Neurodome: Exploring 3D Brain Data in Digital Domes and Virtual Reality

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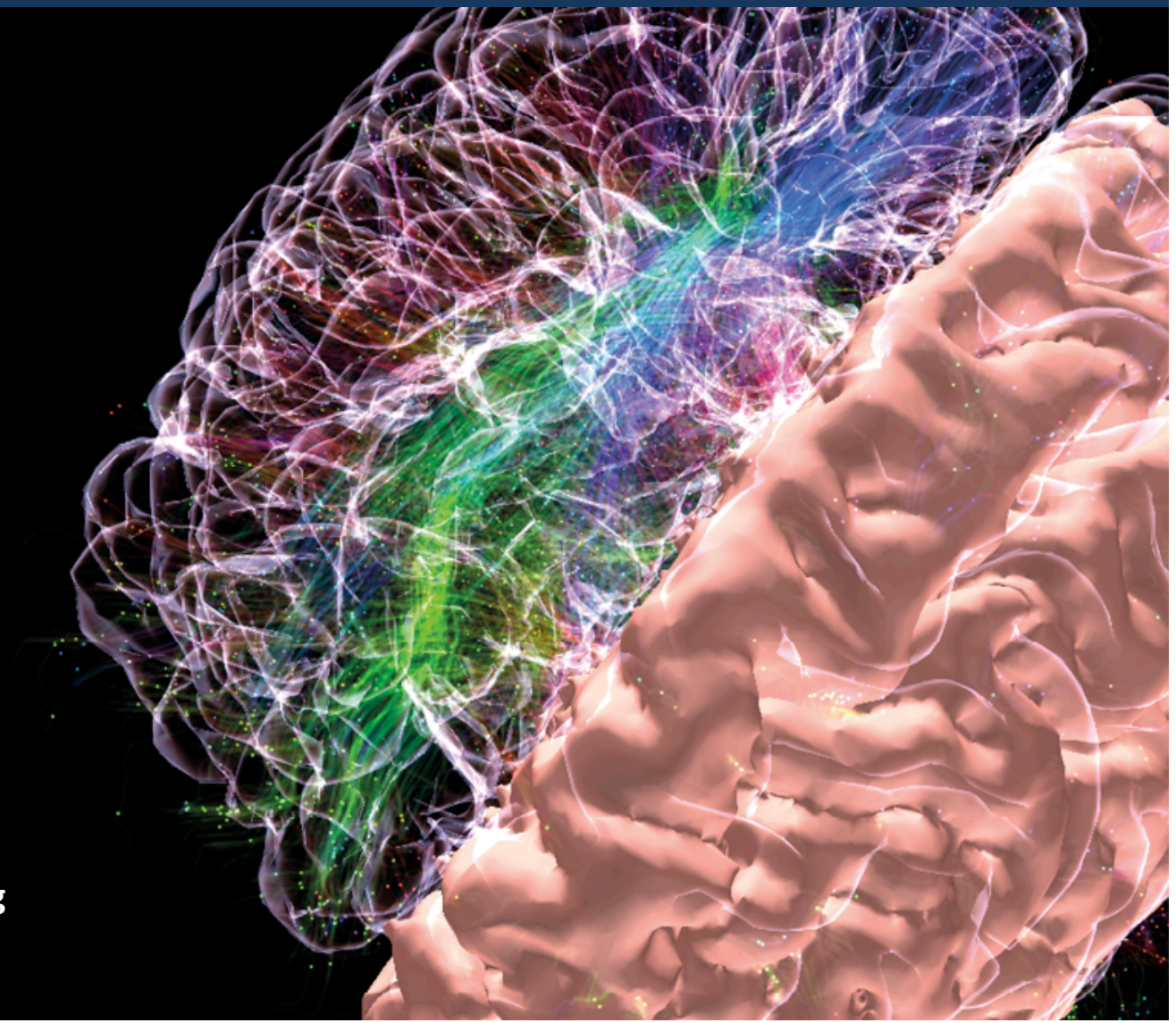
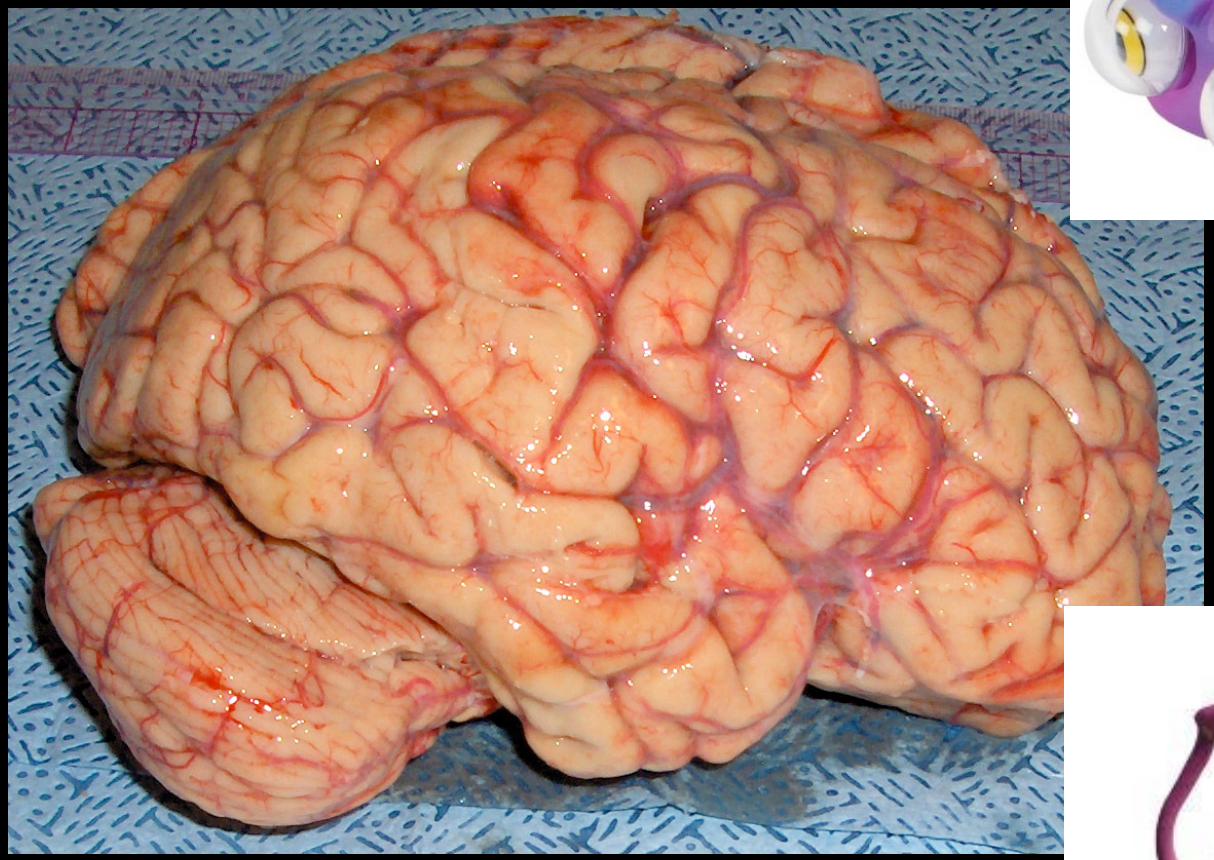
Neurosensory Engineering Lab
New York Medical College



Westchester GIS User Group Meeting
May 16th, 2019

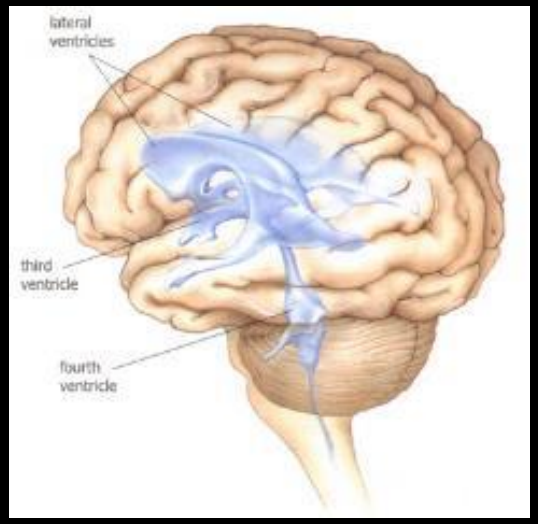
Nurturing the next generation of neuroscientists

Real data is key!

