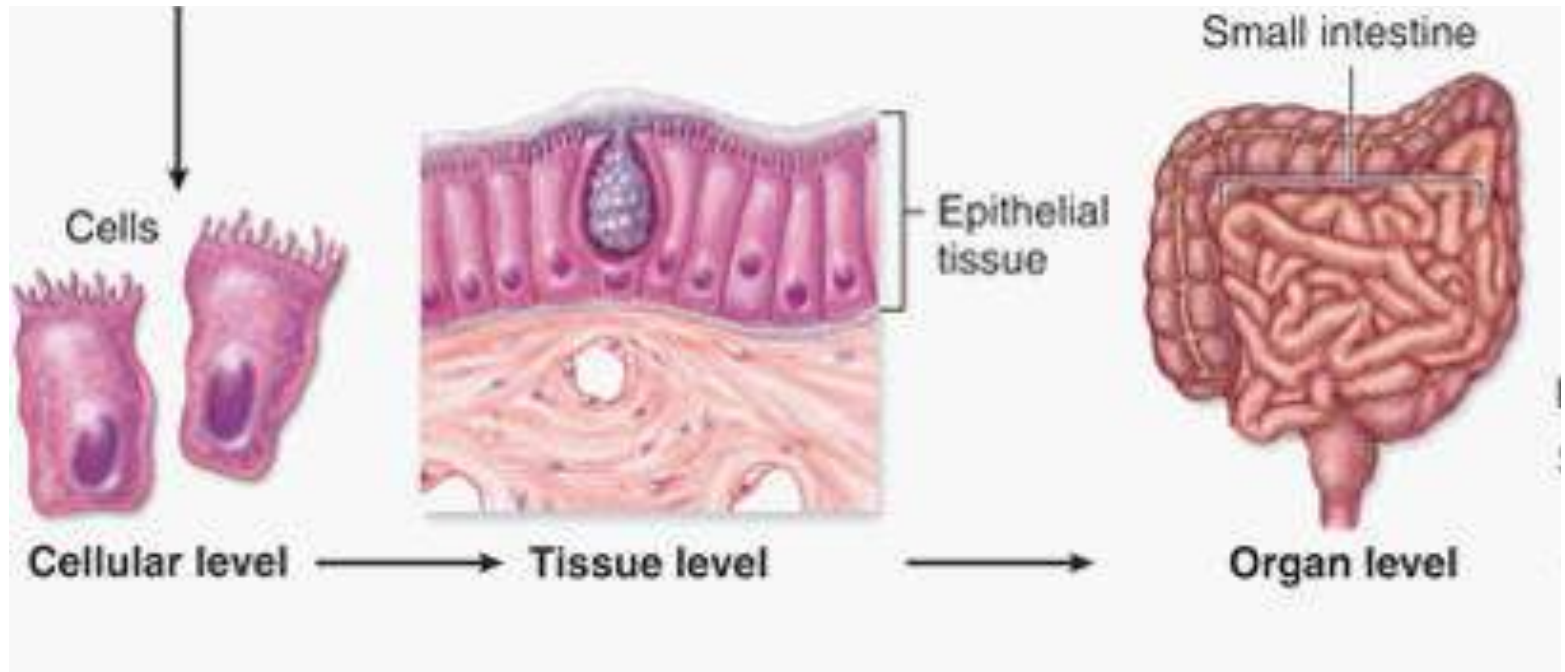
Hi!

The Body Game



What are organs made of?

Resources:
Little Cells Presentation



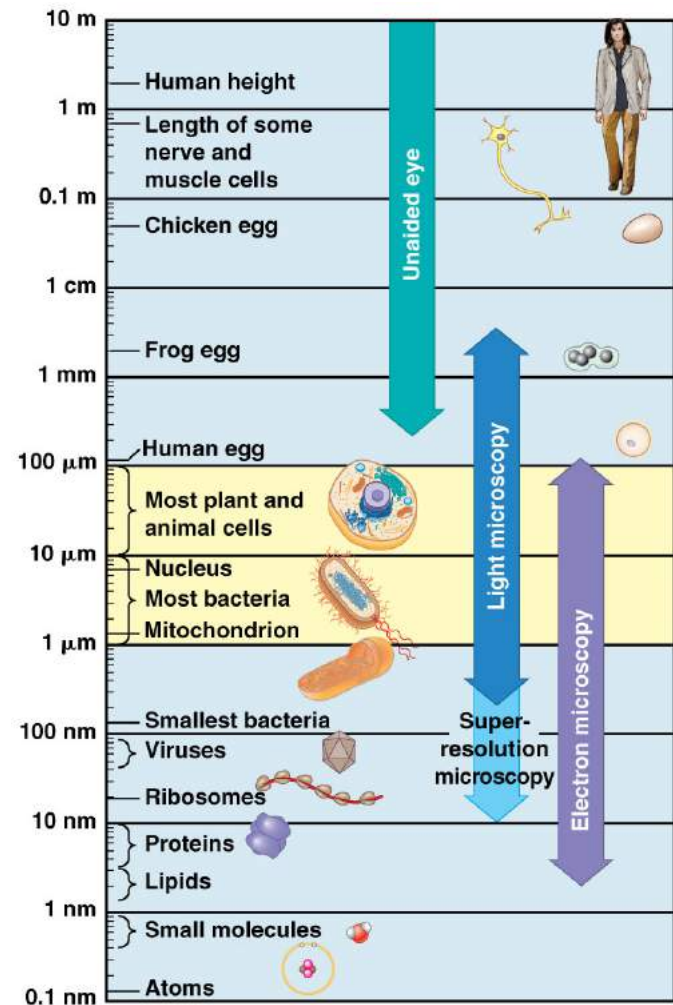
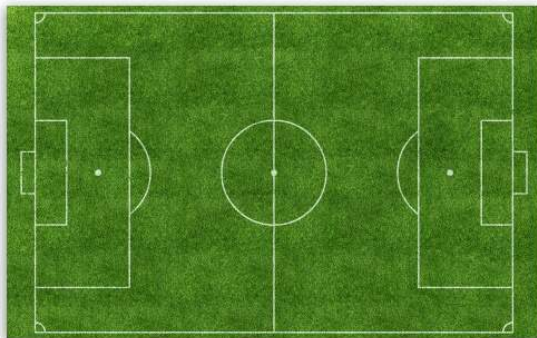
- 100,000,000,000,000 cells in our body
- Very small: 10 to 100 micrometers
- They do specific jobs: 200 cell types
- They look different depending on the job they do

How small are cells?

