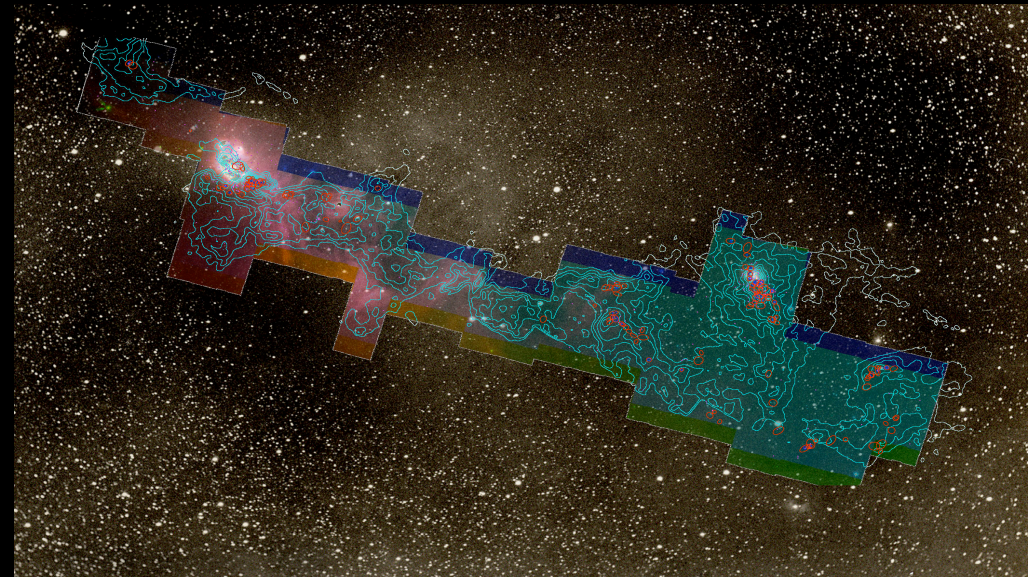
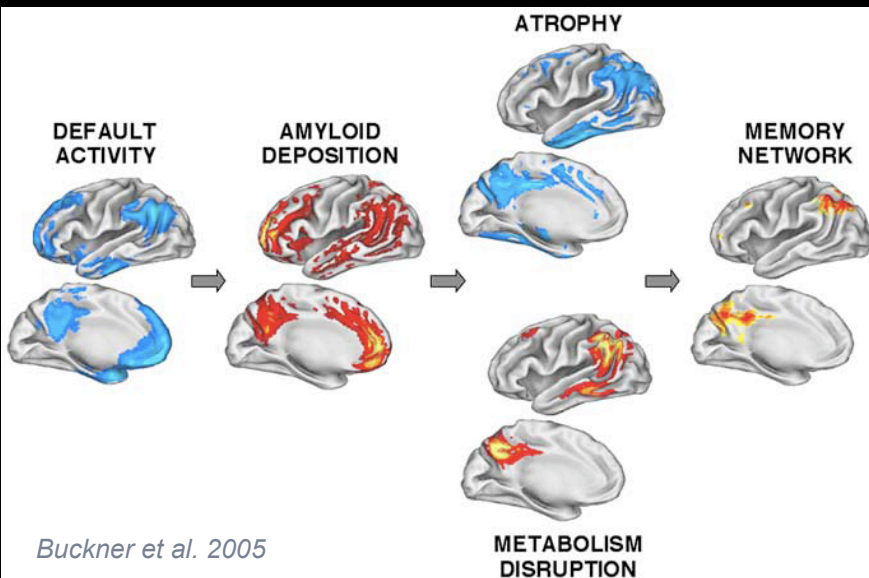
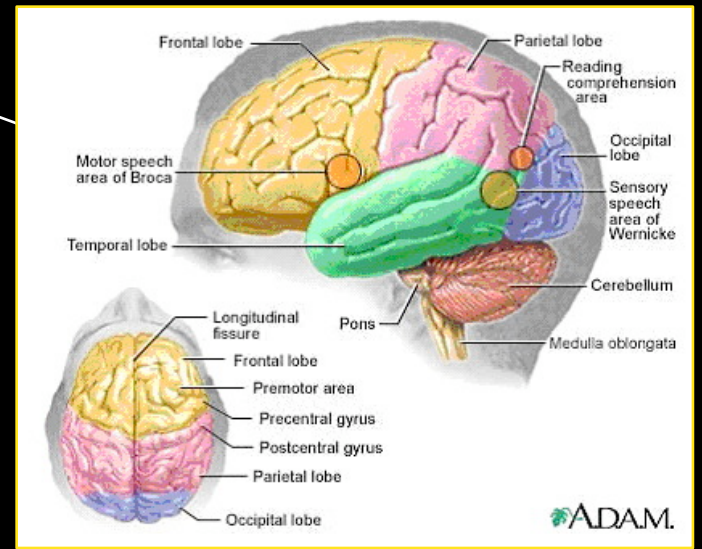
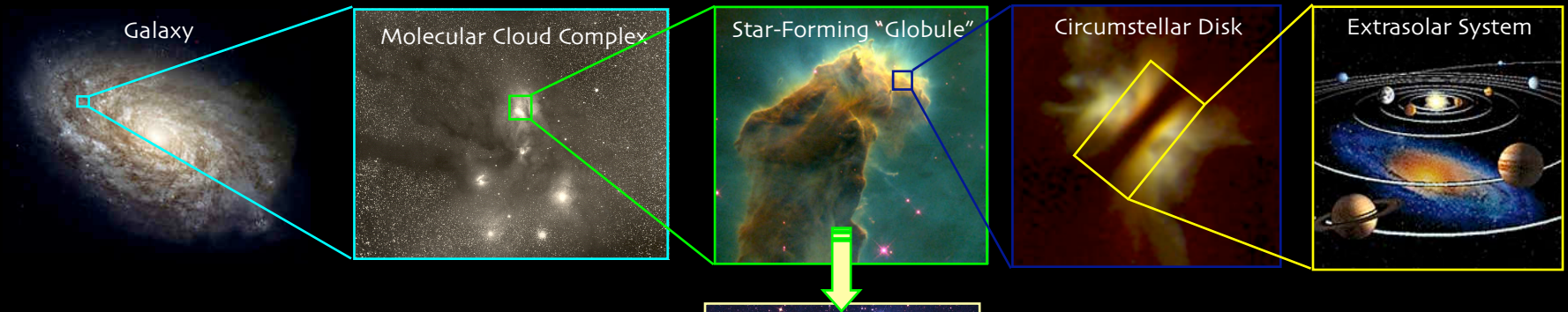


