



Collaborative Learning Environments in VR

Authenticity,
Interactivity,
And Collaboration

Meredith Thompson and Eric Klopfer, MIT Education Arcade

Agenda

VR and AR

Authenticity

Interactivity

Collaboration

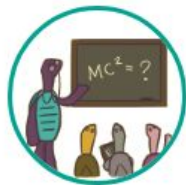


SCHELLER TEACHER EDUCATION PROGRAM education arcade



Design and Create New Experiences

We use games and other tools help kids experiment, explore, and build math and science skills.



Implement and Scale Experiences

We use technology to create powerful learning environments in schools, in the home, and in the community.



Develop Capacity for New Experiences

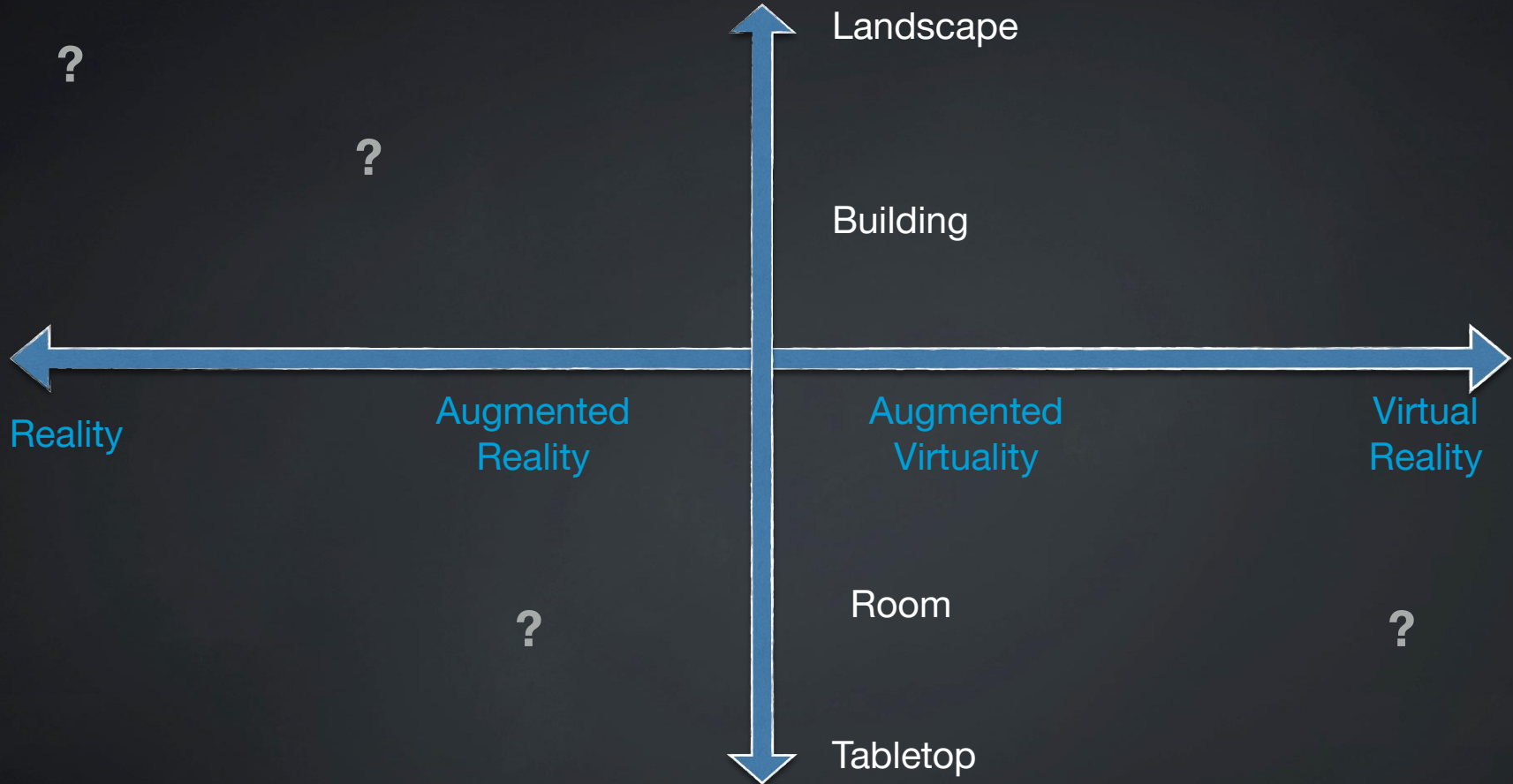
We work with schools, governments, NGOs and other organizations to help them learn new design and development skills and build teacher support capacity.

AR & VR

“Virtual Reality can take you anywhere. Augmented Reality can bring anything to you” - Clay Bavor, Google AR/VR VP

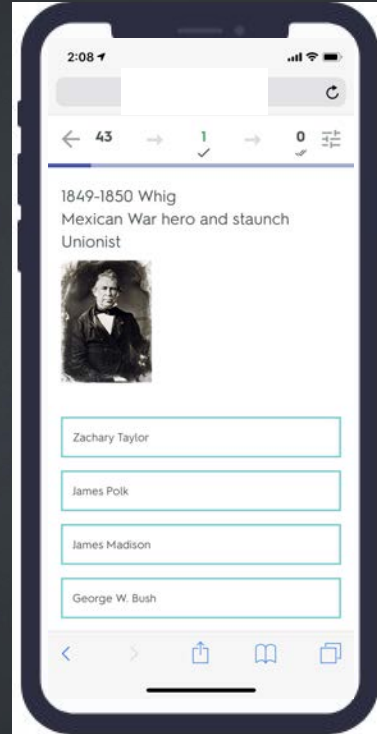
Virtual Reality helps you to experience new worlds.
Augmented Reality helps you experience this world in new ways.

Affordances of Mixed Reality

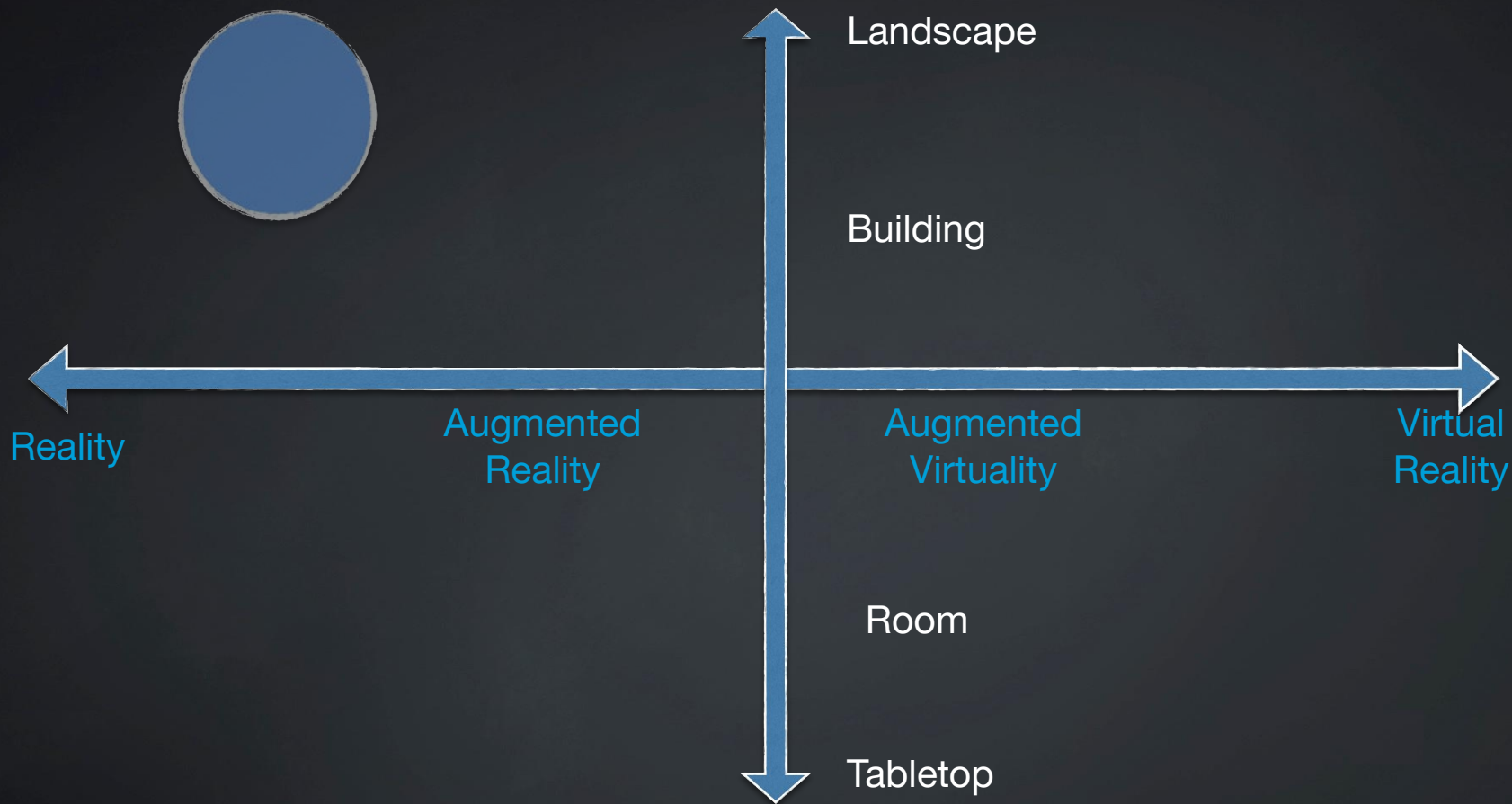


Affordances of Technology

- Affordance \neq Use
- Affordance = Possibility



Mixed Reality

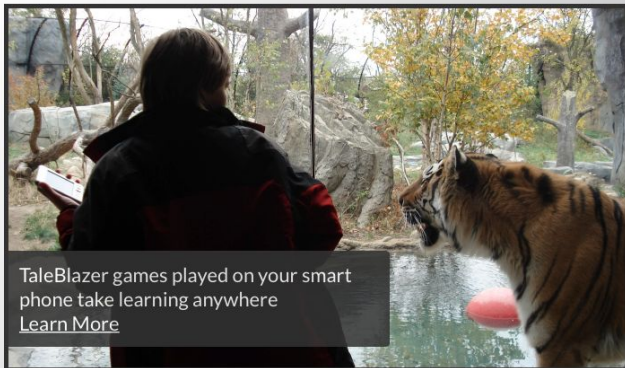


Affordances of Mobile Devices/AR

Klopfer & Squire

- **portability**—can take the computer to different sites and move around within a location
- **social interactivity**—can exchange data and collaborate with other people face to face
- **context sensitivity**—can gather data unique to the current location, environment, and time, including both real and simulated data
- **connectivity**—can connect handhelds to data collection devices, other handhelds, and to a common network that creates a true shared environment
- **individuality**—can provide unique scaffolding that is customized to the individual's path of investigation.