Resources:
Little Cells Presentation
The Sizing Game



Cell





How small is a cell?

1

2

3

4

5



LARGEST

SMALLEST



NUI Galway
OÉ Gaillimh

School of Natural Sciences

Galway Science
& Technology Festival
Féilte Eolaíochta & Teicneolaíochta na Gaillimhe

Science
Foundation
Ireland **sfi**
For what's next

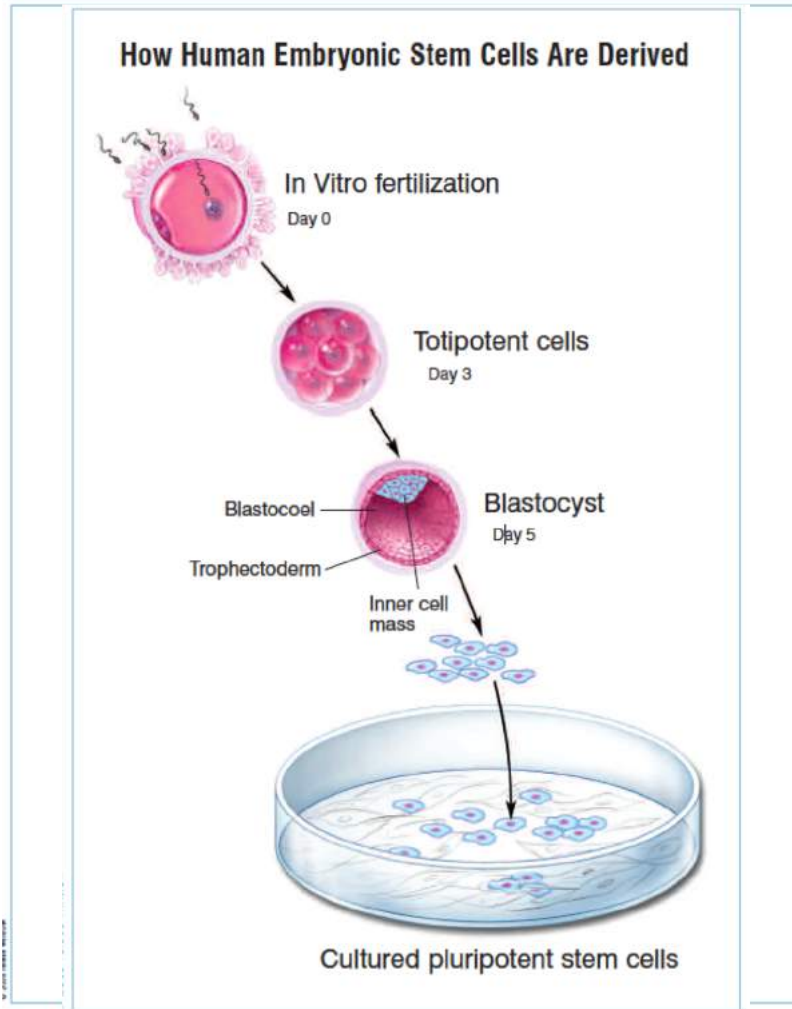
From 1 cell type to 200

Resources: (8 years old +)
Amazing cells Presentation

Origin:

Stem cells:

- Fertilization of egg by sperm results in a zygote
- self-renewal indefinitely to produce more stem cells
- Early embryo development leads to the blastocyst of the body. Differentiation
 - Inner cell mass is the source of human embryonic stem cells (hESCs) pluripotent



Adult stem cells example: Mesenchymal stem cells (MSCs)