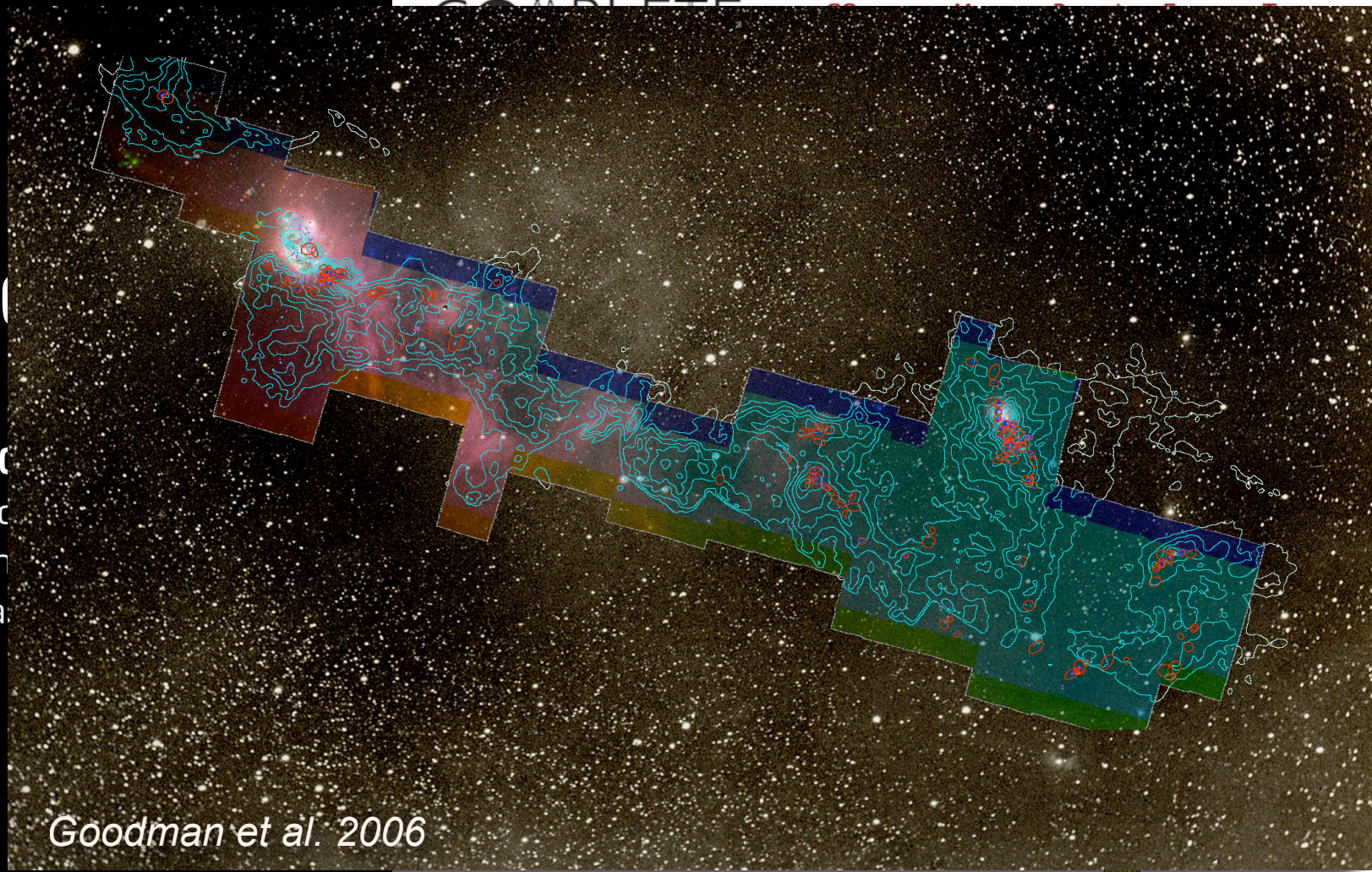
# What's up with the Astronomer\*?