Taleblazer Mobile *Games*

[Home](#)[About](#)[Support](#)[Login | Register](#)

TaleBlazer games played on your smart phone take learning anywhere
[Learn More](#)

[Play games](#)[Make games](#)[Featured Partner:
Explore history](#)[iCSI Project](#)

Play — or make your own — location-based augmented reality (AR) games with TaleBlazer for Android and iOS

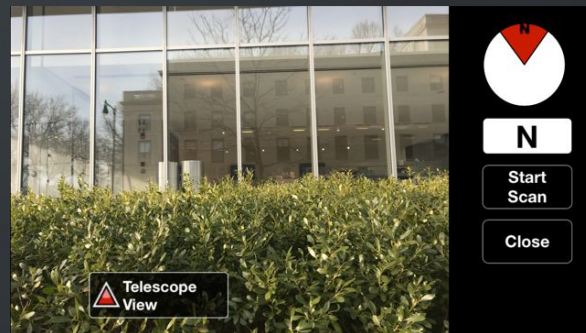
Playing Games

[How to Play](#)[Featured Games](#)[Supported Devices](#)

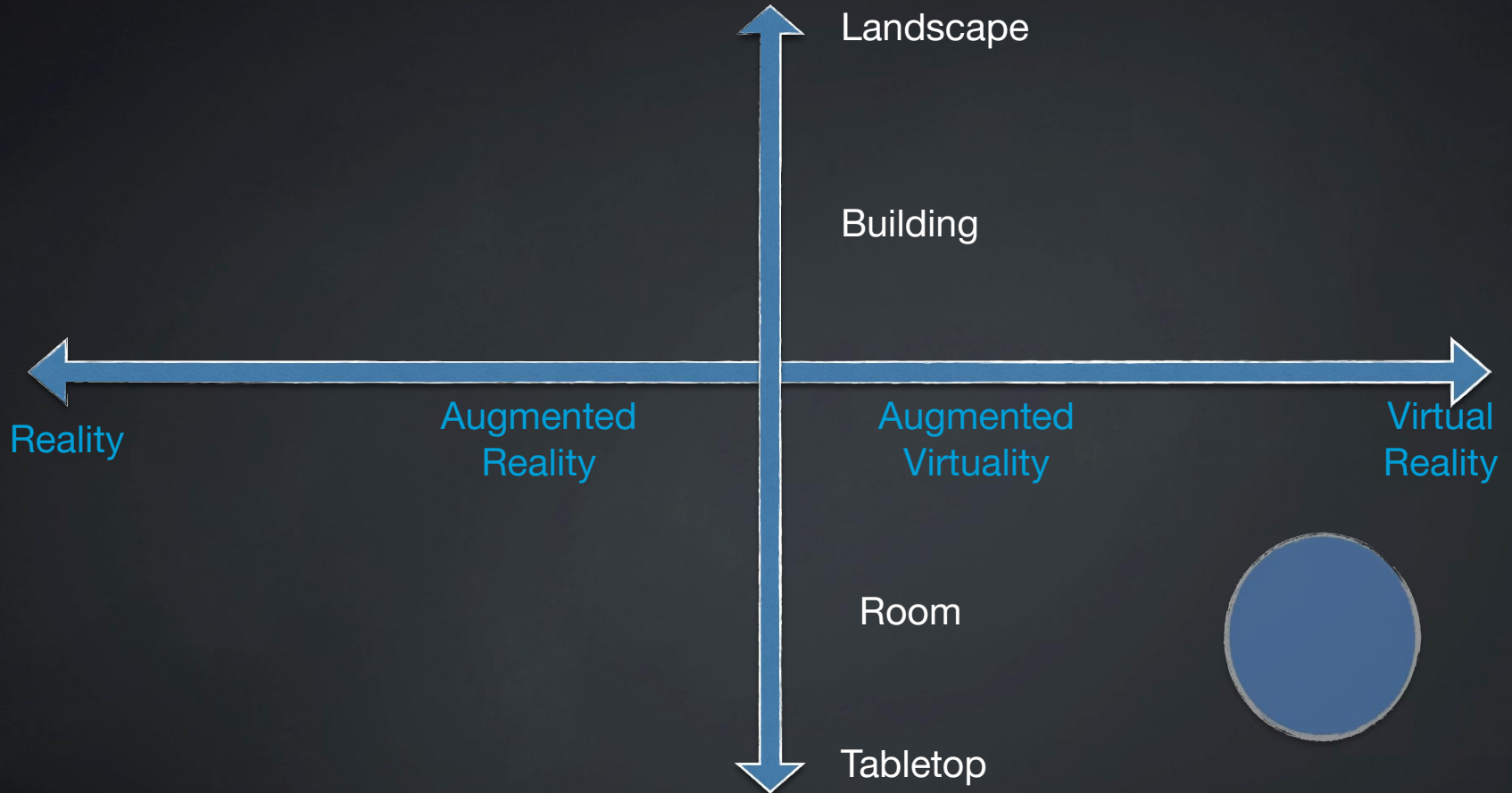
Making Games

[Getting Started](#)[Demo Games/Tutorials](#)[TaleBlazer Editor](#)

Using Games

[For Organizations](#)[For Education](#)[Research](#)

Affordances of Mixed Reality



VR?

...instead of playing video games, students will enter a fully immersive and **scientifically accurate virtual reality chemistry lab**

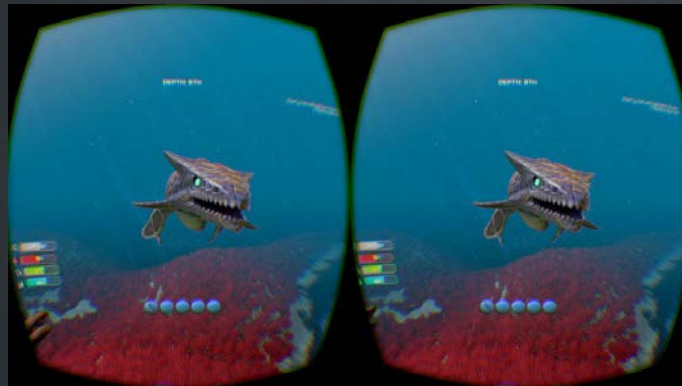
Does adding salt affect the boiling point of water? The student would reach out with hand controllers, take a graduated cylinder, fill it with water, measure out the salt, light a Bunsen burner, add a thermometer, track the boiling point — and then repeat the experiment without adding salt.



VR

...instead of **playing video games**, students will enter a fully immersive and scientifically accurate virtual reality chemistry lab

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Affordances of (full) Virtual Reality

- **Immersion** - can make the participant feel like they are actually there within the place or system being modeled (situated)
- **Perspective** - can provide points of view to the participant, either from another person or arbitrary objects
- **Interaction** - can facilitate natural interactions through movement of the head, body and hands
- **Sensation** - can create visceral and emotional feelings at a subconscious level
- **Spatial Representation** - can show 3D spatial relations and 360 degree views

VR Applications for Education

Collaboration/Communication



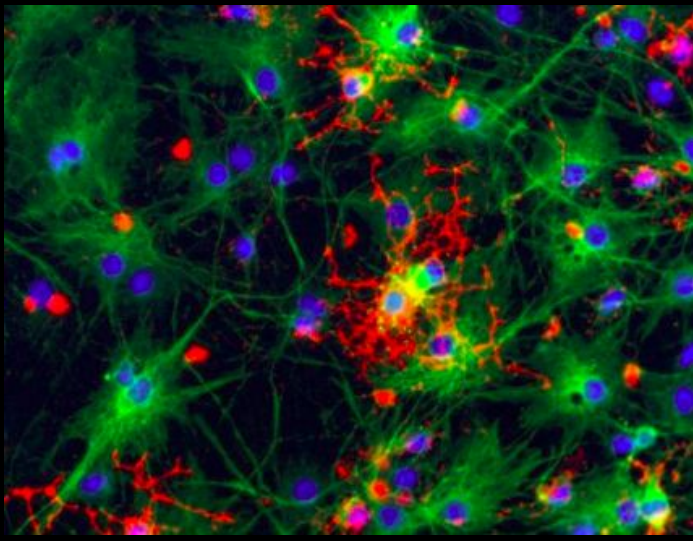
VR Applications for Education

Scale

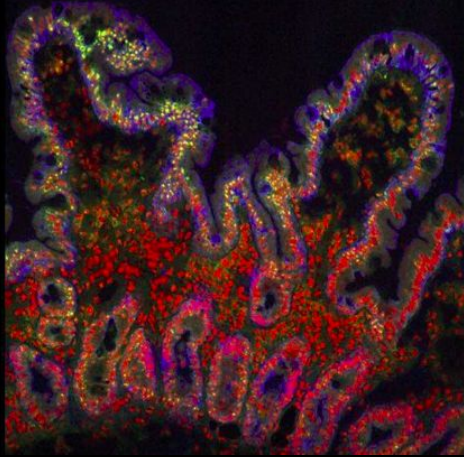
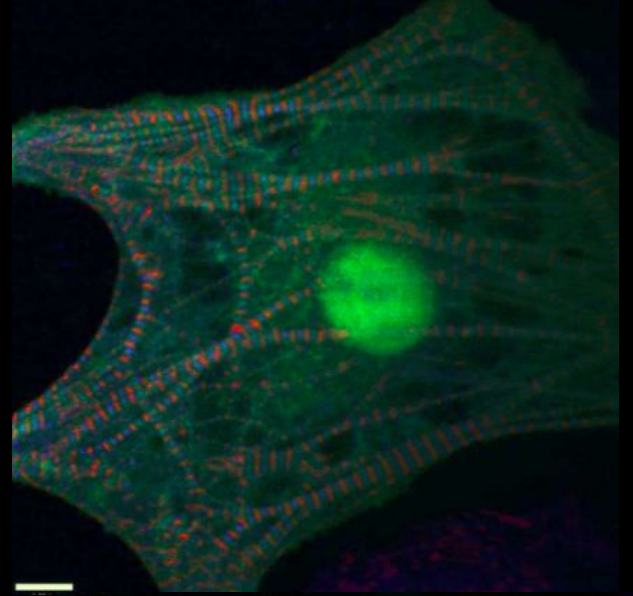