Resources: (8years old+)
Card game by Cúram

Multipotent stem cells found in bone marrow –
produce Bone cells and blood cells

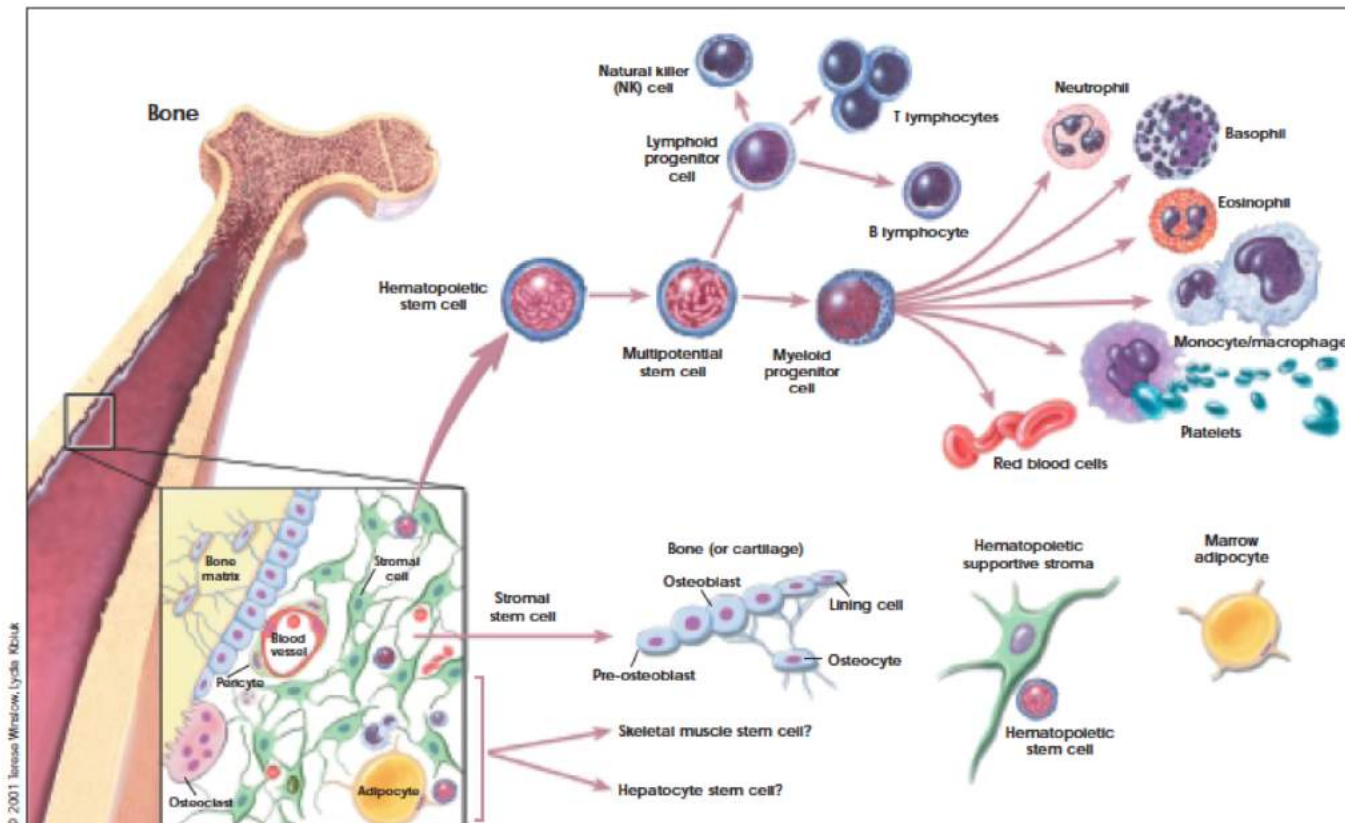
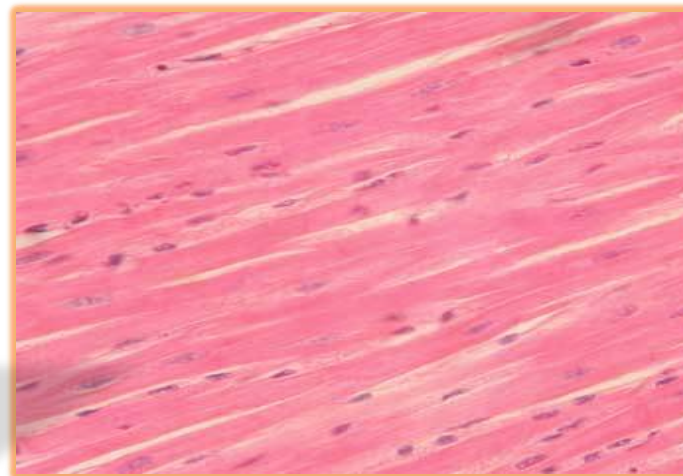
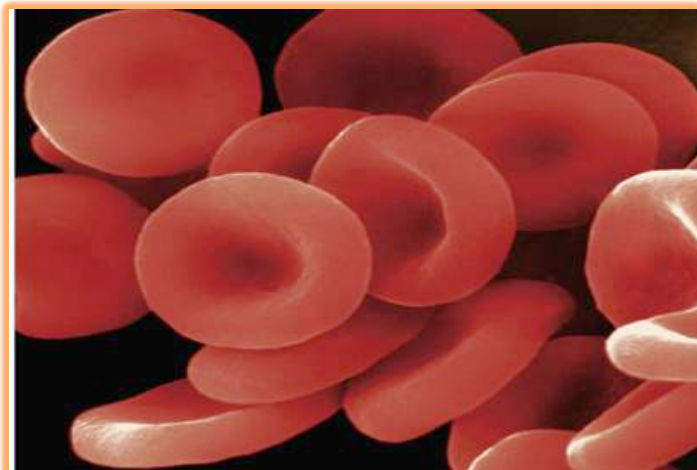


Figure 4.3. Hematopoietic and Stromal Stem Cell Differentiation.

We have many different cells!

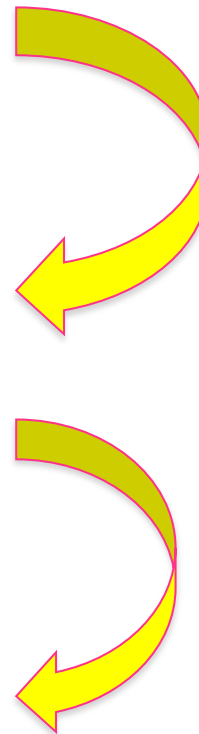
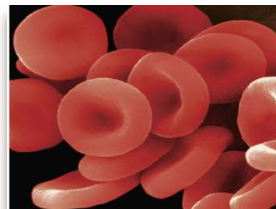
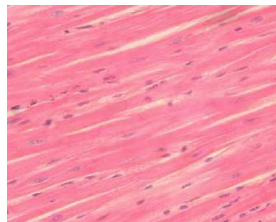
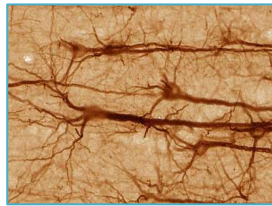
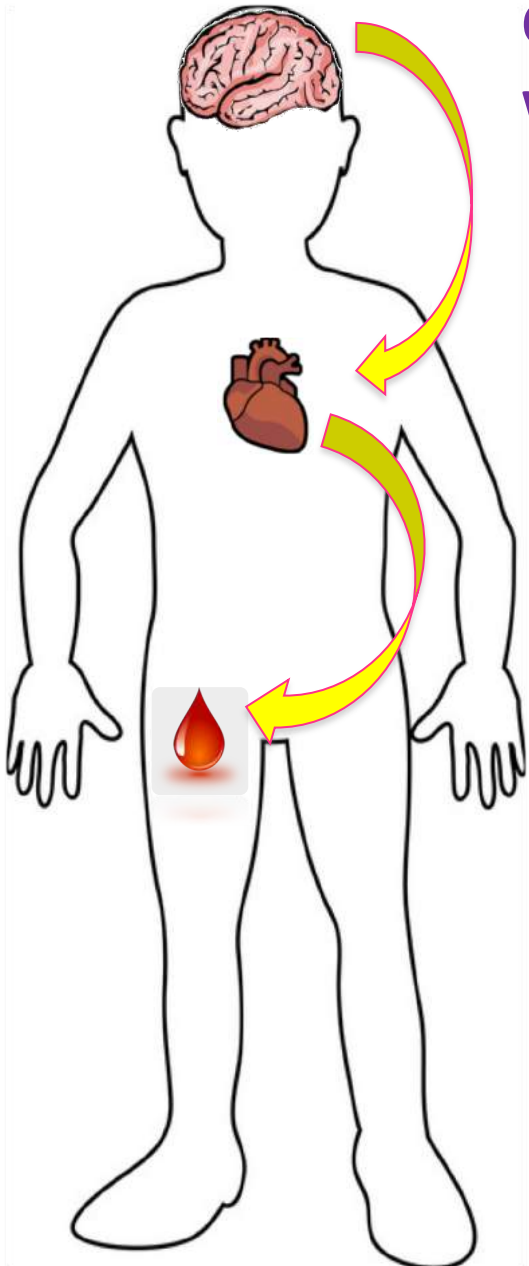