\* Astronomer=Alyssa Goodman, PhD '89, Prof. of Astronomy & Director of the Initiative in Innovative Computing (IIC)

# Anatomy & Demographics in Star Formation





Goodman et al. 2006

[COMPLETE Postdoc, 2007](#)

**Referencing Data from the COMPLETE Survey**

COMPLETE data are non-proprietary. Please reference Ridge, N.A. et al., "The COMPLETE Survey of Star Forming Regions: Phase 1 Data". 2006. AJ. 131. 2921 as

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# The AstroMed Story



Computer  
Scientist



Computer  
Scientist






*“Viz has failed  
the scientific  
community...”*

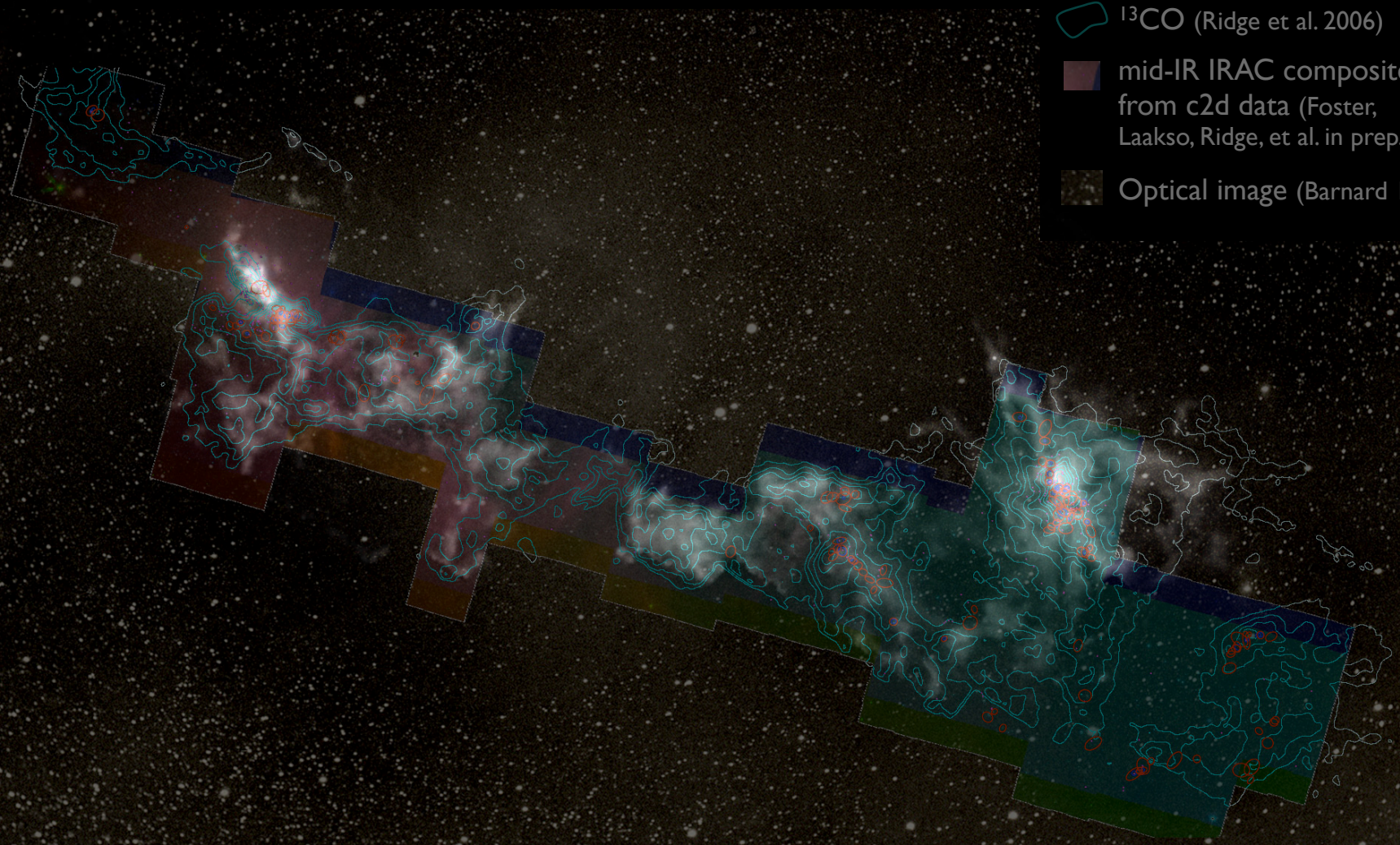


Astronomer

# COMPLETE = COordinated Molecular Probe Line Exinction Thermal Emission

image size: 520 x 274  
view size: 1305 x 733  
VL: 63 WW 107

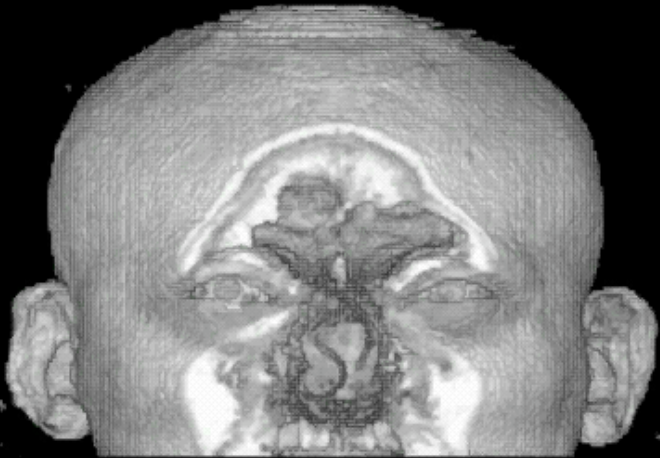
-  mm peak (Enoch et al. 2006)
-  sub-mm peak (Hatchell et al. 2005, Kirk et al. 2006)
-   $^{13}\text{CO}$  (Ridge et al. 2006)
-  mid-IR IRAC composite from c2d data (Foster, Laakso, Ridge, et al. in prep.)
-  Optical image (Barnard 1927)