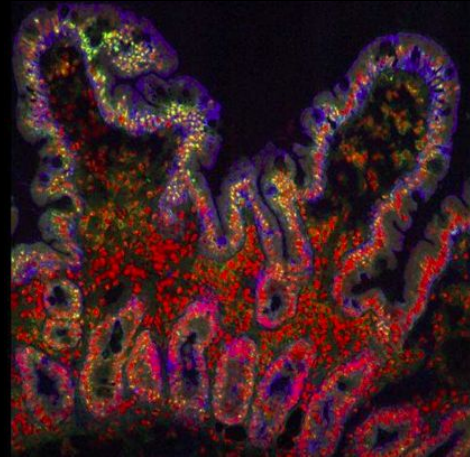
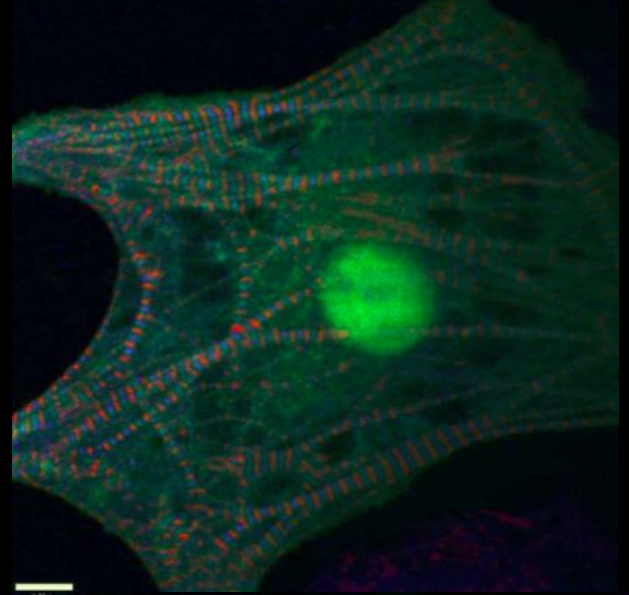
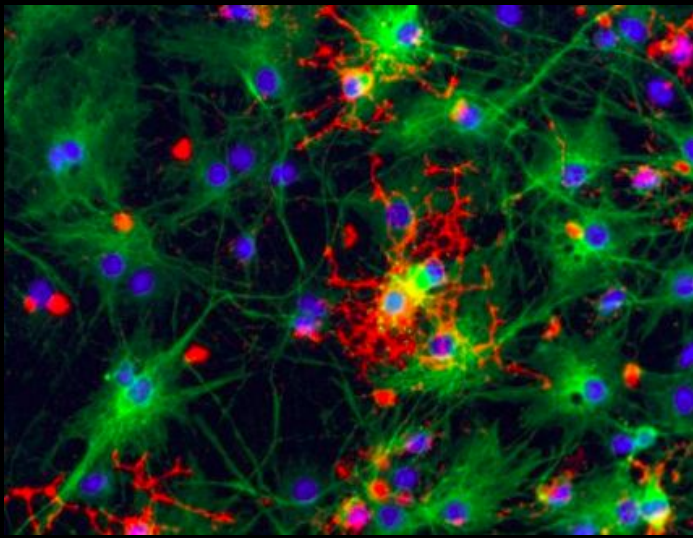
Cellverse

Authenticity



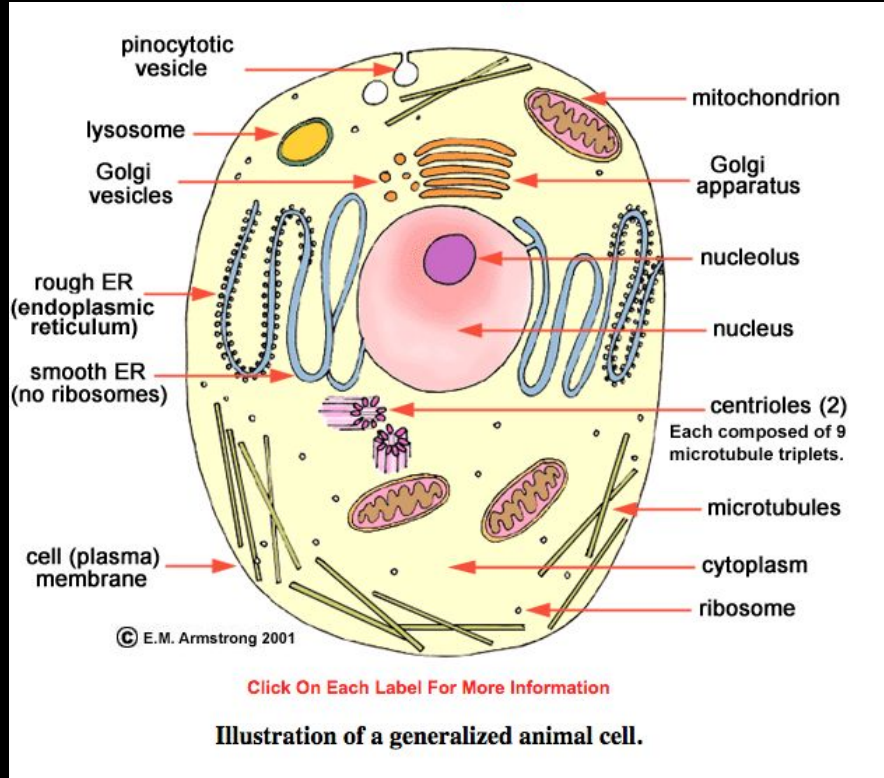
Cells



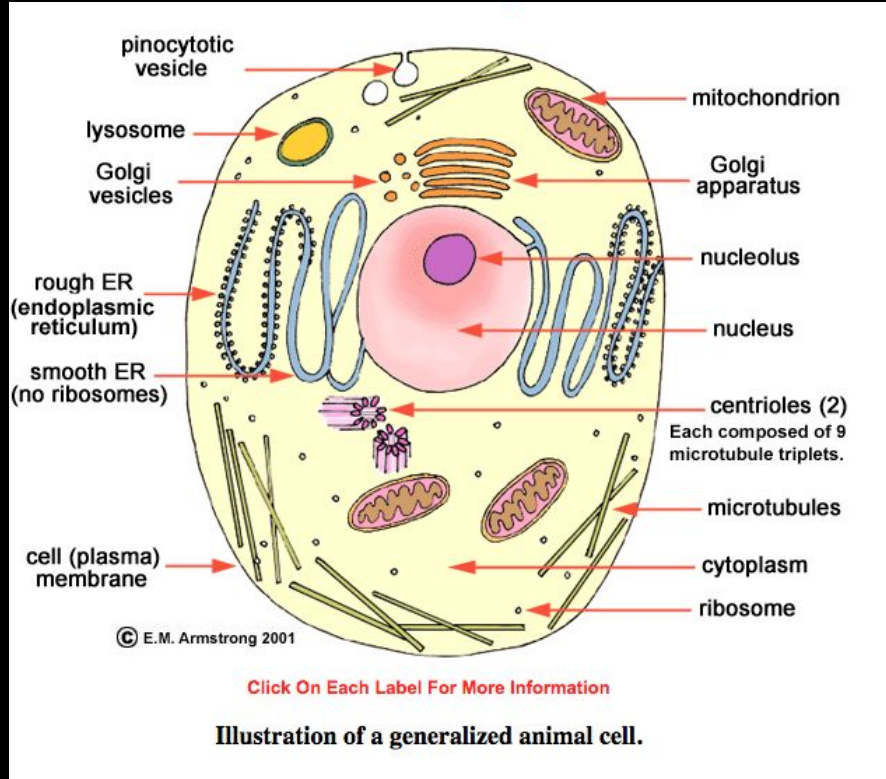


**Cells
are
complex**

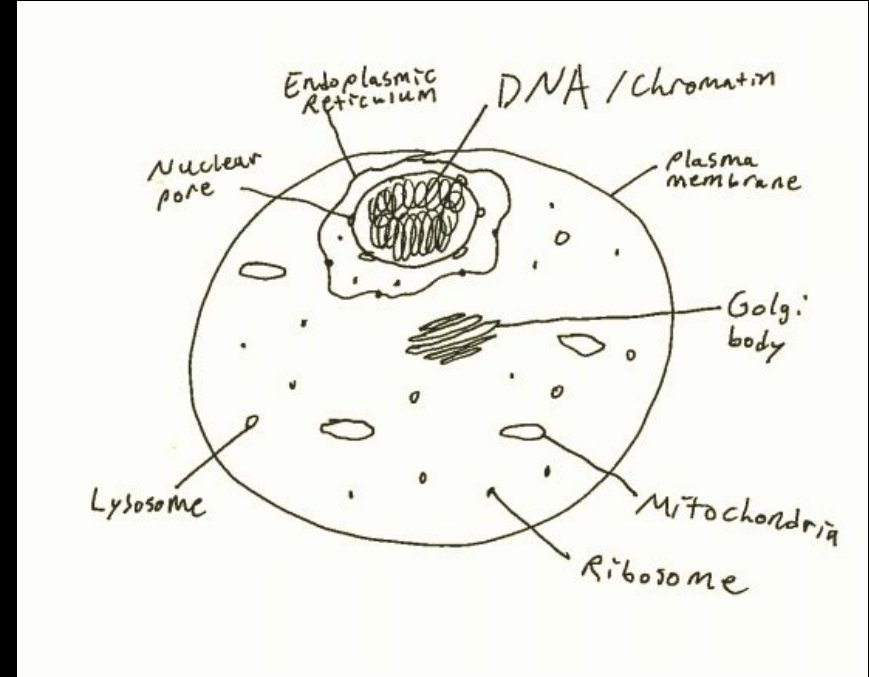
Yet we teach this.....