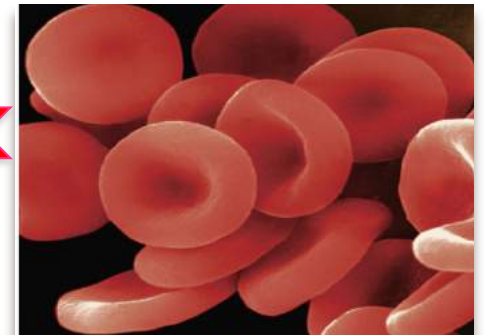
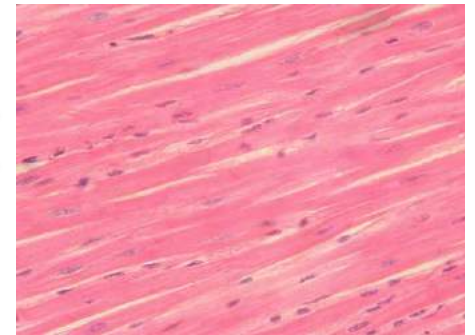
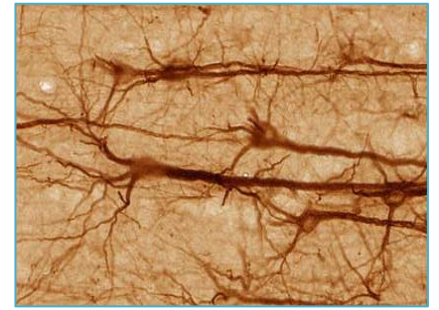
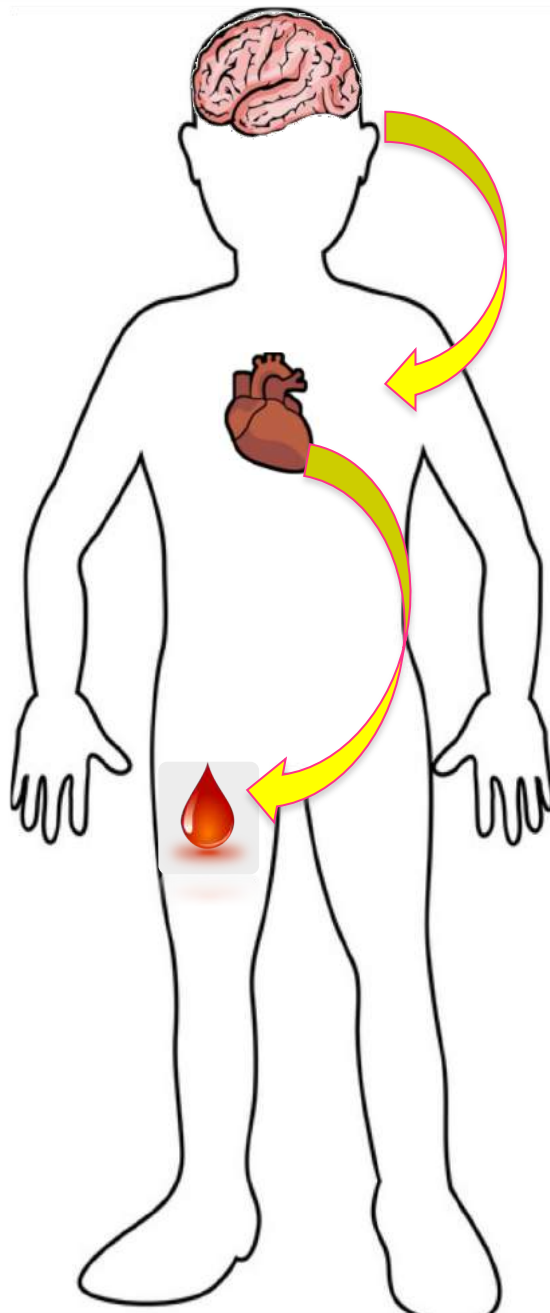
Around **200** different types!



Cells communicate to make the body work properly!

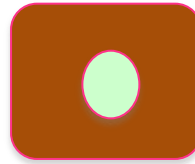
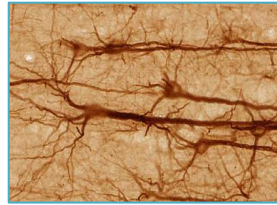
Resources:
Little Cells Presentation
Playing Little Cells Game





Brain and Nerves

1



Teacher's table + buzzer!

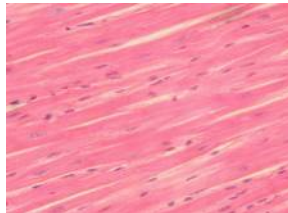
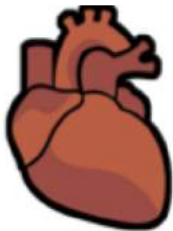


3



Blood and Red Blood Cells

2



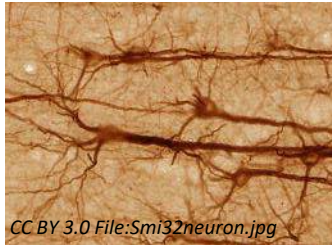
Heart and Heart cells



Build you own cells



Brain Cells



CC BY 3.0 File:Smi32neuron.jpg

Location: The brain & nervous system

Function: We send signals to each other in the brain & send signals from the brain to the body & visa versa!