m: 163/249  
zoom: 227% Angle: 0

# "Slices"

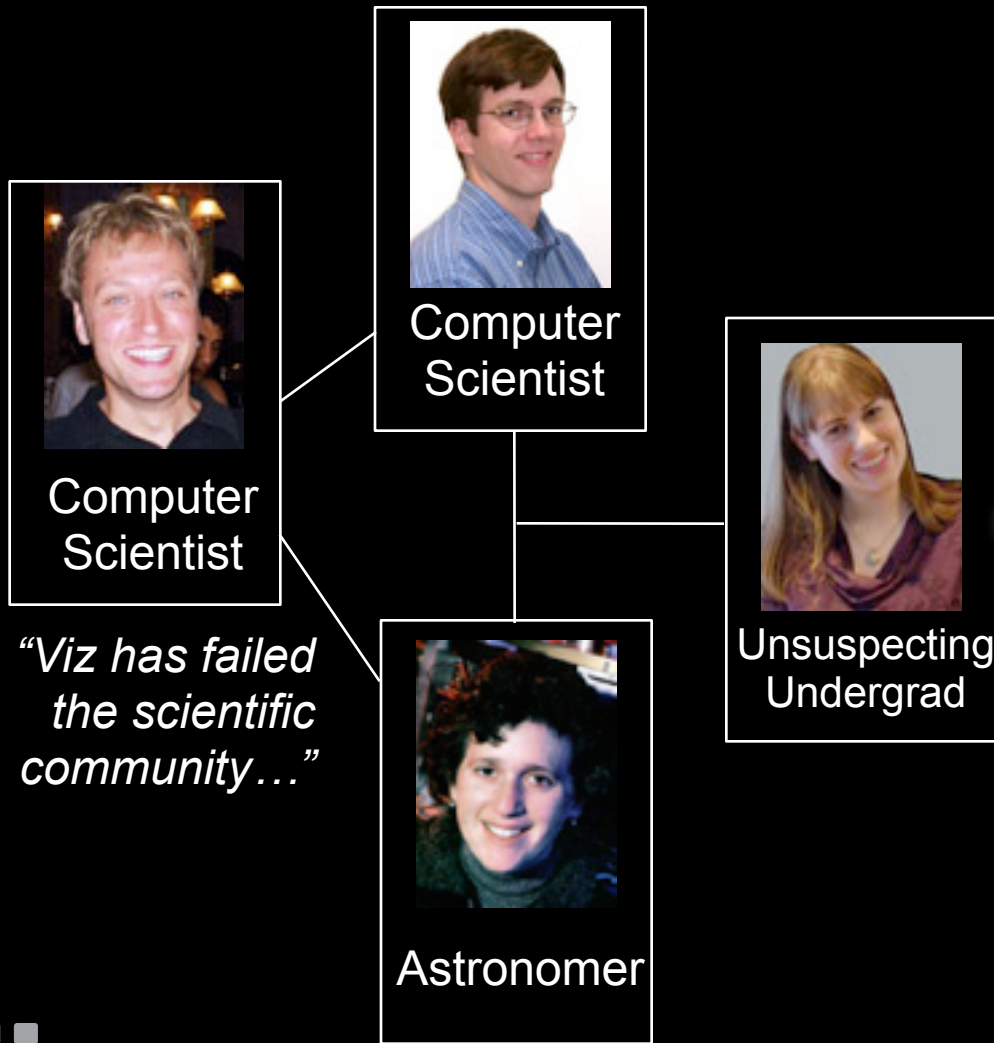
"KEITH"



"PERSEUS"



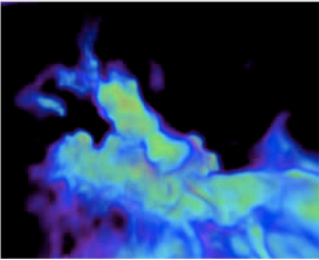
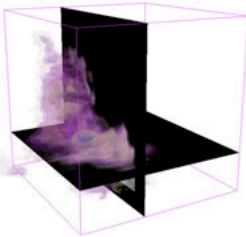
# The AstroMed Story



**iic**  
Initiative in Innovative Computing at Harvard

**projects**

**Astronomical Medicine**



**Lead Investigators**  
Alyssa Goodman (FAS/Astronomy, IIC), Mike Halle (HMS/SPL of BWH, IIC), Ron Kikinis (HMS/SPL of BWH), David Kennedy (HMS/Martinos Center of Harvard, MIT and MGH)

**Project Staff**  
Doug Alan, IIC-Sr. Software Engineer  
Michelle Borkin, IIC-Research Associate  
Jens Kauffmann - IIC-Post Doc

**Description**  
The goal of the "AstroMed" project is to extend the state of the art of complex data understanding in two very different fields, astronomy and medical imaging, using a broad-based approach to data exploration and analysis.