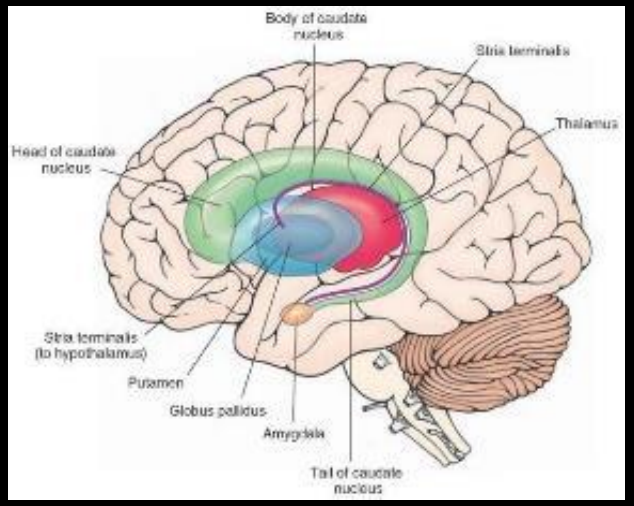


Neuroanatomy is difficult to learn from flat images

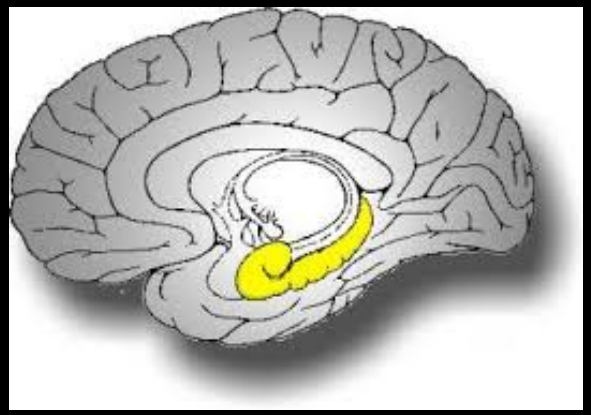
Ventricular system

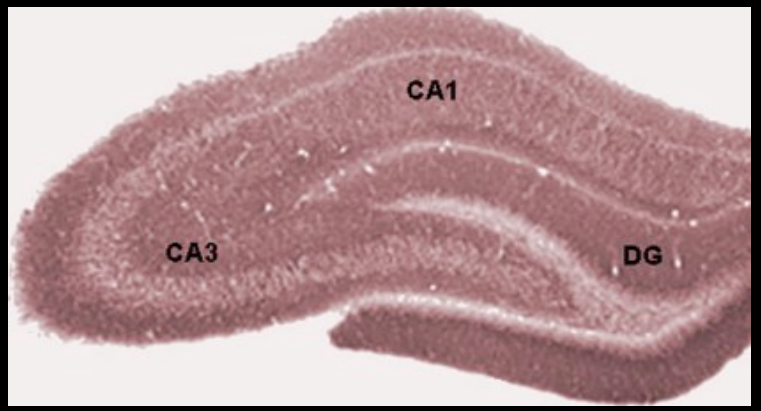


Basal ganglia



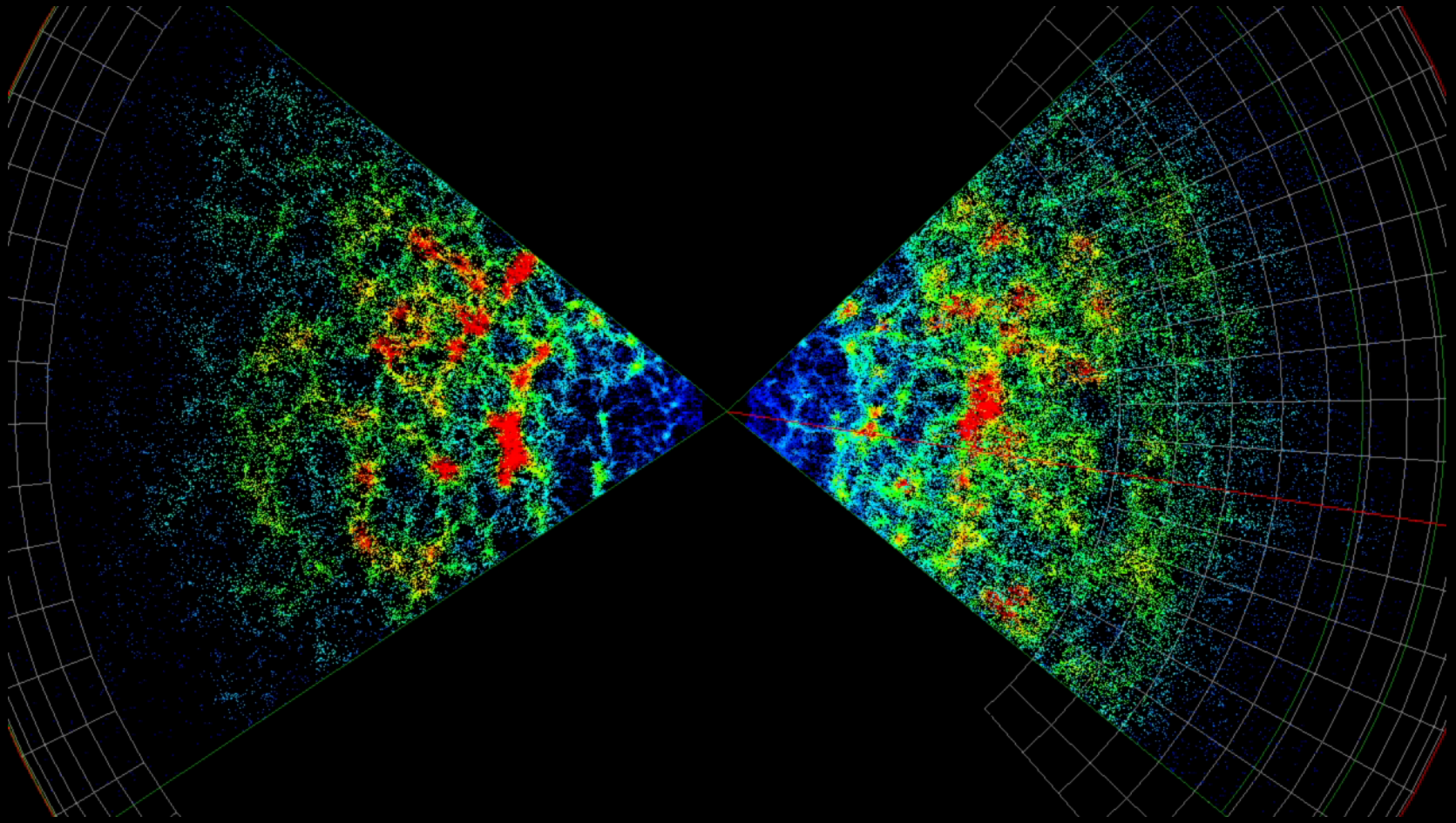
Hippocampus





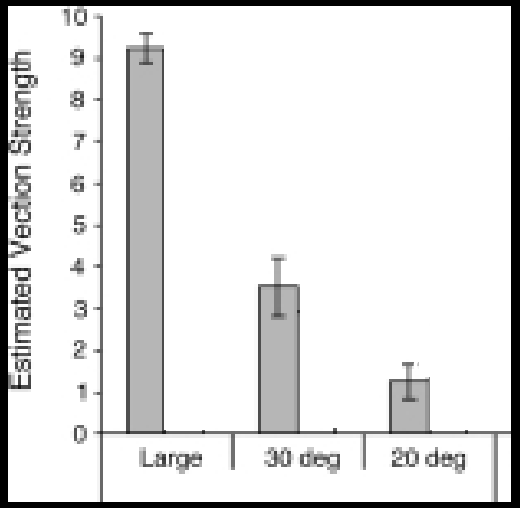
Borrowing tools from astronomy education

Immersive display helps make complex data understandable

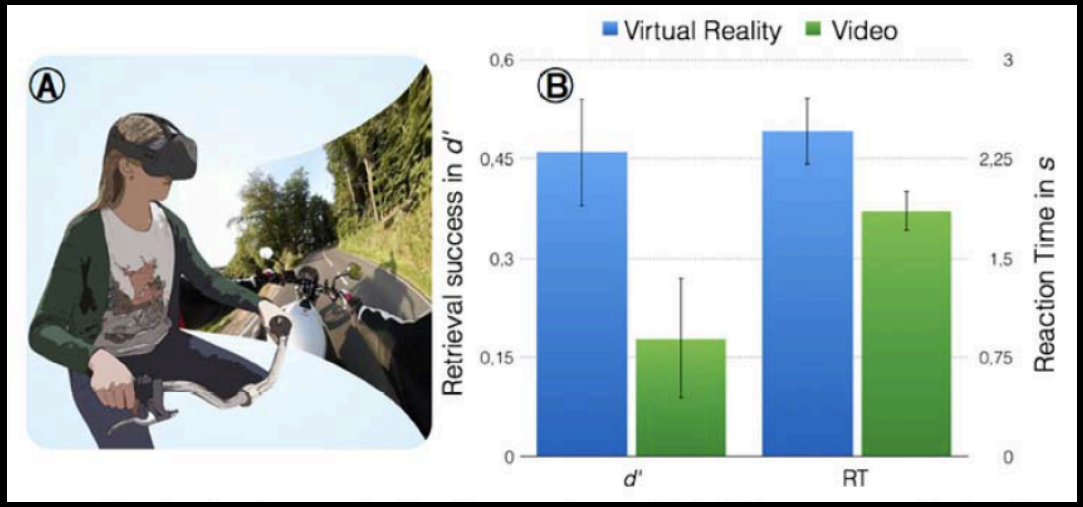


Sloan Digital Sky Survey: Immersive visualization of Digital Universe (AMNH) using Uniview