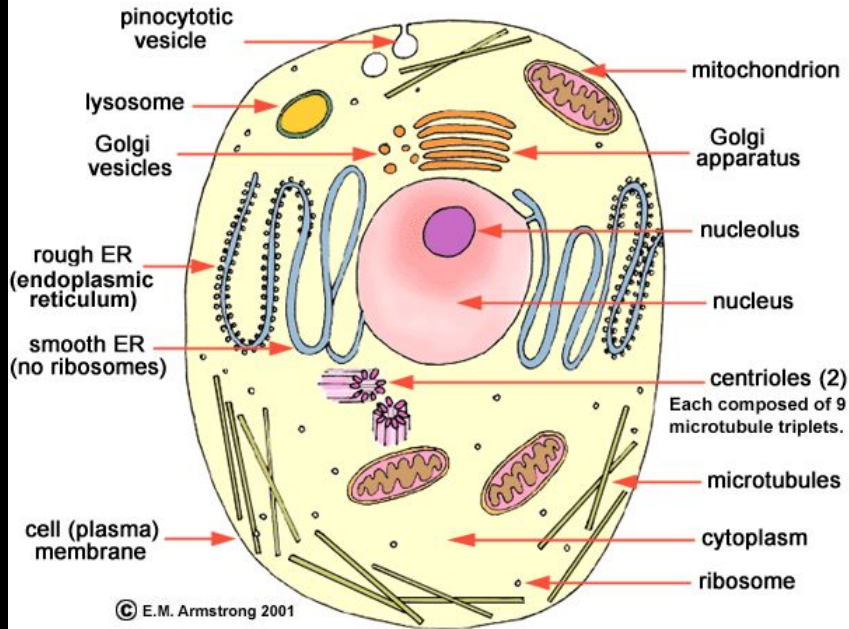


Yet we teach this.....



So kids think of this.....

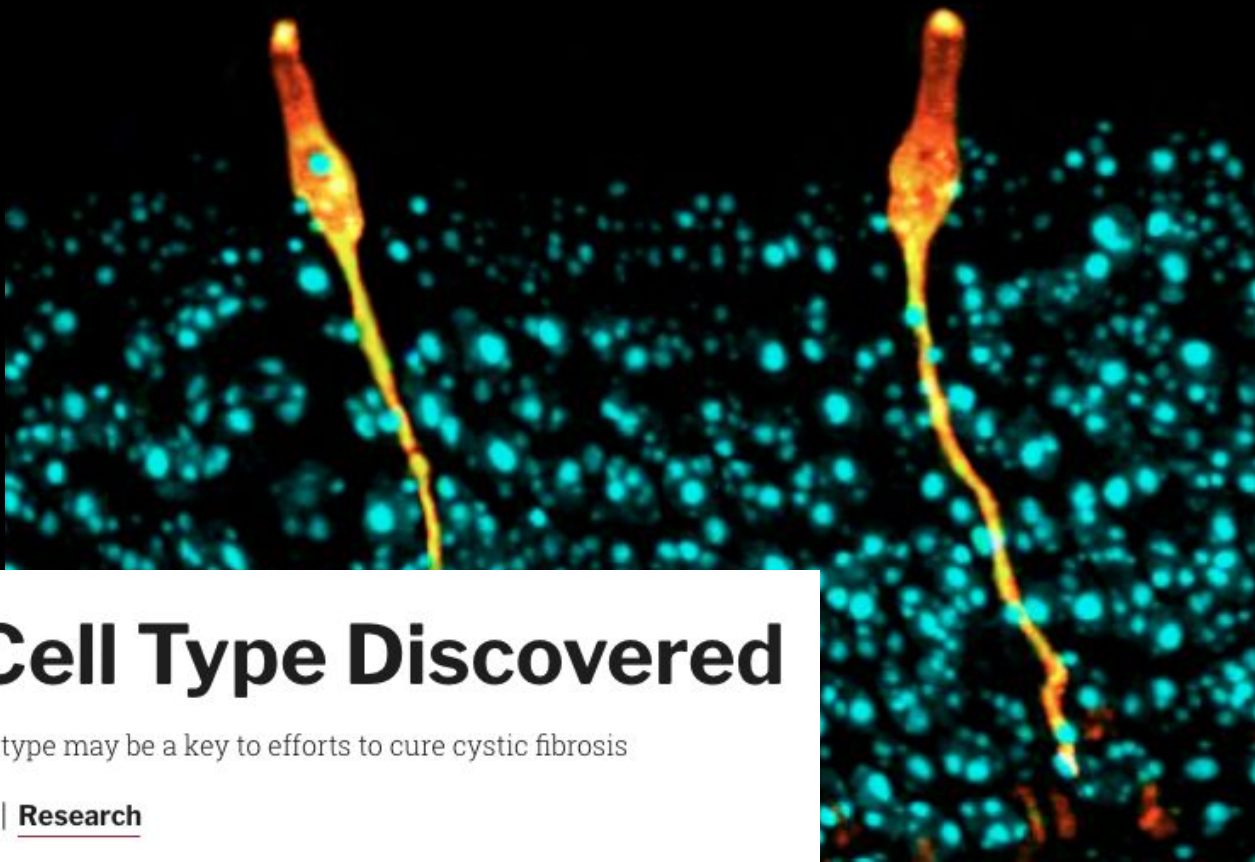




Click On Each Label For More Information

Illustration of a generalized animal cell.





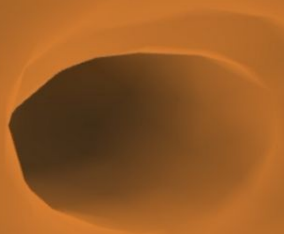
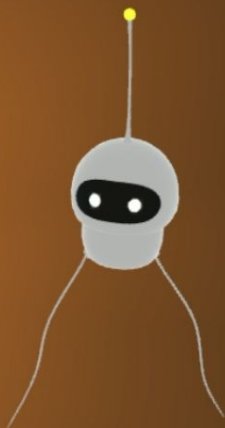
New Lung Cell Type Discovered

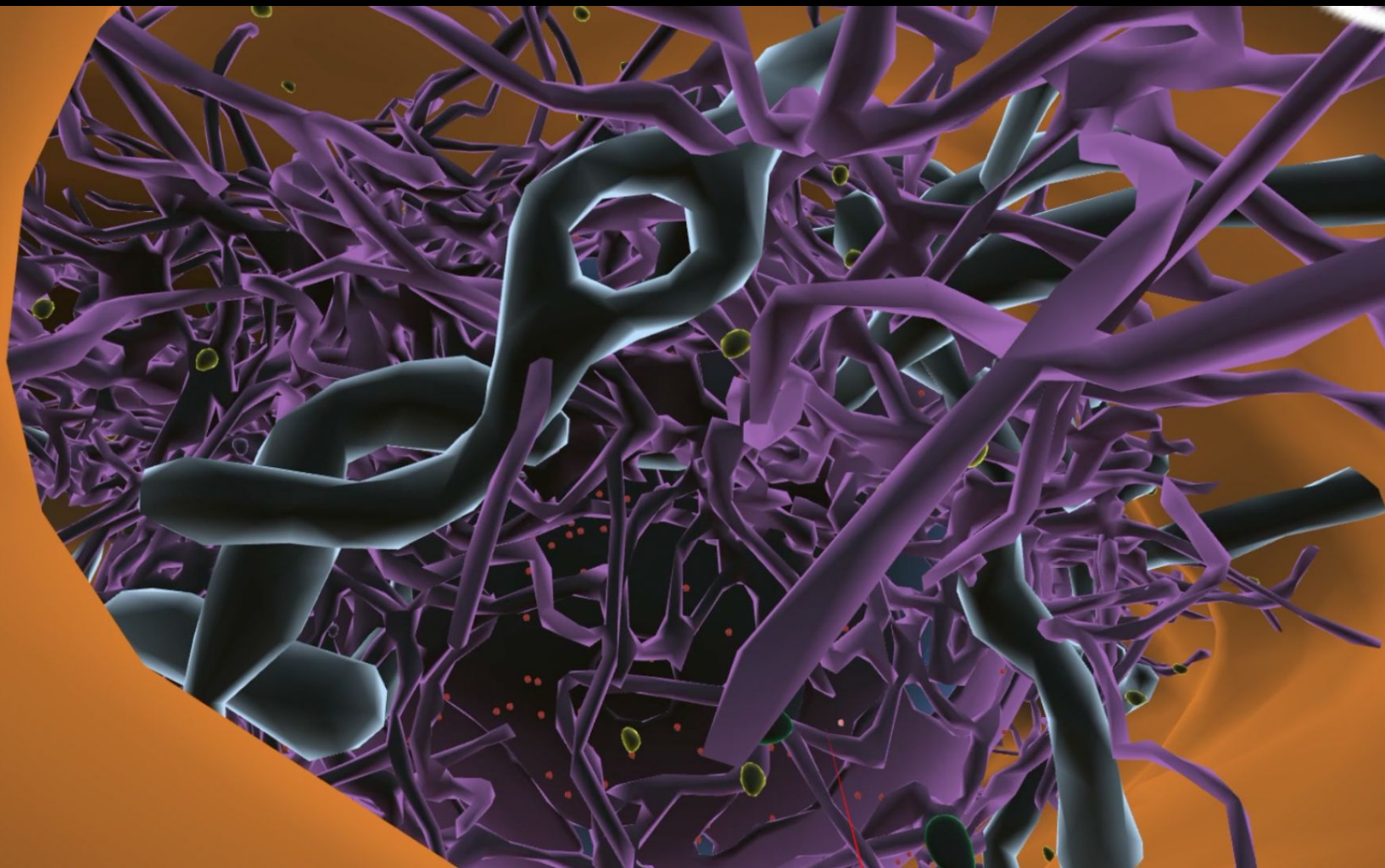
A previously unknown airway cell type may be a key to efforts to cure cystic fibrosis