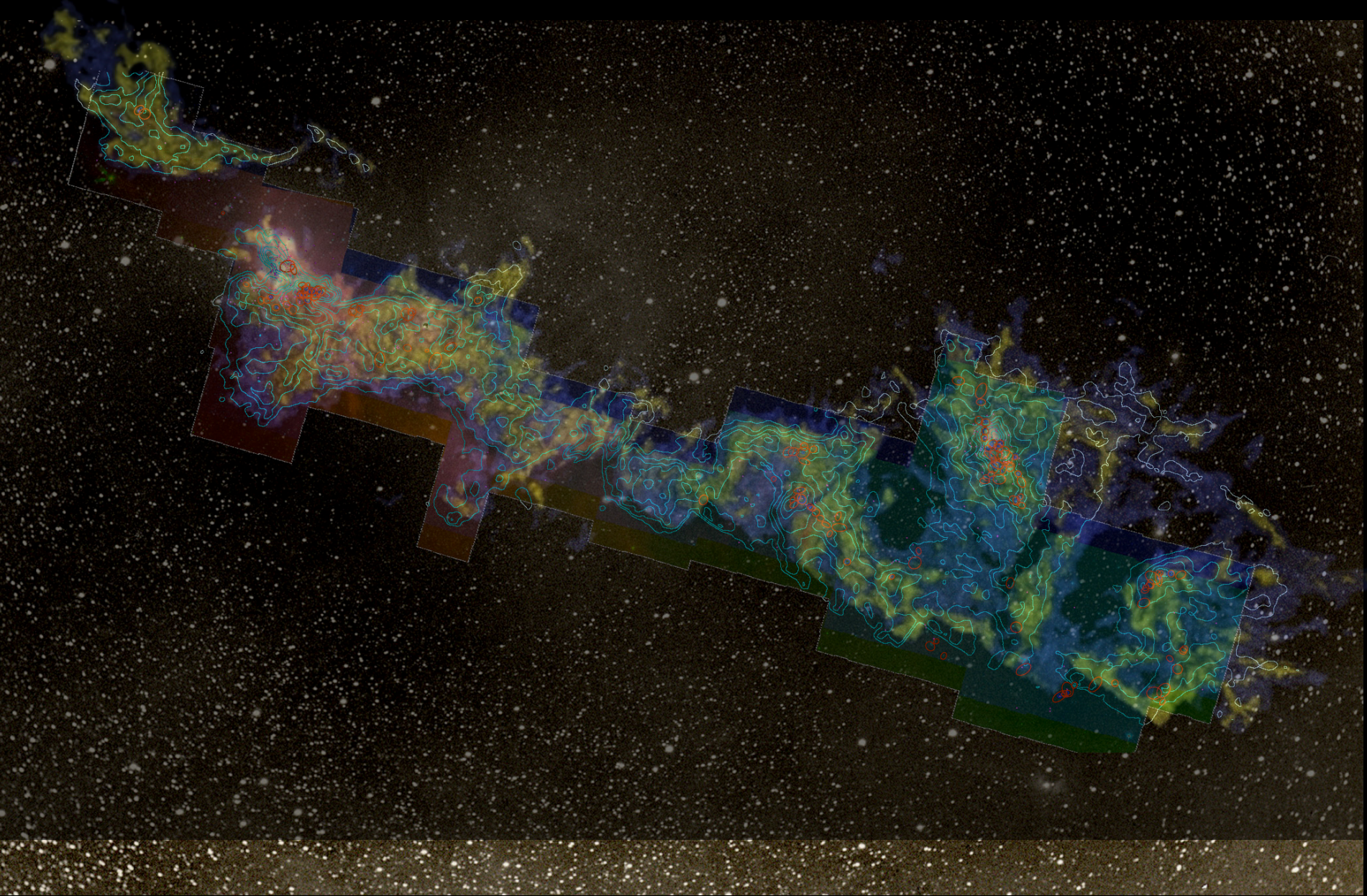
# Real 3D space





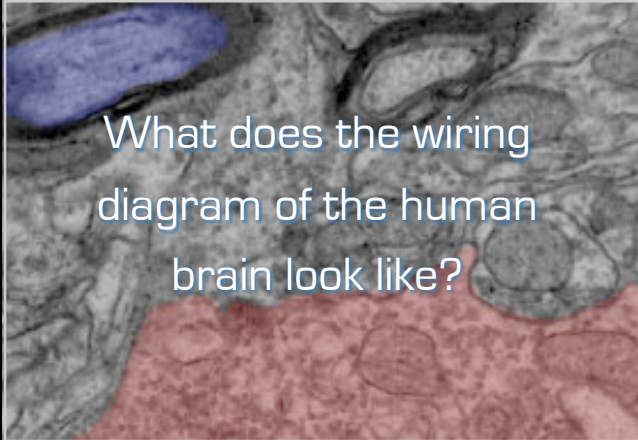
# “Position-Position-Velocity” Space








# Initiative in Innovative Computing at Harvard



What does the wiring diagram of the human brain look like?

A microscopic image of brain tissue, showing various cellular structures and a prominent blue-stained region in the upper left corner.

How do stars form in our Galaxy today?

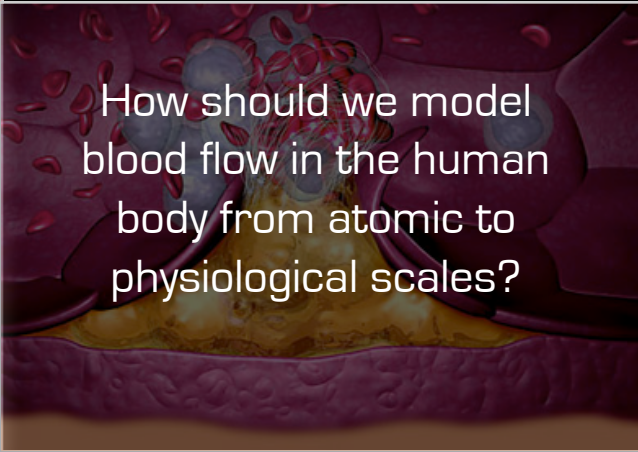
A simulation of a star-forming region, showing a complex, filamentary structure of gas and dust in shades of blue and green, set against a black background.