Immersive displays enhance learning

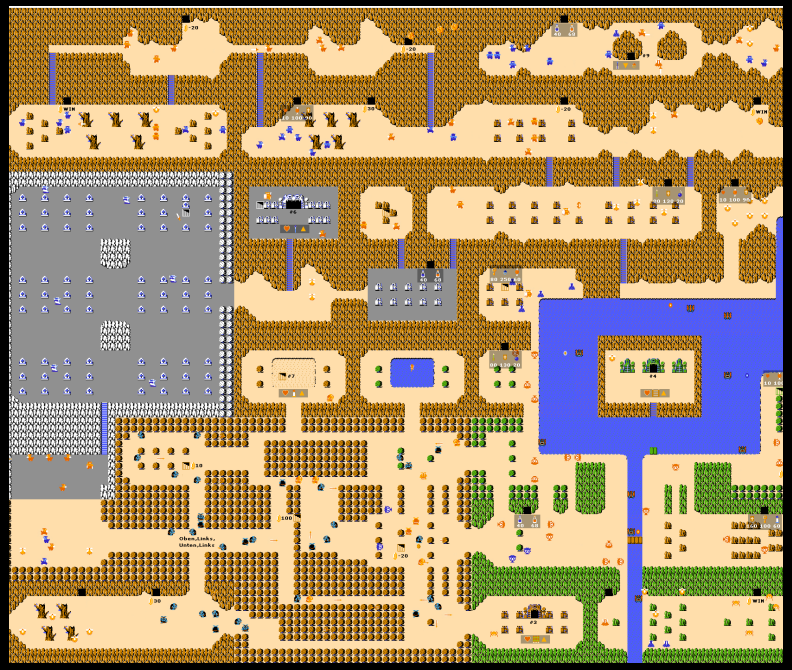


Tarita-Nistor et al., J. Vestib. Res. 2006

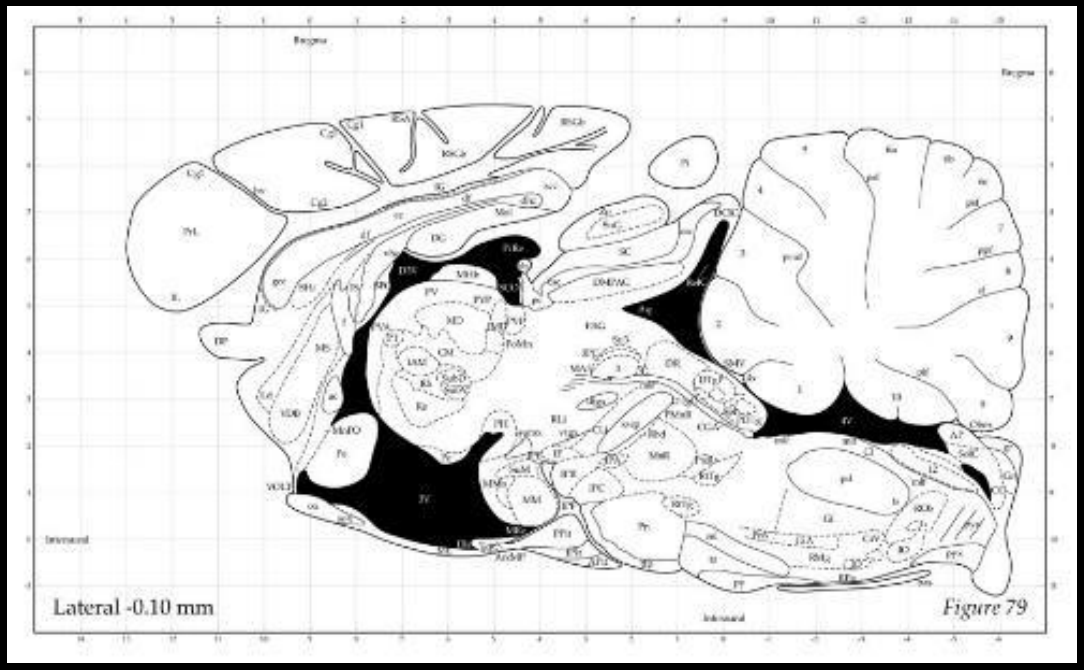


Schöne et al., *Current Psychology* 2017

Map-based spatial learning

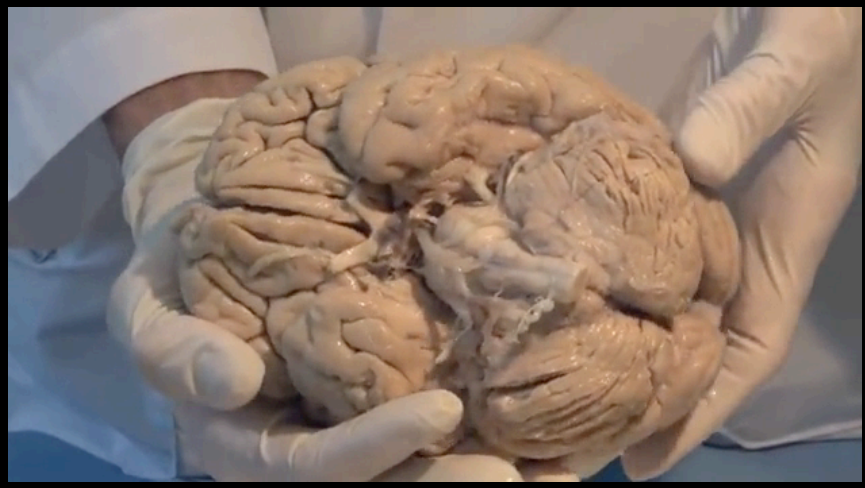


The Legend of Zelda, circa 1987

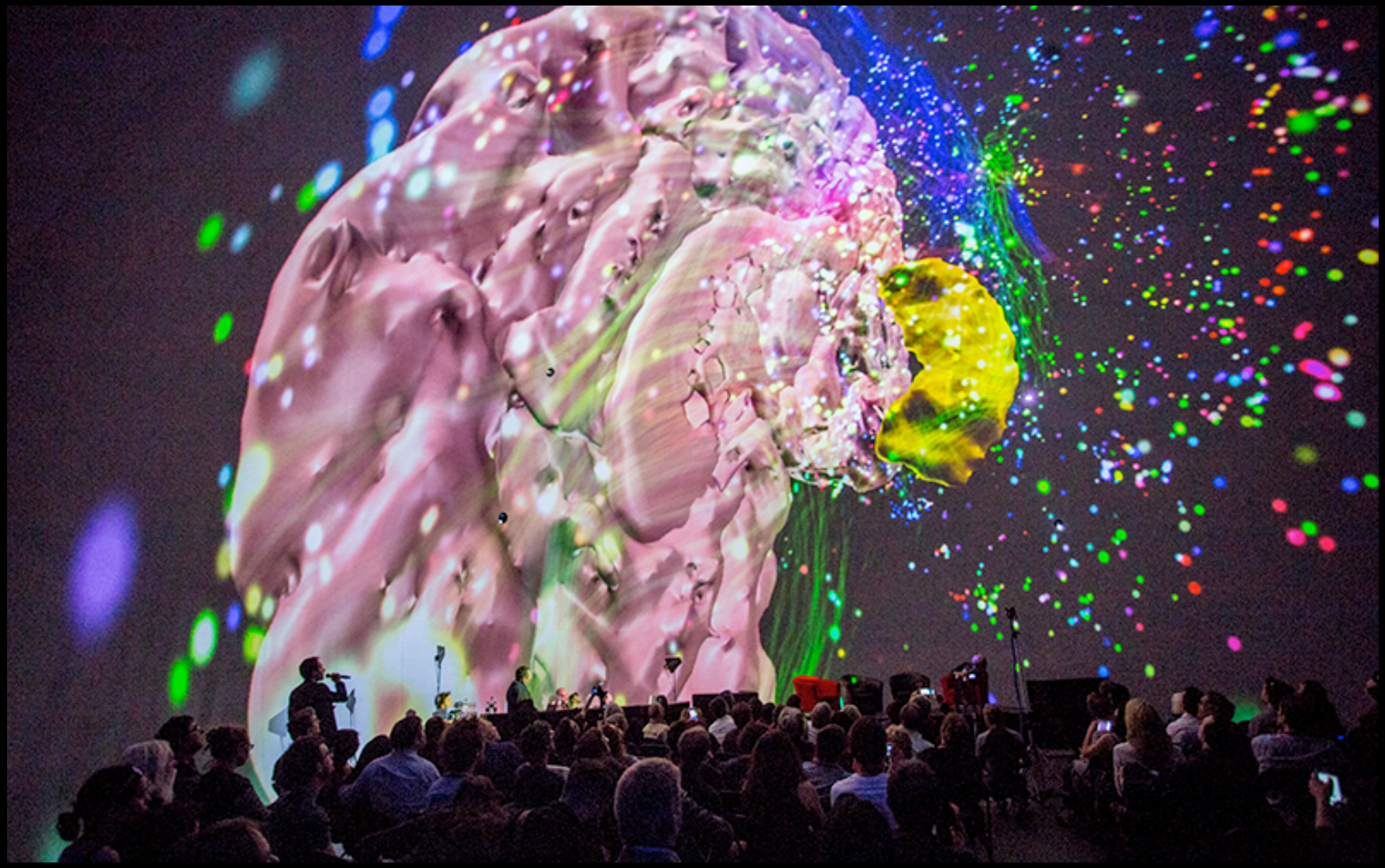


Paxinos & Franklin Stereotaxic Atlas

Route-based spatial learning



Neurodome: Learning through exploring

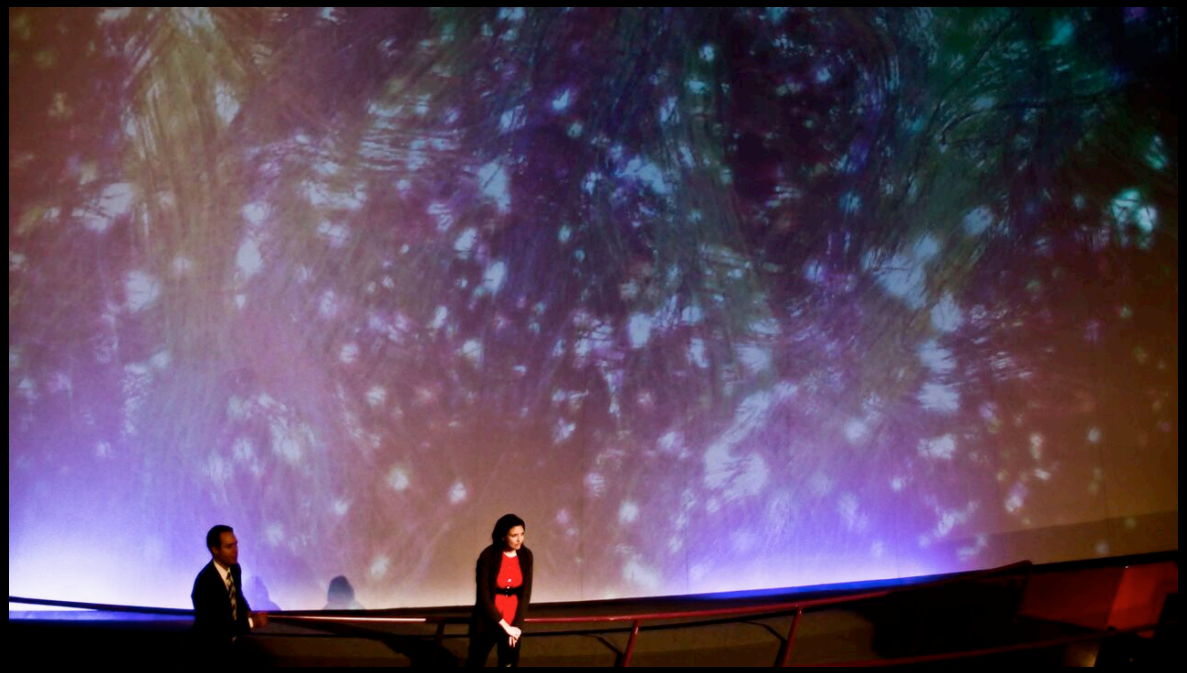


California Academy of Sciences
Denver Museum of Nature and Science
Beijing Planetarium
Société des Arts Technologiques (Montréal)
Hradec Kralove (Czech Republic)

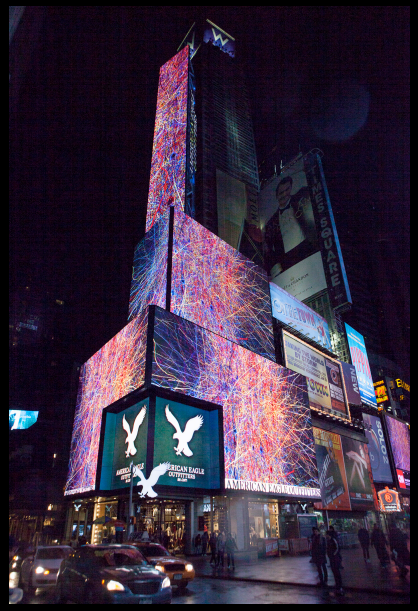
Inspiria Science Center (Norway)
Bell Museum of Natural History (MN)
World Science Festival (NYU Skirball)
University of Michigan Museum of Natural History