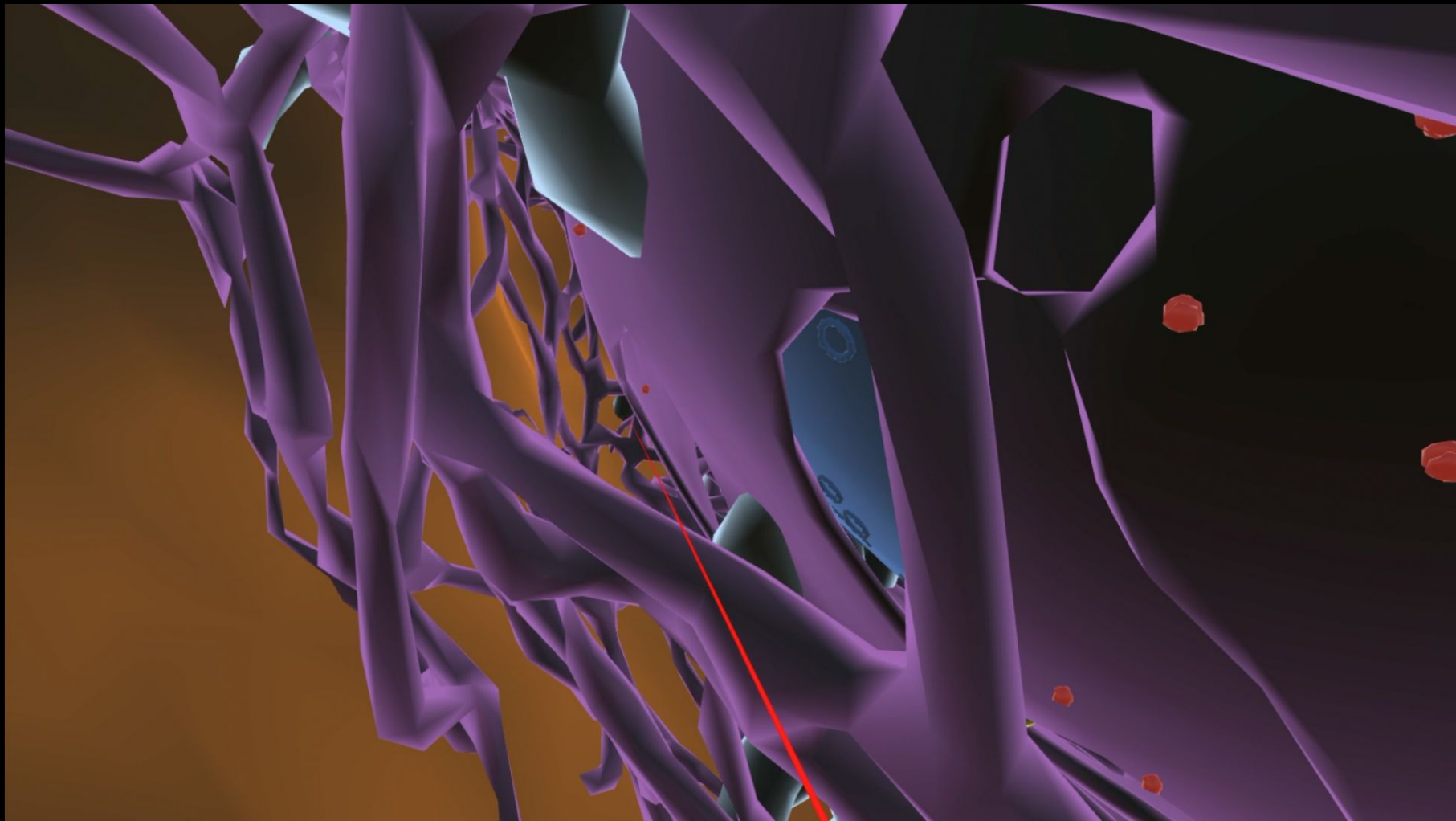
By KEVIN JIANG | August 1, 2018 | [Research](#)

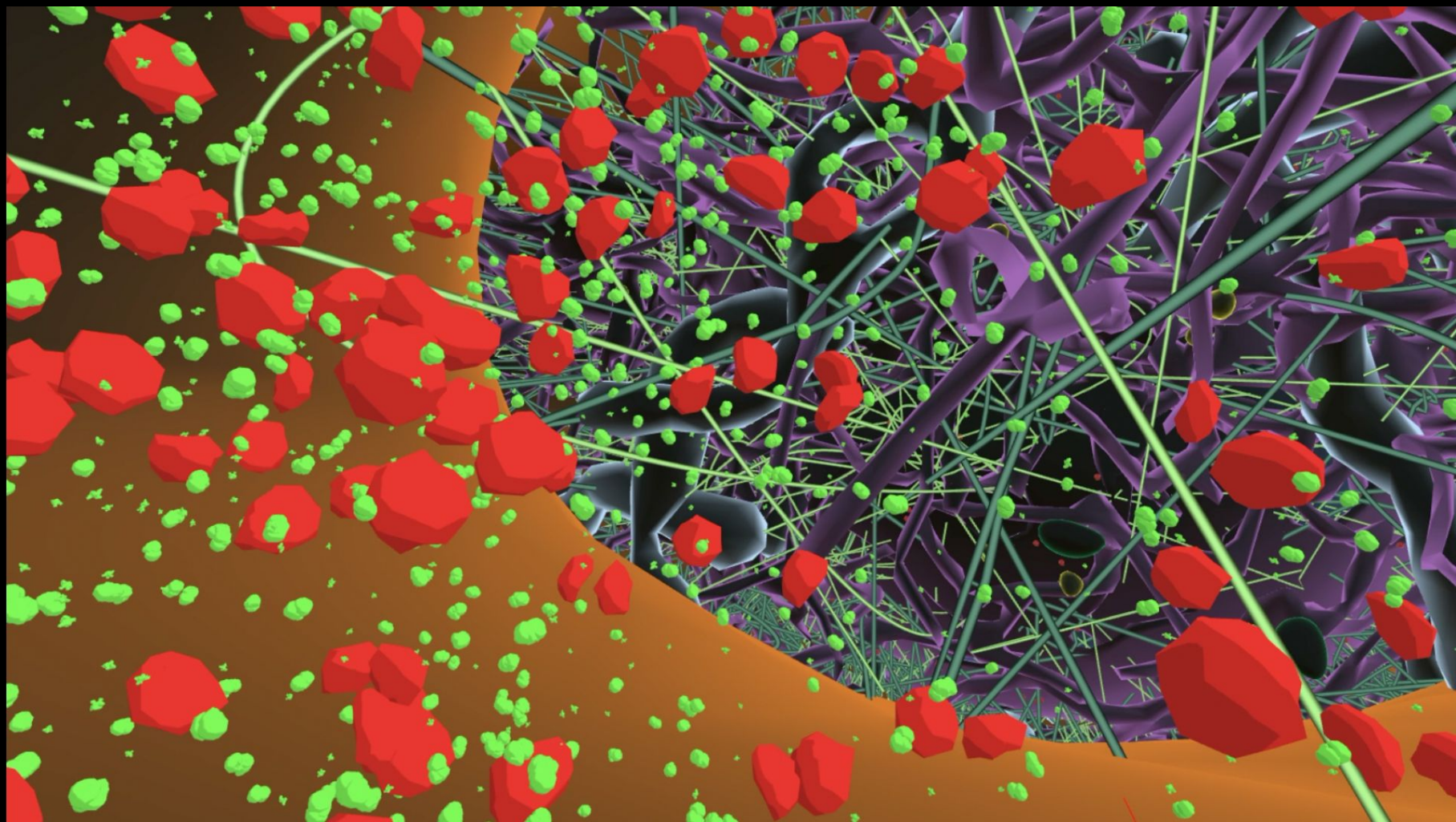


Wonderful! You're a
natural.