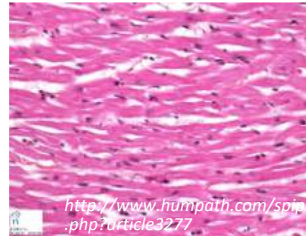
Description: Our long 'fingers' at either end allow us to send & receive messages from other brain cells.

No. in body: approx 100 billion

Fun Fact: If all the brain cells lined up they would stretch for 600 miles!



Heart Cells



<http://www.humpath.com/spip.php?article3277>

Location: Heart

Function: We work together to make the heart beat by squeezing hard!

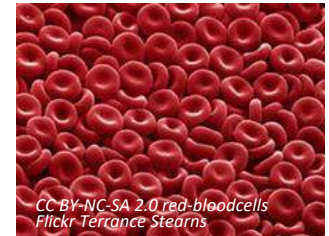
Description: We are long muscle cells that pack tightly together

No. in body: approx 2 billion

Fun Fact: A child's heart beats around 90 times a minute, while an adult's heart beats about 70 times a minute.



Red Blood Cells



CC BY-NC-SA 2.0 red-bloodcells
Flickr-Terrance Stearns

Location: Blood

Function: We carry oxygen from the lungs around the body & carbon dioxide from the body to the lungs!

Description: We are round & flexible so we can easily pass through narrow blood vessels.

No. in body: 25 trillion!!

Fun Fact: There are about 250,000,000 red blood cells in one drop of blood!



Fantastic DNA

An introduction to Molecular Biology

8 - 13 years old



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Science
Foundation
Ireland **sfi**
For what's next

 **NUI Galway**
OÉ Gaillimh
School of Natural Sciences

School Roadshow 2018



10 teams
190 volunteers
64 schools
96 classes
2451 children visited
1912 children visited in classroom

**Reach counties of low levels of STEM
intervention and schools in
disadvantaged area**

**13 counties, including 9 with low
levels of STEM intervention**
20 DEIS schools
37% of schools in rural area
1341 Children Feedback
58 Teacher Feedback

The 'Fantastic DNA' session



- **Public targeted:** 9-14 years old
 - Perception of science
 - Decide if science is for them
 - Consider science as a career
- **Break stereotypes about scientists:** Science role models in the classroom
- **Modern biology:** extra curricular, an introduction to DNA
- **Engagement:** real experiment, hands on, small group teaching
- **Change perceptions of science:** talk about the nature of science and careers

Meeting with a scientist is a positive experience

"If you don't understand something they were ready to help with a nice attitude"
Had you met a scientist before the Cell EXPLORERS?

"I understood them, I felt like I was a cell explorer"

"they taught me things I didn't know"

"It was fun to see a scientist in real life and not just on the TV"

"It was nice to do an experiment with real science"

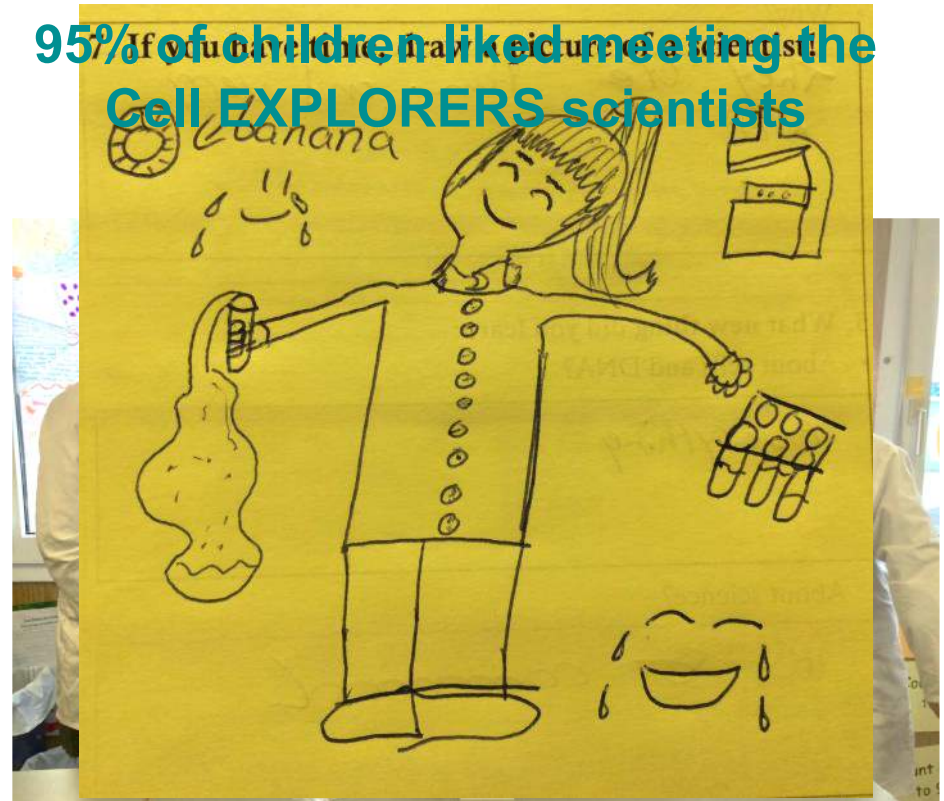
"I liked being able to do the experiment myself"

"I liked meeting the Cell EXPLORERS because I never seen a scientist girl before"