MacMillan Space Center (Vancouver)

Planetario del Parque de las Ciencias (Spain)
Lower Eastside Girls Club
Bronx High School of Science
Otago Museum (NZ)
Cradle of Aviation JetBlue Planetarium

Scales: macro, meso, micro



Lion King scale



NeuroDome Evaluation Questions

Name: [redacted]

School, city, state: [redacted]

Email: [redacted]

Some questions are most applicable to local Twin Cities teachers. We still value your input, so if you are not in the area, please answer the questions as if it were a possibility. The NeuroDome presentation is available state- and nationwide and there could be an opportunity for you to use it at your location.

1. The NeuroDome presentation was a valuable experience for my professional development.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

2. The NeuroDome presentation would be a valuable experience for my students.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

3. Would you be interested in having a NeuroDome presentation either

   a. at your school in the portable ExploraDome Museum?

   yes maybe no

   b. on field trip to the Bell?

   yes maybe no

4. If yes or maybe, would your preference be to have (please circle one)
   a. a presentation planned and given by Bell education staff
   b. a presentation tailored to your needs by working with Bell staff in advance
   c. either way works

5. Would you be interested in giving the presentation yourself (with advance preparation), and Bell staff running the computer?

   yes maybe no

6. Do you prefer
   a. Movie
   b. Live presentation
   c. Both

Please turn over to add more comments

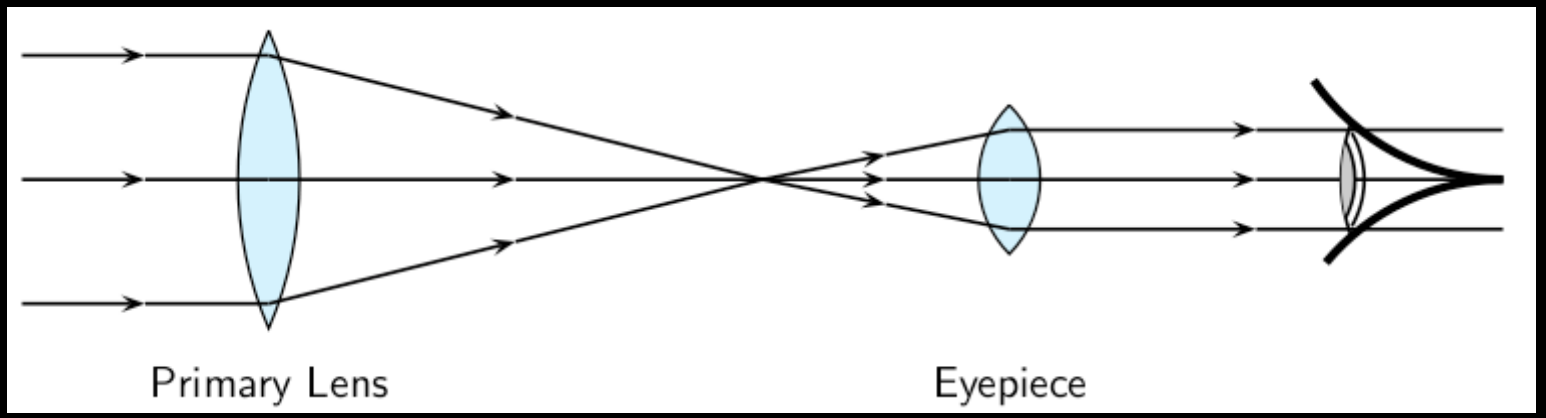
8/5/2015

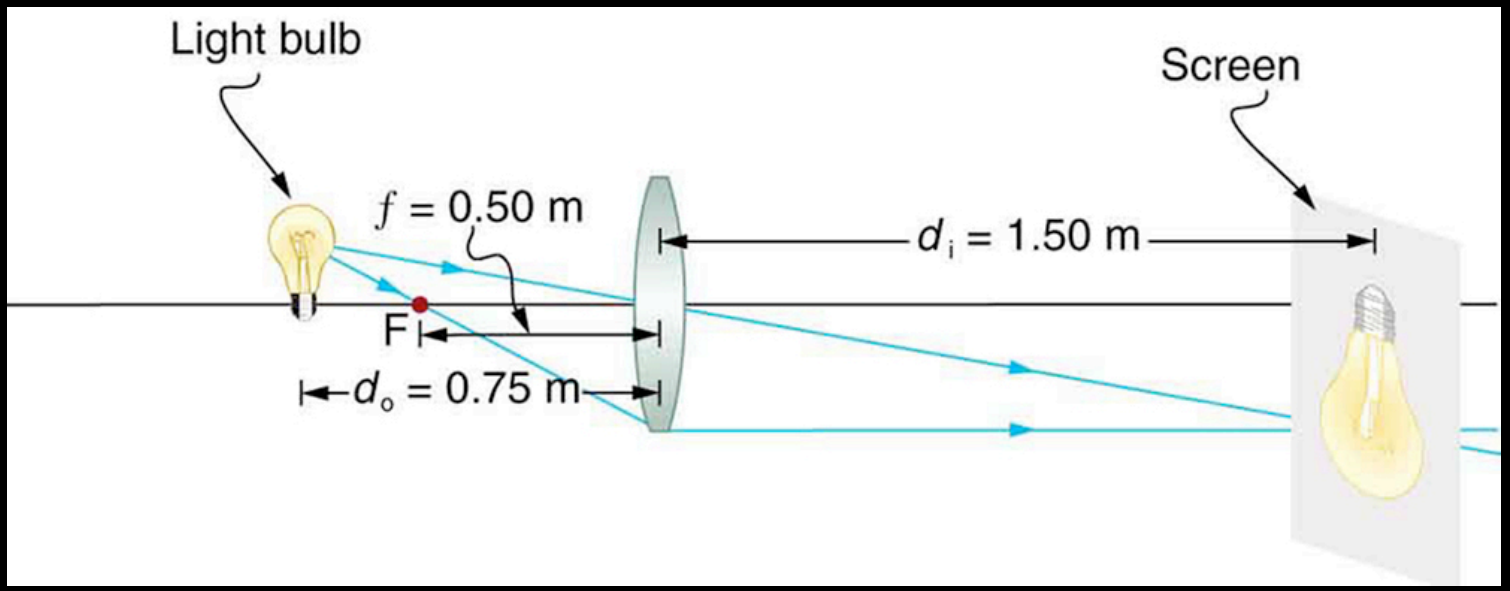
Please share any other comments about the presentation:

I am VERY interested in presenting this to my class! So cool!

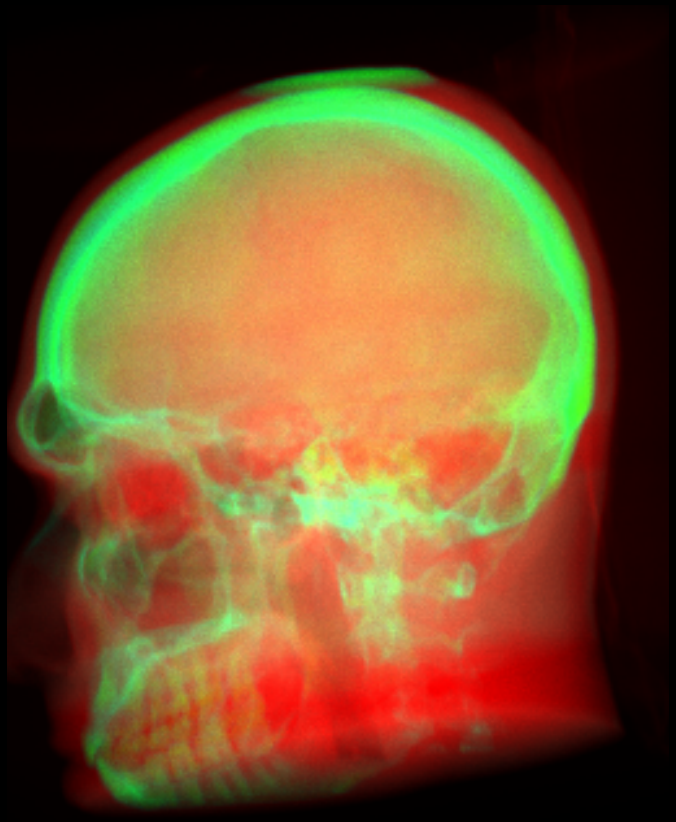
Telescope vs. Microscope:

2D vs 3D



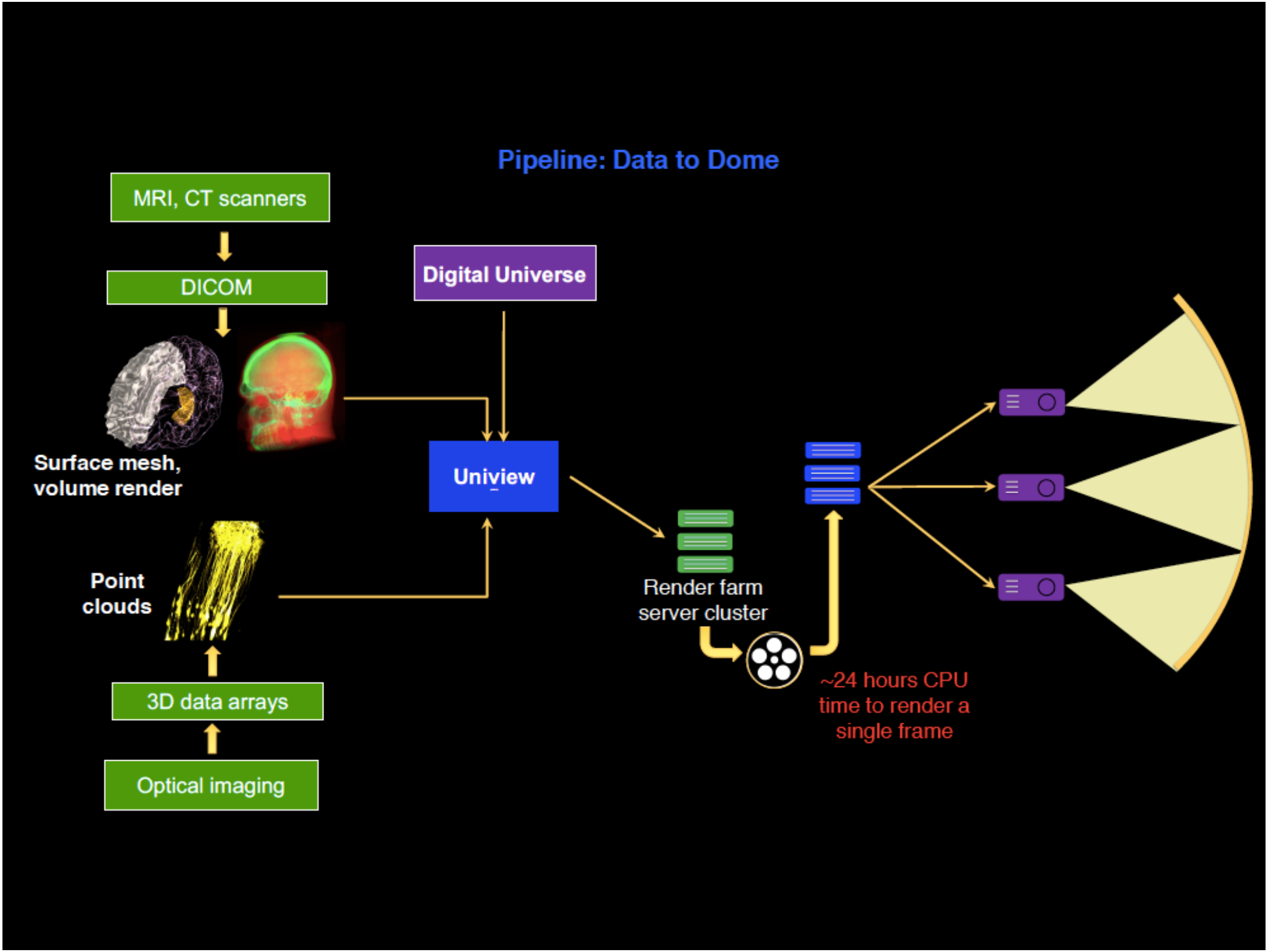


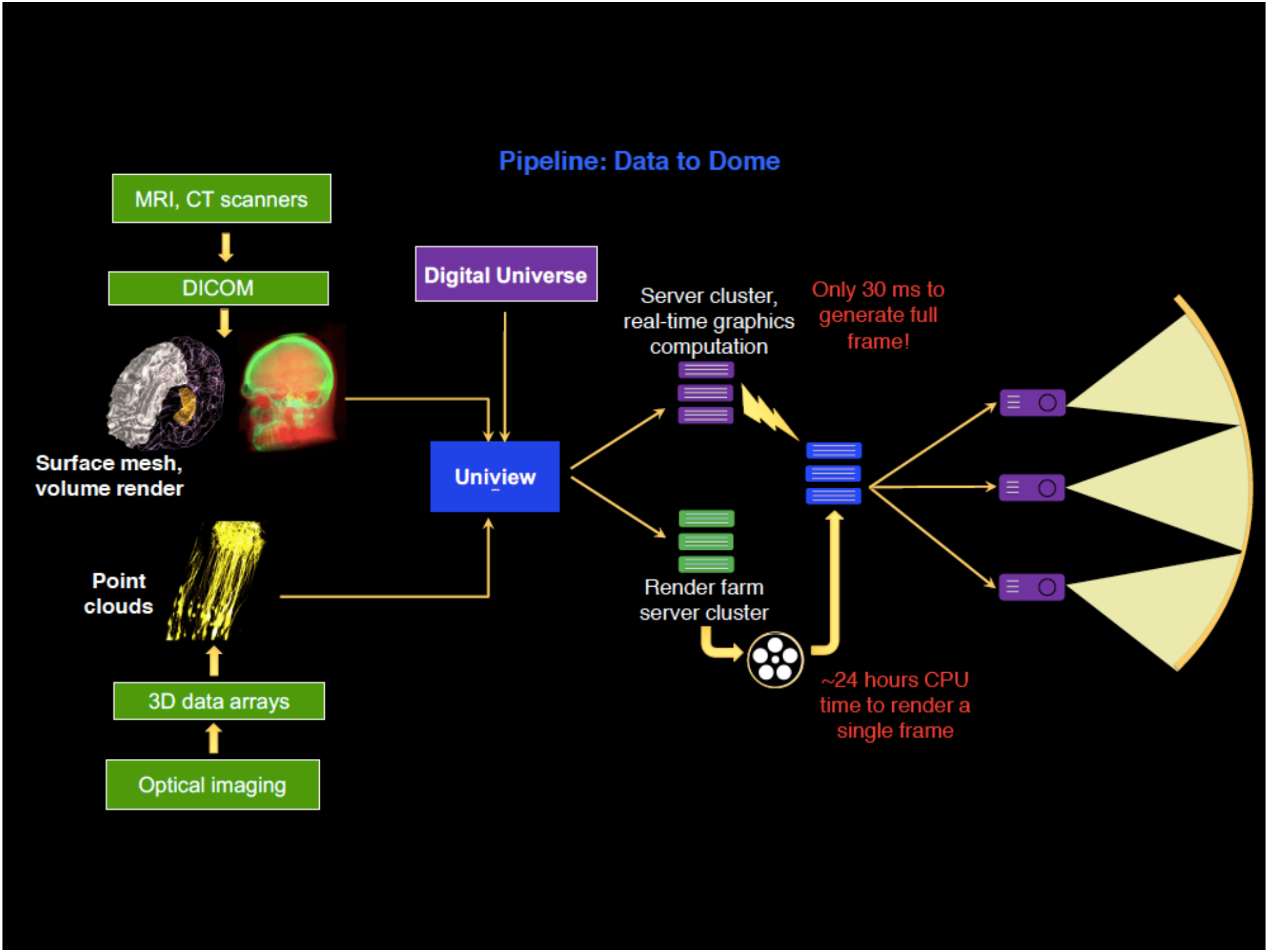
To see anything meaningful you need to “throw away” data