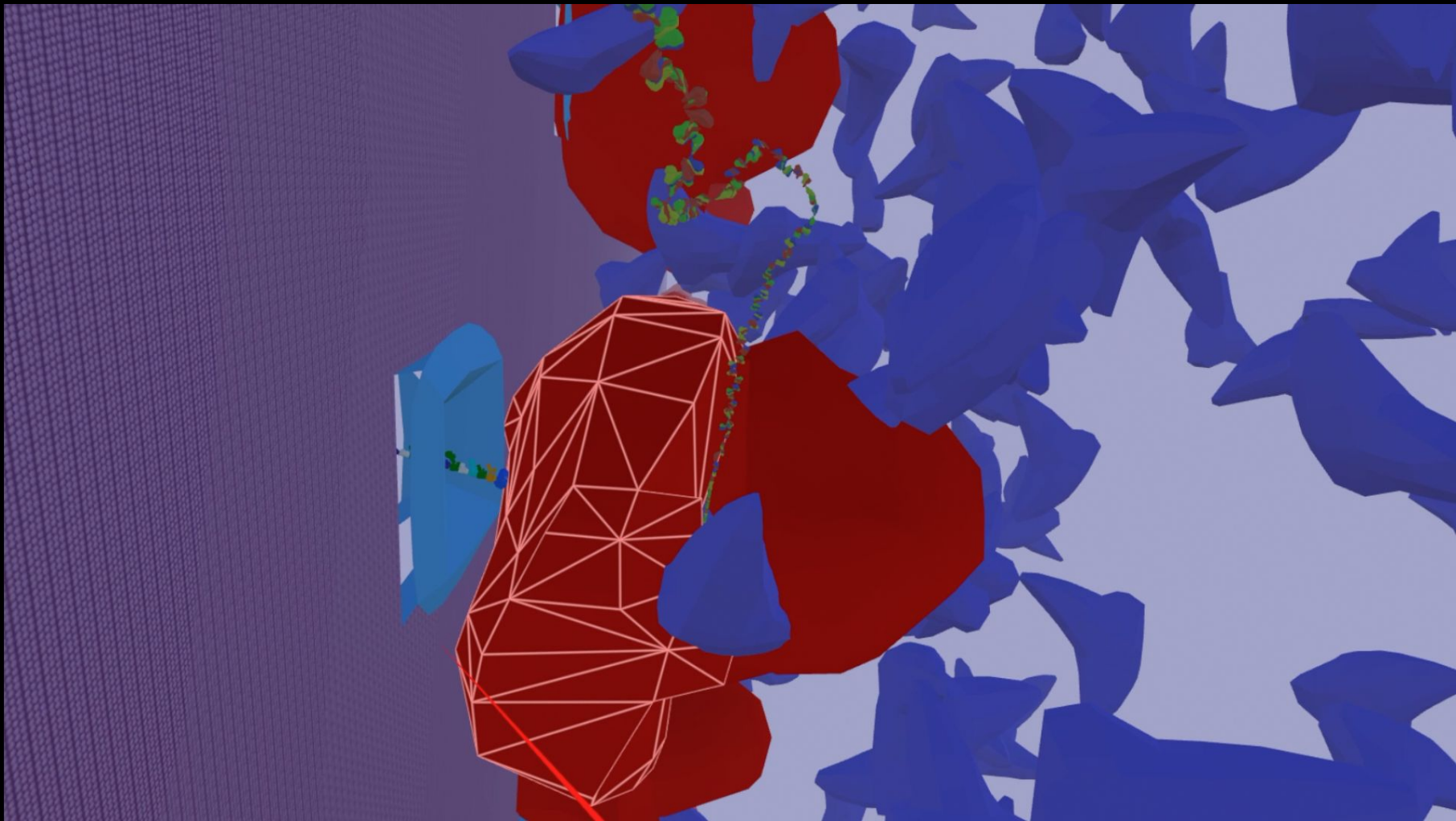








Size and scale





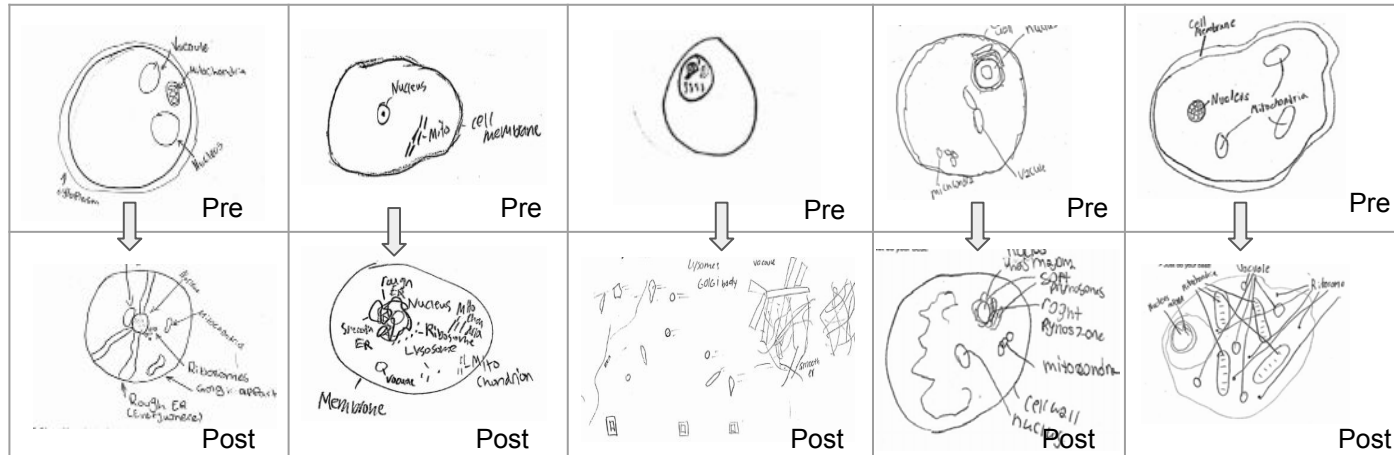
A 3D molecular model of a protein structure, likely a DNA-binding protein, shown against a light blue background. The protein is represented by a series of colored spheres (blue, green, yellow, red, cyan) connected by lines, forming a helical or zigzag pattern. A specific residue is highlighted in red and labeled "GLUTAMINE". A red line extends from this residue towards the bottom right corner of the image. On the left side, there is a vertical strip of a purple surface with blue rectangular patches, possibly representing a DNA double helix or a membrane.

GLUTAMINE

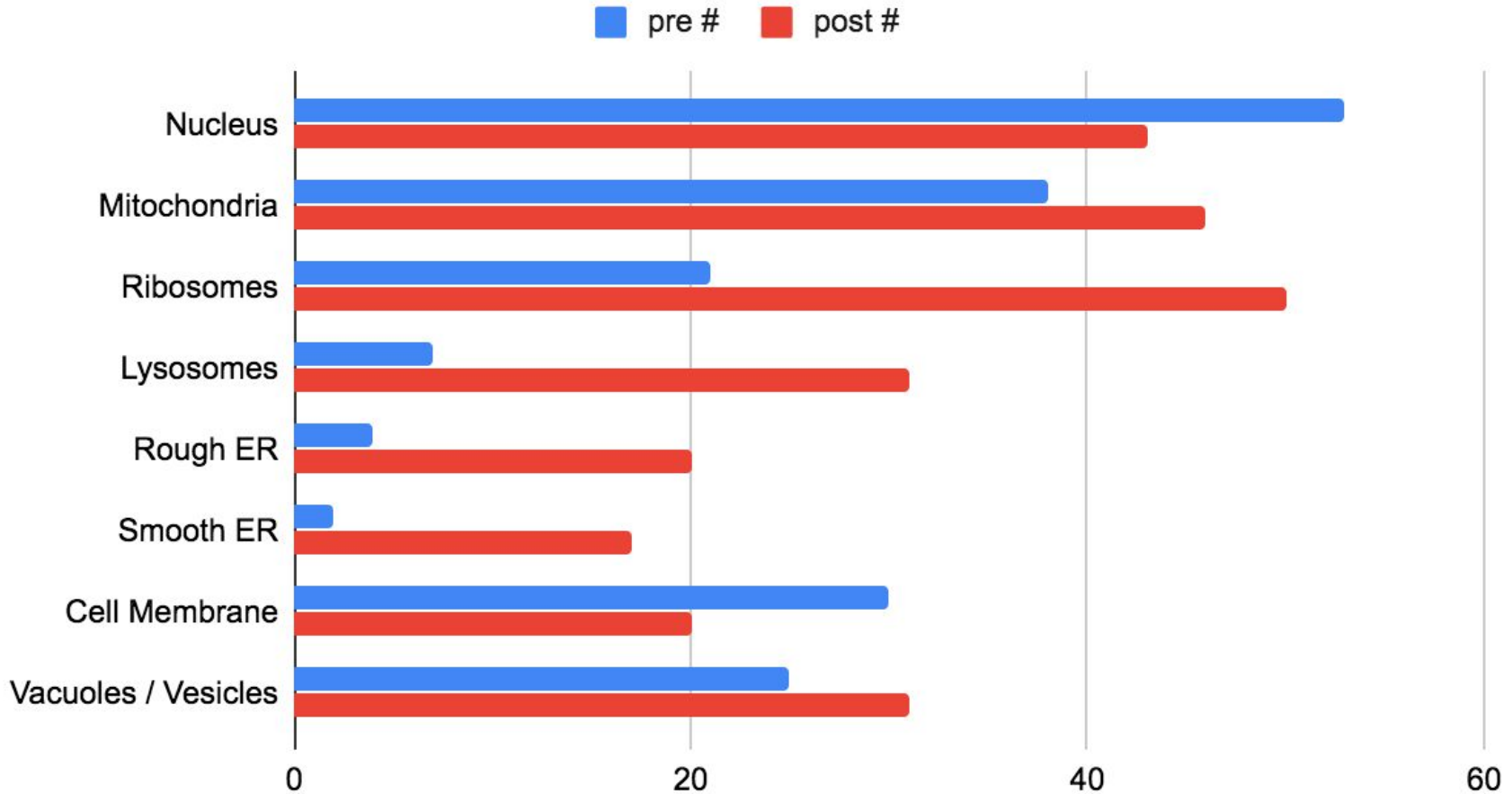
What do they learn?

Cell Drawings- GLTS

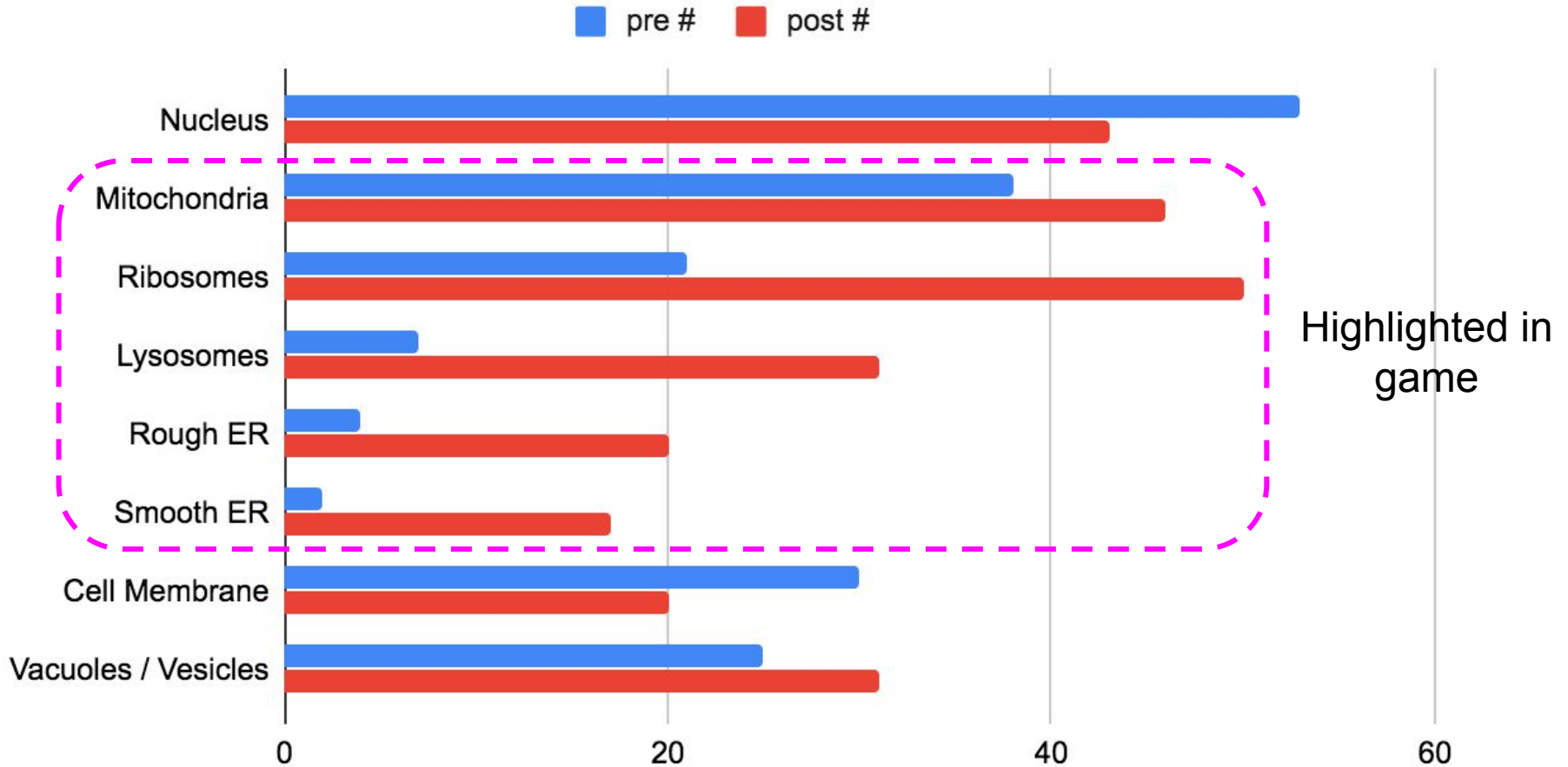
- Total # of labeled organelles in pre-drawings: 138
- Total # of labeled organelles in post-drawings: 234
- More texture, more organelles with labels were drawn in post cell drawings. Sizes and shapes changed.