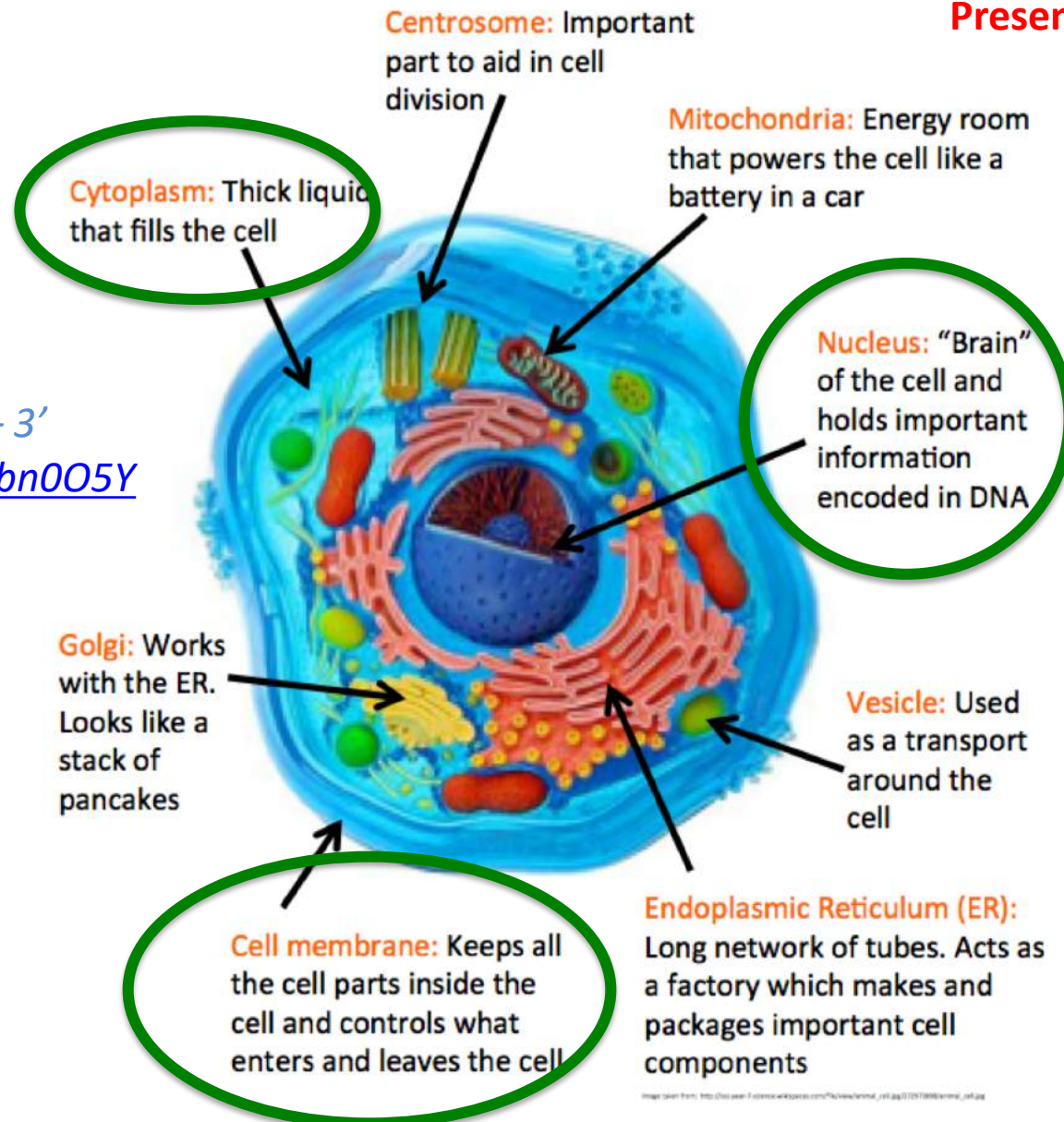
2016 2017
 ■ Yes ■ No

95% of children liked meeting the Cell EXPLORERS scientists



Parts of the cell

Resources:
Fantastic DNA
Presentation

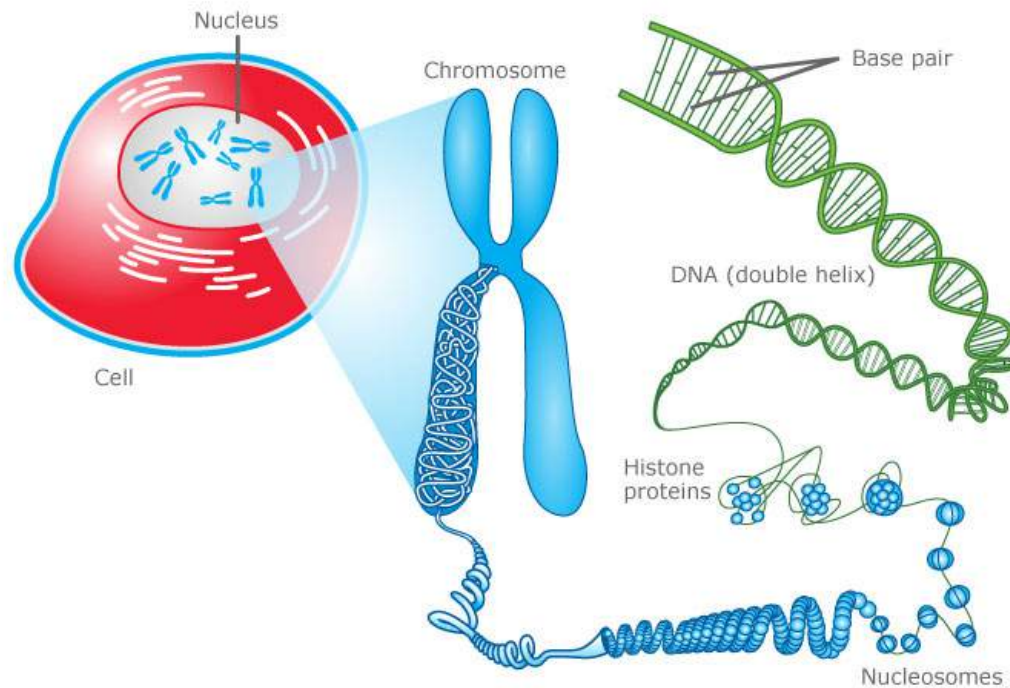


Youtube Video:
The inner life of a cell – 3'
<http://youtu.be/wJyUtbn005Y>

Long narrated version:
<https://www.youtube.com/watch?v=FzcTgrxMzZk>

DNA is located in the cell nucleus

Resources:
Fantastic DNA Presentation



1. Contain cellular instructions
2. Instructions encoded in a 4-letter code : A T G C
3. Species-specific
4. Highly structured to allow its replication