How is science best communicated?

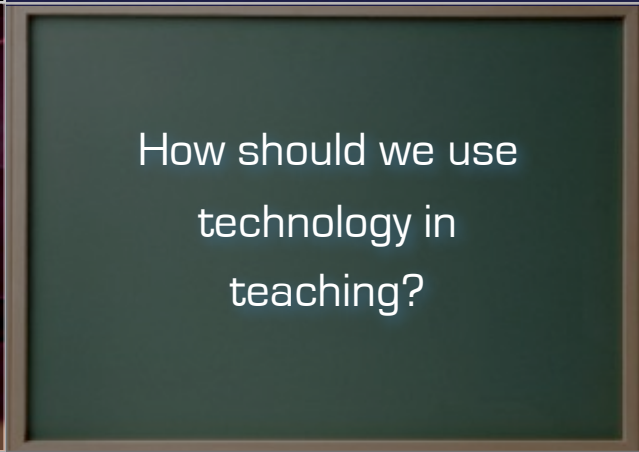
A visualization of a DNA microarray or similar data set, showing multiple horizontal lines of varying colors (red, green, blue, yellow) and patterns, representing different data points or genes.

What's "Dark Energy"?

What are the earliest structures in the Universe?

A visualization of the universe's large-scale structure, showing a complex network of filaments and voids, with a central region of high density and a background of distant stars and galaxies.

How should we model blood flow in the human body from atomic to physiological scales?

A cross-section of a blood vessel, showing the internal structure of the vessel wall and the flow of red blood cells through the lumen.

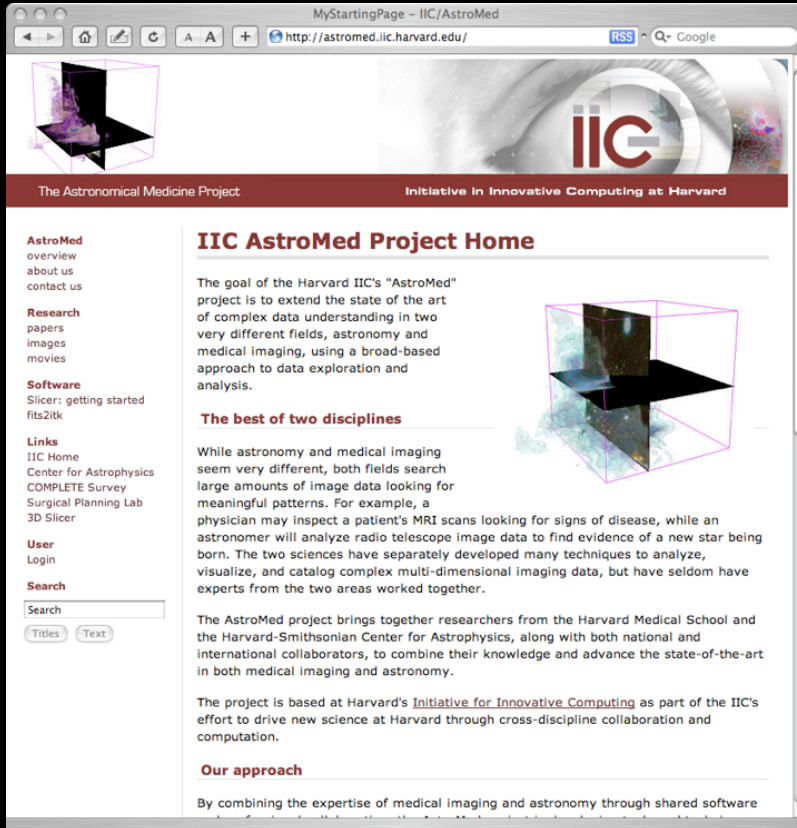
How should we use technology in teaching?

A simple, light green chalkboard with a dark border, serving as a background for the text.