Cell drawings pre and post comparison



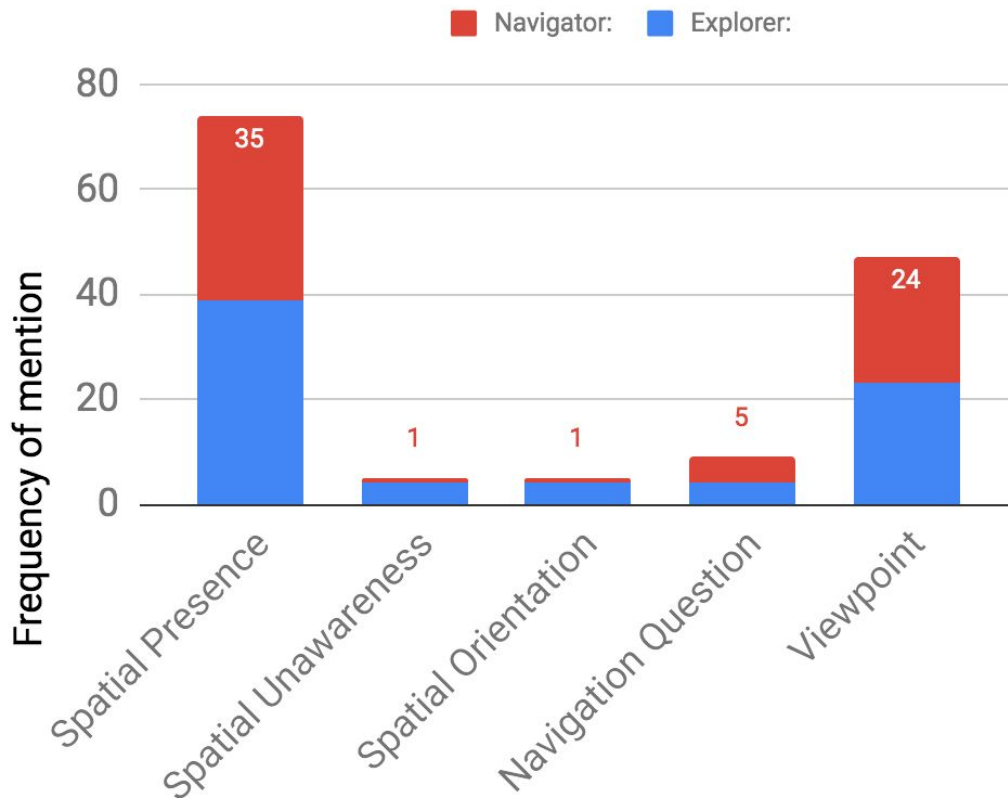
Cell drawings pre and post comparison



Interactivity

Strong sense
of spatial
presence in
the game

Spatial topics discussed by Navigator and Explorer roles



Hands on

I usually just like listen to a teacher read about it. But now like **we actually like got like a hands on experience of like what we're supposed to learn about**



Navigation

There were tubes, it looked like **I was traveling down a tube of some kind to the nucleus**, um...I didn't think a cell would be like that. I thought it would be more simple and would only have so many parts as was displayed in diagrams.

Environment

It actually lets us go in depth of the cell and then every piece so we know the layers and every part and what's it called and the name so **it actually leaves the image in our head.**

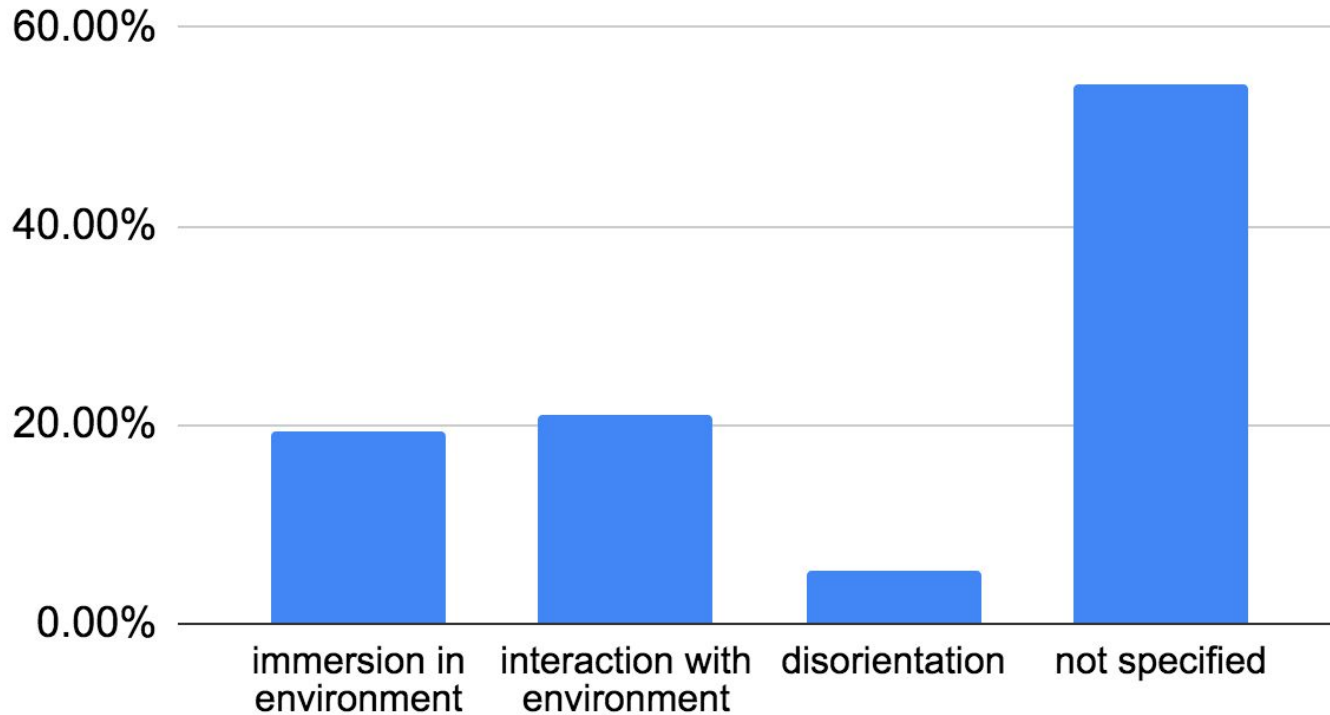




Perspective

VR it **gave me a better look of it from up close**, rather than looking at it from a diagram, like from above. Like I said, there were a lot more parts of a cell than I thought there would be, from other ways that I've learned it.

Why did you feel like you were there? (N=63)



Interaction

Hands on
Navigation

Immersion

Perspective
Environment

Collaboration

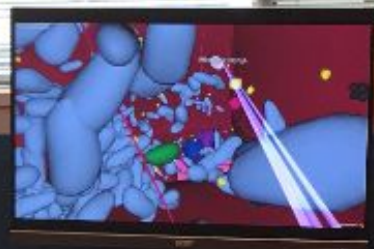




Collaboration:
Logistically helpful
in classrooms









UNIDENTIFIABLE. You need to turn on the microscope for this organelle



Mitochondria - Also known as "the powerhouse of the cell", the mitochondria is responsible for generating energy in the form of ATP.





Diseases

Healthy

I

II

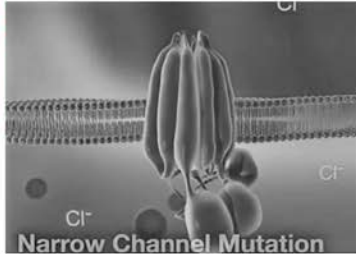
III

IV

V

Cystic Fibrosis: Class IV

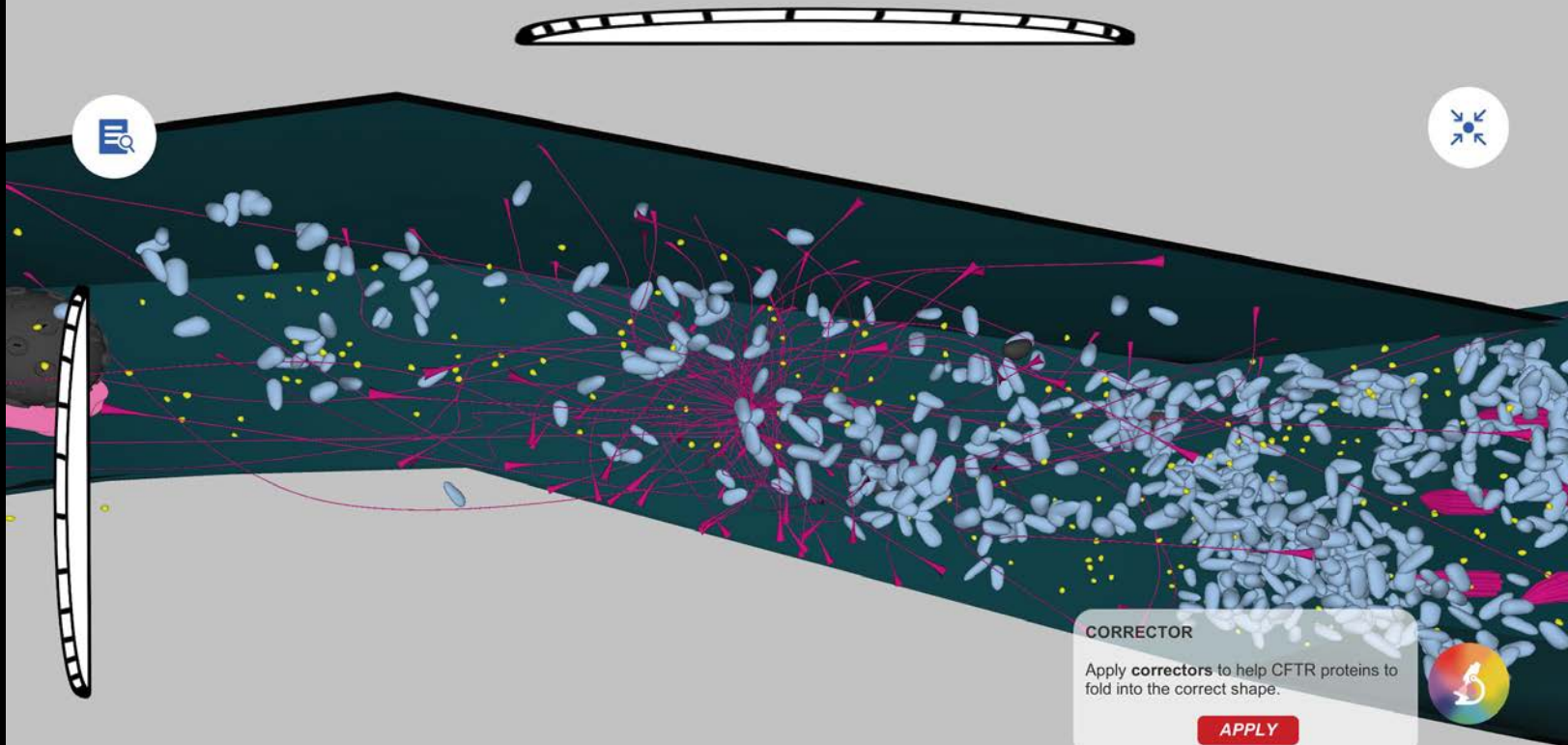
The transcription, translation, and folding of the CFTR protein is successful, but once the protein reaches the membrane, the **protein channel is faulty**. Only a **small percentage** of chloride or sodium ions needed are **allowed to pass** in or out of the cell.