DNA structure discovery

Francis Crick

James Watson

Rosalind Franklin



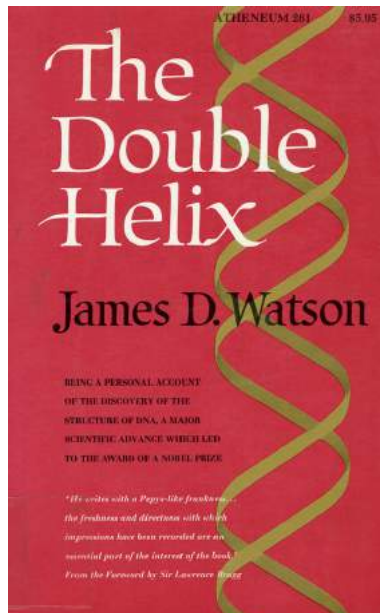
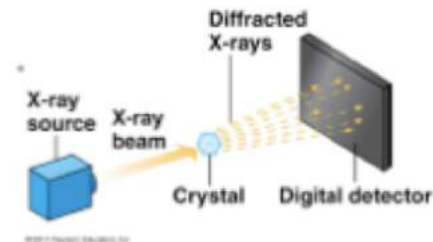
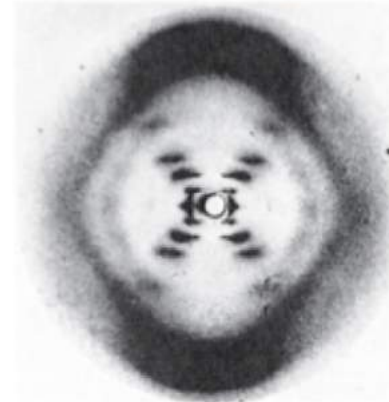
Courtesy of Cold Spring Harbor Laboratory Archives. Noncommercial, educational use only.



Courtesy of Cold Spring Harbor Laboratory Archives. Noncommercial, educational use only.

Resources:
Fantastic DNA Presentation

X ray diffraction image of DNA



(c) Space-filling model

© 2011 Pearson Education, Inc.

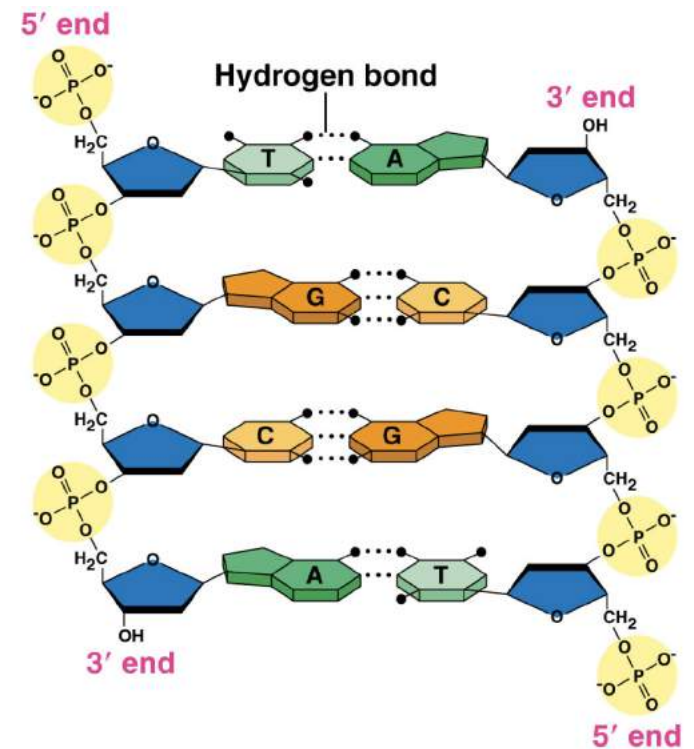
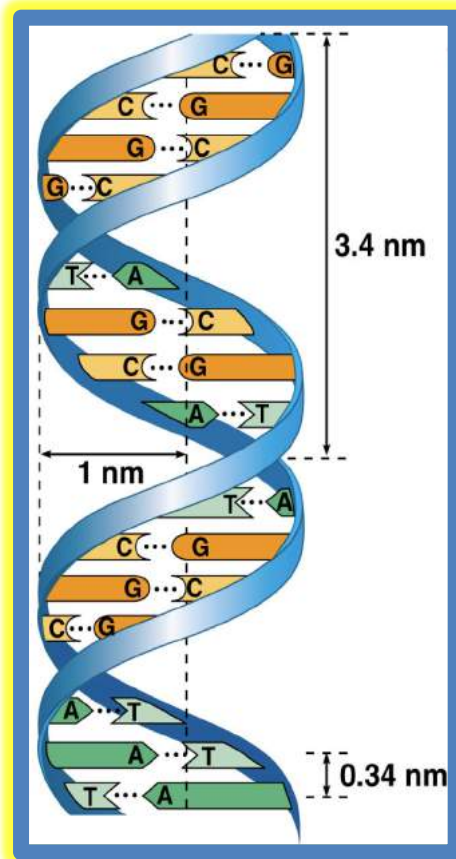
DNA structure and rules

A with T, C with G

Resources:

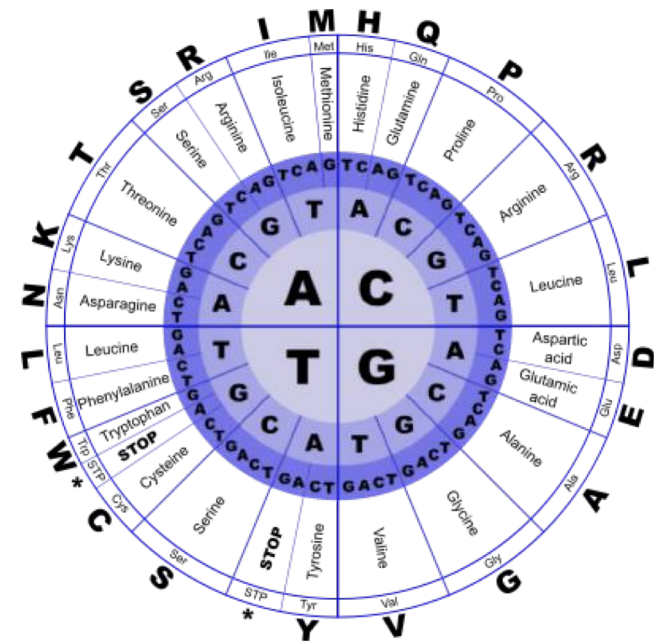
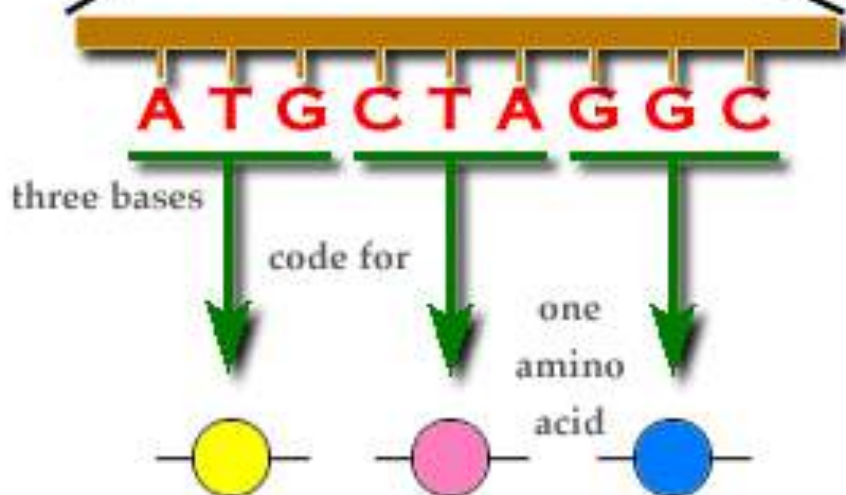
Fantastic DNA Presentation

Model building resources on website



Reading the code

Resources:
Fantastic DNA Presentation



Courtesy: National Human Genome Research Institute.

Extracting DNA

Resources:
Fantastic DNA Presentation
DIY DNA experiment

- Basic step in DNA profiling, diagnostic and engineering experiments
 - Extracted
 - Amplified/sequenced
- Principle:
 - Free up the DNA from:
 - Cell membrane → **mashing, soap**
 - Proteins → **salt**
 - Render DNA insoluble to collect it: **alcohol**

Activity:

Do it yourself DNA extraction

- Step 1: Collect what you need according to your checklist
- Step 2: Let's follow together the "how to do it" instruction (protocol)
- Step 3: Report on what you have done on your poster

Checklist per pair of children

- ☐ 2 x teaspoon of salt
- ☐ 1 x tube of liquid soap
- ☐ 2 x large plastic cup filled with water
- ☐ 2 x plastic sandwich bags
- ☐ 2 x J-cloths
- ☐ 2 x wooden stirrers
- ☐ 2 x pairs of gloves
- ☐ 1 x banana
- ☐ 2 x small plastic cups


What you can do in the classroom:

- *Variation on measurements:
Measuring volume, Weight*
- *Check importance of each
component in the step. Try
omitting a step/ingredient
→ the scientific method*

Resources:
DIY DNA experiment

Poster report and presentation

Resources: Poster template



Cell EXPLORERS Fantastic DNA Poster Session

Authors:
School:




NUI Galway
OÉ Gaillimh

Title:
Aim:


Results and Conclusion

What did you like best?
What did you find difficult?


Procedure

Step	Diagram	Why do we do this?
1. Smash banana in plastic bag and mix with salty solution		Fill me in!
2. Filter to recover 5 mL of liquid		Fill me in!
Fill me in!		Fill me in!
Fill me in!	Fill me in!	DNA is <u>insoluble</u> in ethanol (it will not mix with it). After this step, DNA will float to the top separating it from the cell suspension.

Cell EXPLORERS funders




NUI Galway Biochemistry
School of Natural Sciences




Genome Stability Laboratory
Centre for Overcome Biology


Cell EXPLORERS partners




NUI Galway School of Education




Sfi Discover



Galway Science & Technology Festival



Youth Academy



Title:

Authors:
School:

NUI Galway
OÉ Gaillimh

Aim:

- What was the question?
- What did you want to find out?


Results:
In summary what happens during the experiment?

Conclusion:
By looking at the results obtained what is the answer to the question you asked?


Procedure:

- What did you do?
- How did you do it?
- Why did you do it?

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School of Natural Sciences




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Youth Academy

Cell EXPLORERS resources

‘Teacher Zone’ of website

www.cellexplorers.com



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OUR RESEARCH

ACTIVITIES

TEACHER ZONE

VOLUNTEERS

CONTACT US



Teacher Zone

Hello and welcome to our Teacher Zone.

Scientix Cell EXPLORERS workshop presentations:

- Scientix Future classroom Lab, Brussels June 2018.
- Scientix Estonia, Tartu February 2019.



Resources mentioned in these presentations can be found on the **resources pages below.**

FANTASTIC DNA RESOURCES

OTHER TOPICS

Other resources – Biomedical Sciences with CÚRAM



SFI Centre for Research in Medical Devices

- CÚRAM teacher-in-residence programme:
- Lesson plan kits developed by teachers in collaboration with scientists
- Available to download:

<http://www.curamdevices.ie/curam/public-engagement/teachers-in-residence/>

Please fill out the evaluation form

Stay in touch!

- If you use our resources, please let us know;
 - pictures
 - summary
 - link to class blog
 - modifications

Contact us with queries:
muriel.grenon@nuigalway.ie
shane.mcguinness@nuigalway.ie

Thank you!

- Organisers of Scientix Estonia
- Funders
- Current and past team members and coordinators
- All children & teachers
- All partners:
 - ✓ Research centres
 - ✓ Outreach collaborators
 - ✓ Biochemistry, Microbiology
 - ✓ College of Science
 - ✓ School of Education
 - ✓ CELT
 - ✓ CKI
 - ✓ Schools & Teachers



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