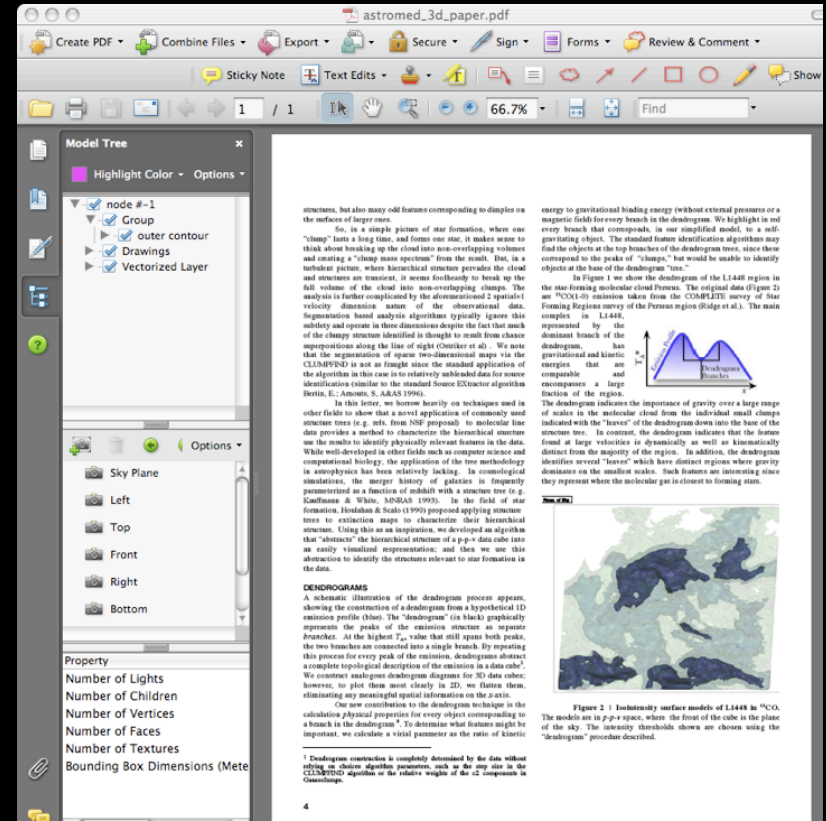
# Generalizing & Sharing

Open-Source code released, and explained, as it is developed.

Changing the future of scientific publishing.



The screenshot shows a web browser window displaying the "IIC AstroMed Project Home" page. The browser's address bar shows the URL "http://astromed.iic.harvard.edu/". The page features a header with the IIC logo and the text "The Astronomical Medicine Project" and "Initiative In Innovative Computing at Harvard". A sidebar on the left contains navigation links for "AstroMed overview", "Research papers", "Software", "Links", "User", and "Search". The main content area is titled "IIC AstroMed Project Home" and contains several paragraphs of text describing the project's goals and approach. A 3D visualization of a cube with a black plane is shown on the right side of the page.



The screenshot shows a PDF viewer displaying a scientific paper titled "astromed\_3d\_paper.pdf". The viewer's interface includes a toolbar at the top with options like "Create PDF", "Combine Files", "Export", "Secure", "Sign", "Forms", and "Review & Comment". A "Model Tree" panel on the left shows a hierarchical structure with nodes like "node #-1", "outer contour", "Drawings", and "Vectorized Layer". The main content area shows a page of text with a dendrogram and a 3D visualization of a cube with a black plane. The text discusses the construction of a dendrogram from a topological 3D emission profile and its application in astrophysics. A figure caption at the bottom right reads: "Figure 2 | Isosurface models of L1448 in  $^{13}\text{CO}$ . The models are in  $p$ - $p$  space, where the front of the cube is the plane of the sky. The intensity thresholds shown are chosen using the 'astromed' procedure described."



# Scalability

$10^6$  pixels

this projector

$10^7$  voxels

an MRI of your brain, at 0.5 mm resolution

$10^8$  voxels

**Perseus COMPLETE** data cube

$10^{14}$  voxels

the **Connectome**,  $0.5 \text{ mm}^3$  of brain tissue

$10^{16}$  pixels

Google **Earth Imagery** at 1 foot resolution

$10^{19}$  voxels

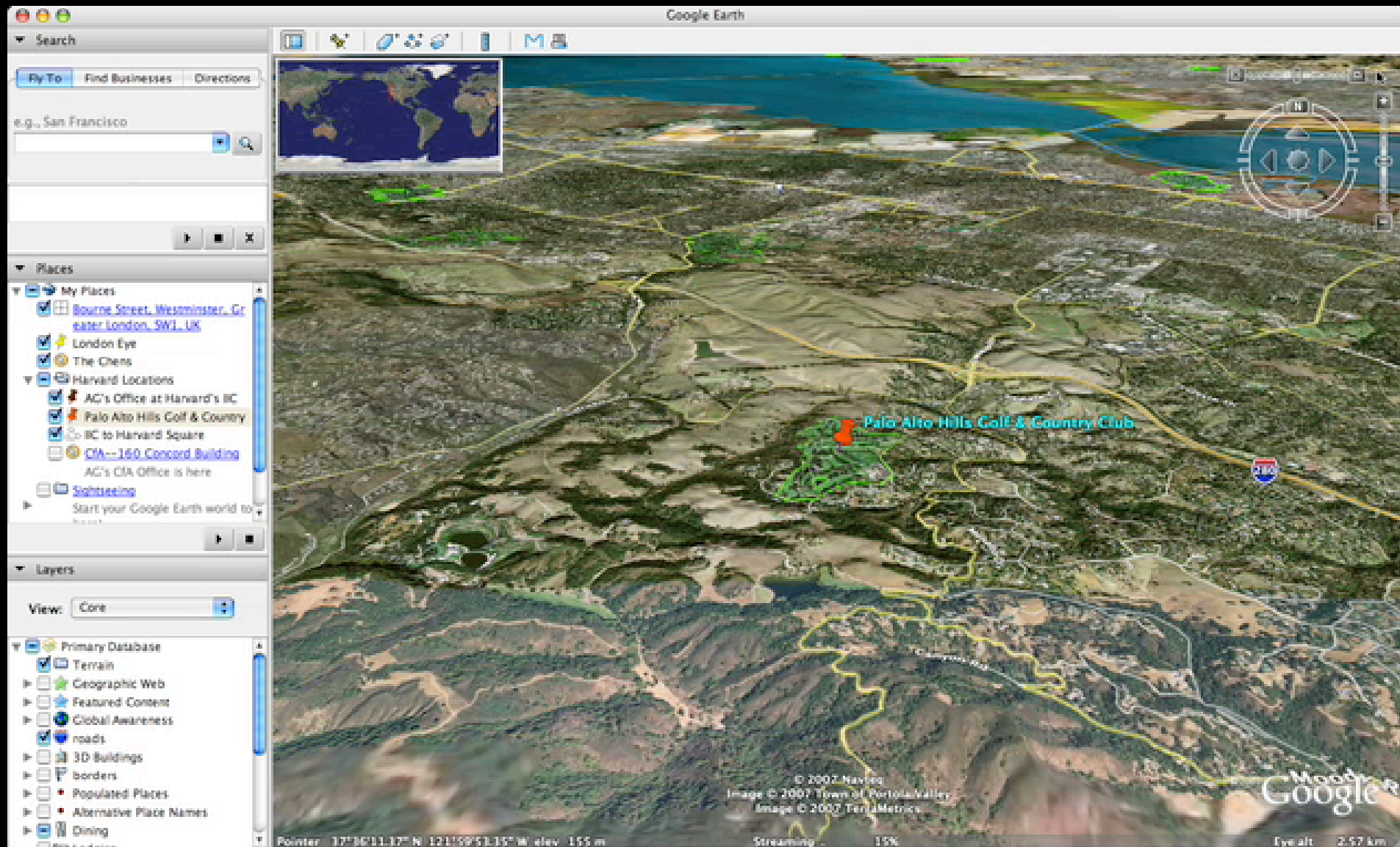
Google **Earth 3D**,  $\pm 1000$  feet of elevation, 1 ft. res.