The image above depicts a channel protein that only allows passage for a few chloride ions.

i





CORRECTOR

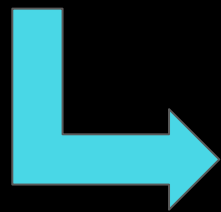
Apply **correctors** to help CFTR proteins to fold into the correct shape.

APPLY

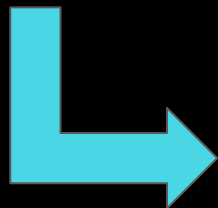


Shared vision

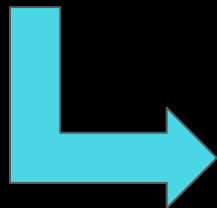
Group Flow



Ownership & Contribution



Communication



Collective Emergence

Sawyer, K. (2017). *Group genius: The creative power of collaboration*. Basic Books

Data Collection

Audio & Video Recording


Transcription & Coding

Pre- & Post-Game Interviews

Cell Drawings

YouTube

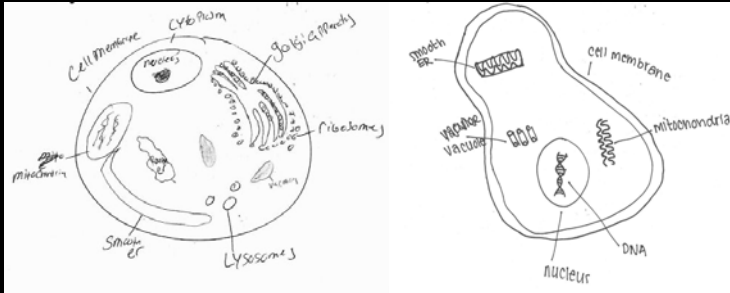
Search



Transcript

English (auto-generated)

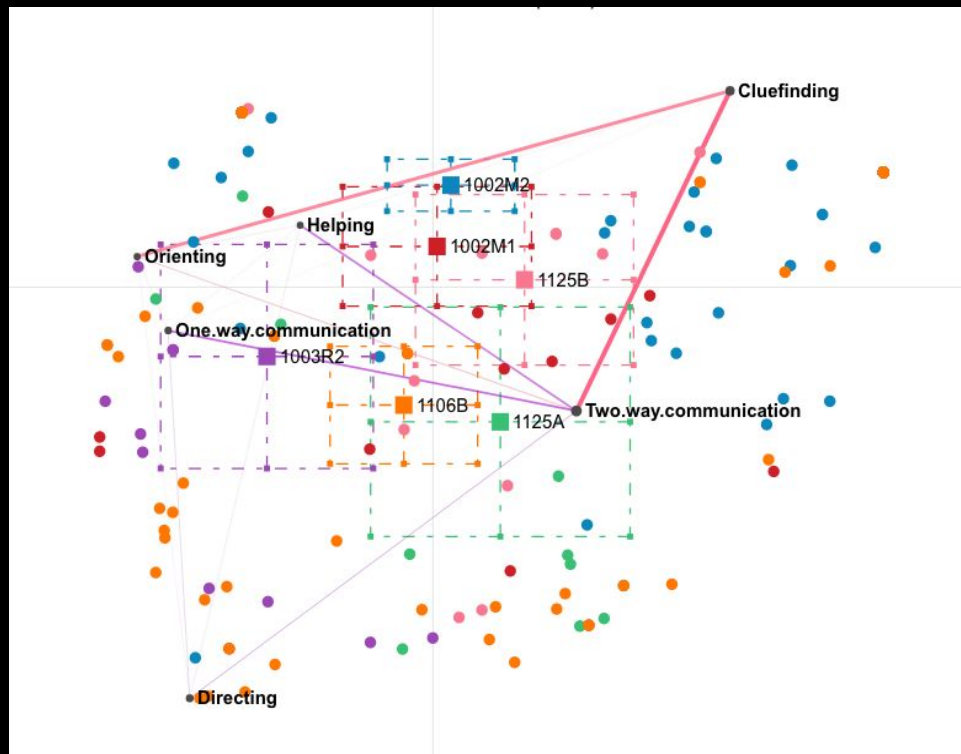
19:56 we're talking a few more comfortable so
20:02 I might touch you there a bit okay yeah
20:21 is that too tight no not one that's okay
20:25 mmm okay great there's no and there's a
20:40 there's a little slider here that you
20:44 can adjust for focus mm-hmm so if you
20:47 feel like you want to adjust the chicken
20:48 you can do that from right there okay
20:51 and this one's the left yes



Epistemic Network Analysis

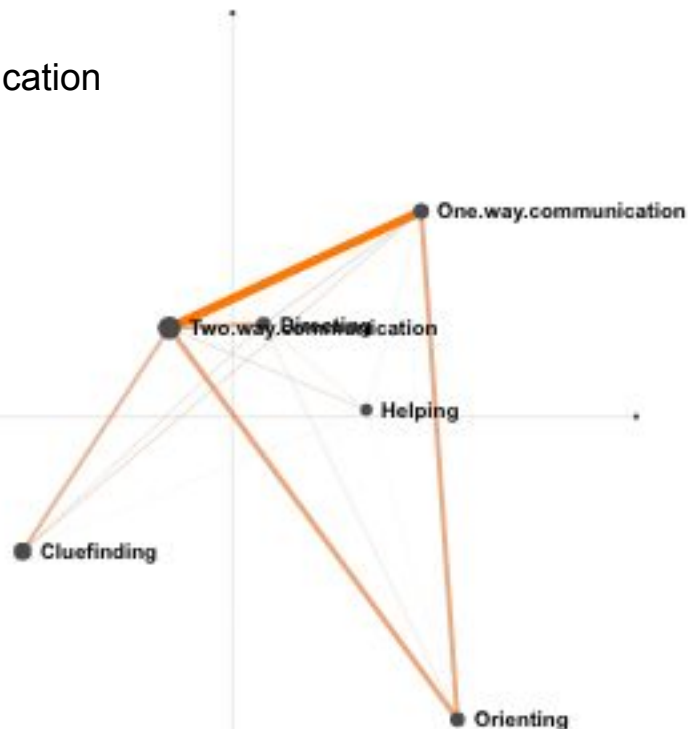


Connections between
ideas in conversation

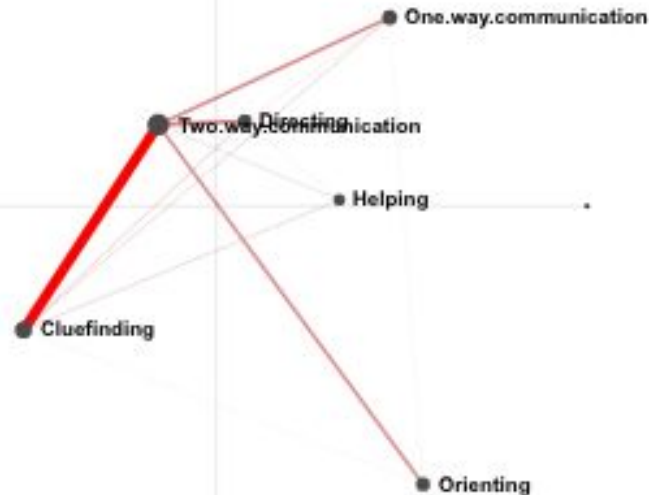


Epistemic Network Analysis

Clarification



Collaborative cluefinding



User study 2017
N=60

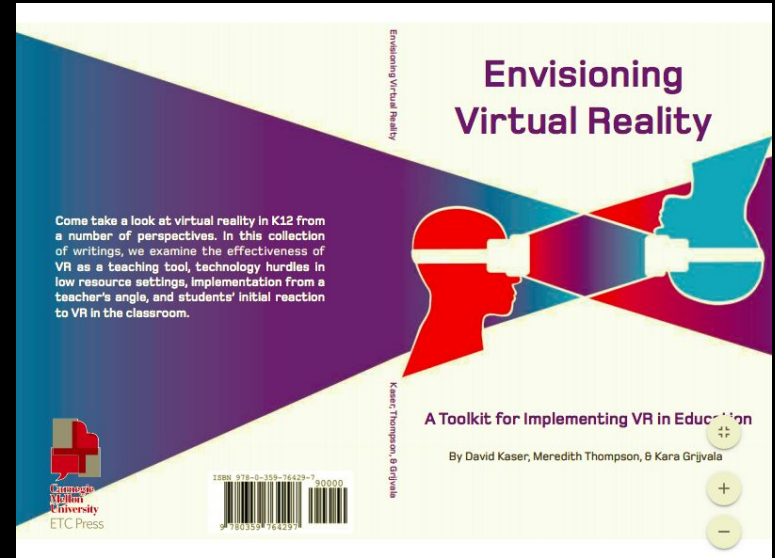
Expert and novice input helps design

Qual study 2018
N=26

*High spatial presence
collaboration changes over time*

Quan study 2019
2 urban high-needs schools
(N=130)

CMU's ETC
Press



Thank you!