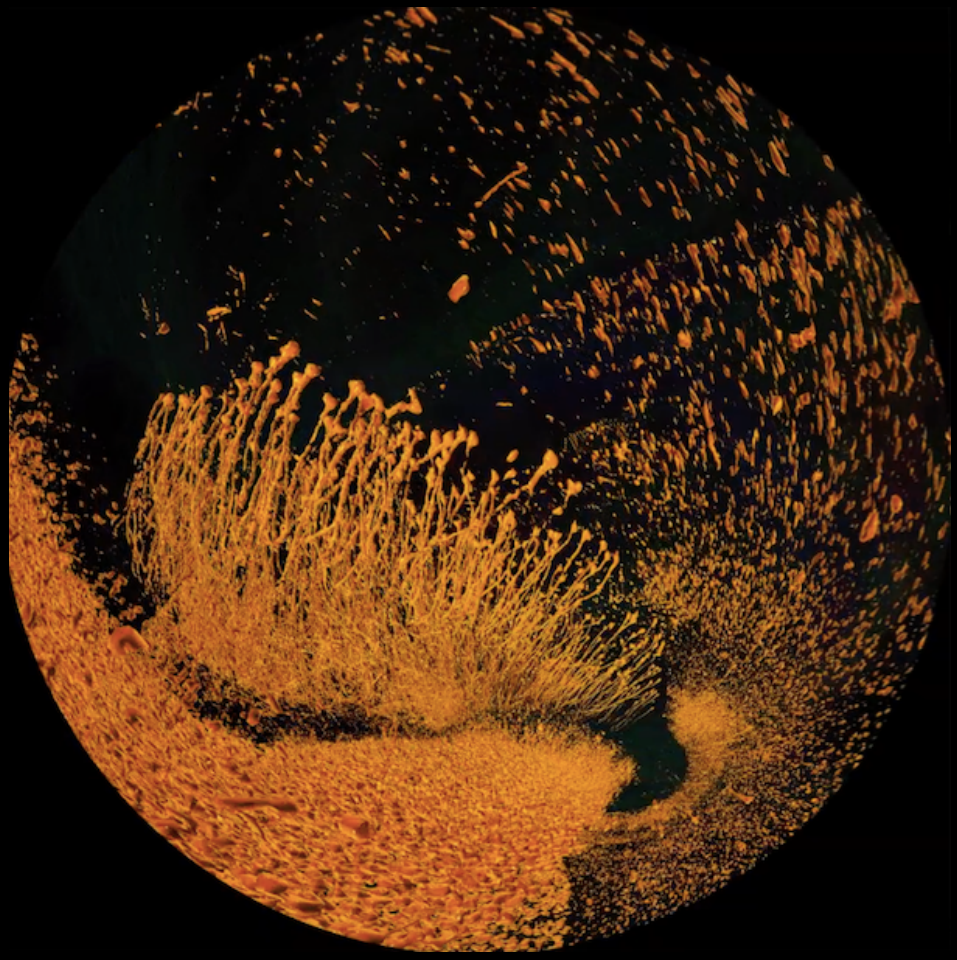
Full CT dataset

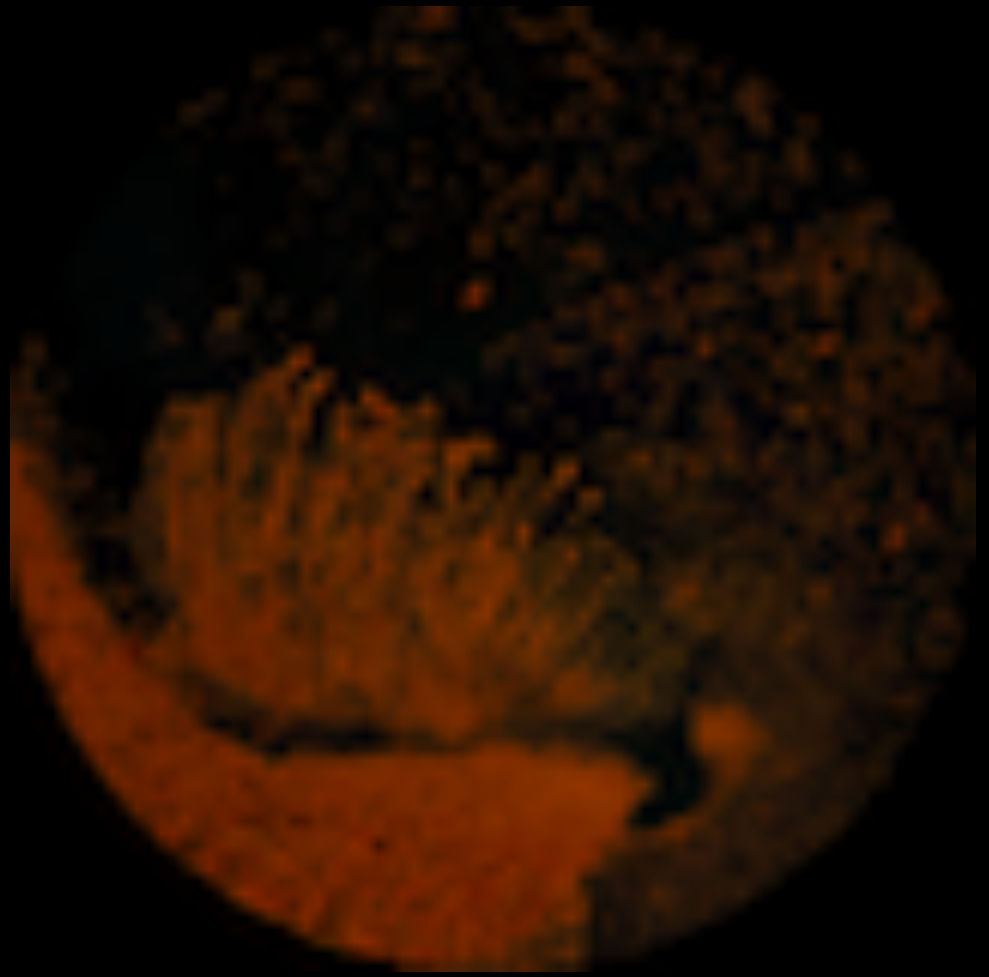
Two intensity windows (bone, skin)


Pipeline: Data to Dome
MRI, CT scanners
DICOM
Digital Universe
Surface mesh,
volume render
Uniview
Point
clouds
Render farm
server cluster
3D data arrays
Optical imaging
~24 hours CPU
time to render a
single frame

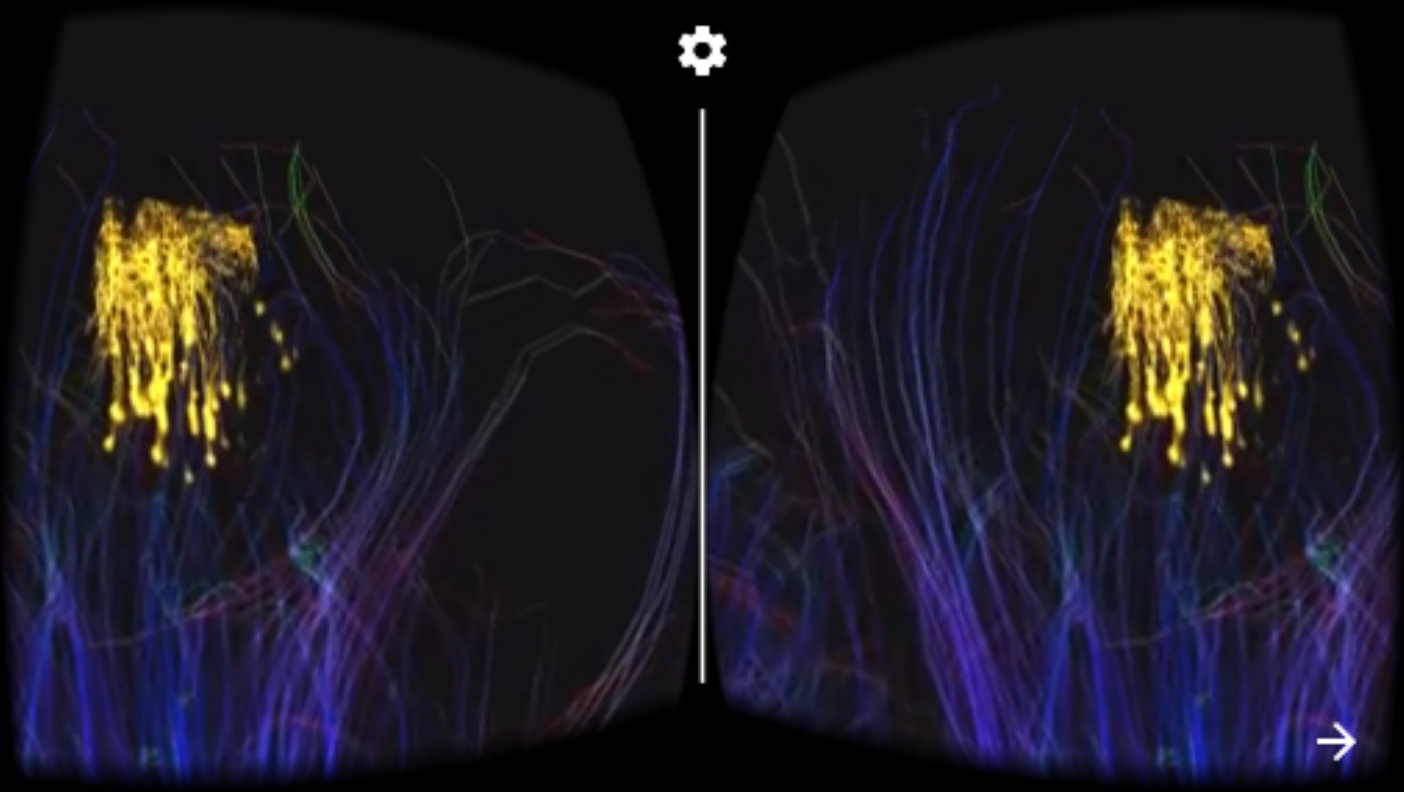

Pipeline: Data to Dome
MRI, CT scanners
DICOM
Digital Universe
Server cluster, real-time graphics computation
Only 30 ms to generate full frame!
Surface mesh, volume render
Uniview
Point clouds
Render farm server cluster
~24 hours CPU time to render a single frame
3D data arrays
Optical imaging

Large format: Practical challenges





Alternative immersive format: Head mounted display (HMD)



VR in classroom settings:
YouTube360 live stream + Uniview

Neuroanatomy course at NYMC

Survey responses (42 participants):

~60% of students had not personally experienced VR

100% of students wanted VR incorporated into medical neuroanatomy somehow

~20% of participants experienced some transient discomfort during an uninterrupted 45 minutes of viewing

Thanks!

Adler Planetarium
Patrick McPike
Mark SubbaRao
Jeffrey SubbaRao

American Museum of Natural History
Carter Emmart
Douglas Harsch

Rockefeller University
Aaron Steiner (Pace)
Jeanne Garbarino
Joshua Salvi

Columbia University
Kelley Remole

SCISS AB
Daniel Arnberg
Staffan Klashed

Weill Cornell Medical College
Michael Dayan

Hunter College
Kelle Cruz