$10^{22}$  voxels

the **Connectome**, full human brain



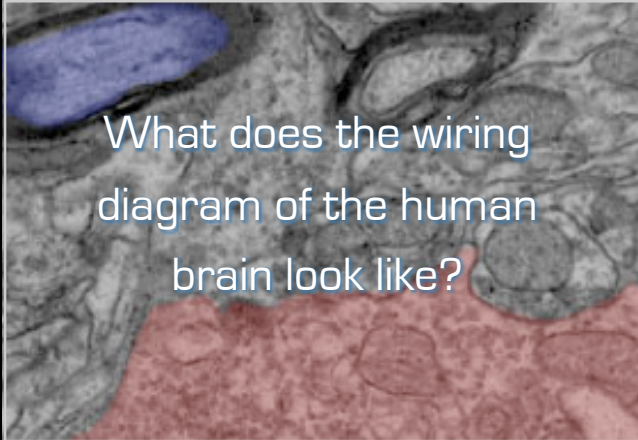
# Google Earth, 2007




51 second movie, downgraded to 640 x 480 (compressed to 19MB); original was 1440 x 900 (uncompressed .mov 1GB)



# Initiative in Innovative Computing at Harvard



What does the wiring diagram of the human brain look like?

A microscopic image of brain tissue, showing various cellular structures and a prominent blue-stained region in the upper left corner.

How do stars form in our Galaxy today?

A vibrant, multi-colored nebula or star-forming region, with shades of blue, green, and yellow against a dark background.

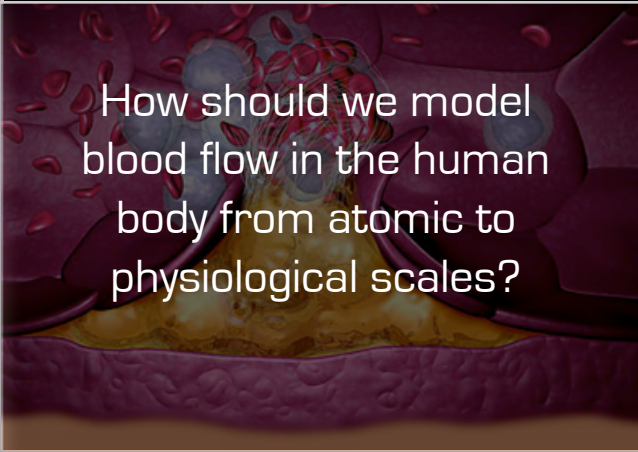
How is science best communicated?

An abstract visualization of data or information, featuring horizontal lines in various colors (red, green, blue, yellow) and patterns, resembling a stylized waveform or data stream.

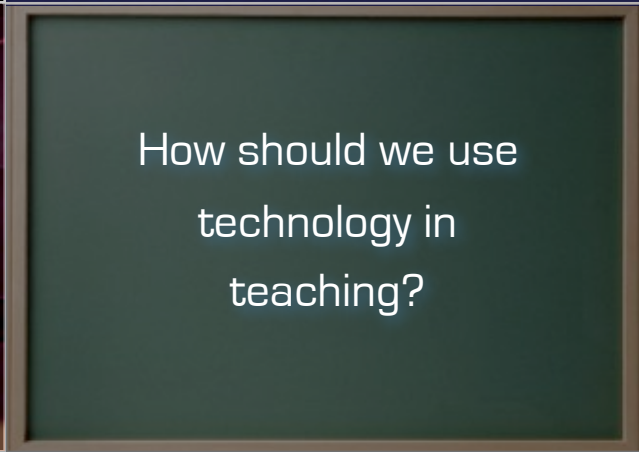
What's "Dark Energy"?

A visualization of cosmic structures, showing a central point with concentric circles and a network of lines connecting various points, set against a dark background with scattered light points.

What are the earliest structures in the Universe?



How should we model blood flow in the human body from atomic to physiological scales?

A cross-section of a human body, showing internal organs and structures, with a focus on the circulatory system and the flow of blood.

How should we use technology in teaching?

A chalkboard with a green surface and a wooden frame, containing the text.