Balancing Artistic Expression and Scientific Rigor in Successful Visualizations for Communications

Robert Hurt
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Cosmic Explorations, Sept. 23 2022
Career Trajectory

→ Grad Student → Postdoc(x2) → Staff Scientist
→ Airbrush/Photo → Photoshop → 3D Graphics

Inspirations
Career Trajectory

→ Grad Student → Postdoc(x2) → Staff Scientist
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“Astrovizicist”

Spitzer  GALEX  [NEO]WISE  Herschel  NuSTAR  Kepler  ZTF  LIGO  EHT (+...)

[Images of astronomical objects such as galaxies, planets, and spacecraft]
Often data can tell the story...
... but sometimes it needs help.
Inspire Astronomy Illustrations
Astronomy Illustrations

Inspire
Inform
“Early Work”

Robert Hurt
Acrylic/Airbrush

*Untitled Galaxy* (circa 1979)
Galaxies of the ’70’s
Power of Visualizations

Spitzer Space Telescope
Infrared Light
Messier 81 (2019)
Visualizations can deeply affect our mental geography of the universe. Even Especially Artwork.
What is “Communications”?

- Education
  - Classrooms
- Informal Ed
  - Museums
- Communications
  - News Media
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- Education
  - Classrooms
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Pre-Arranged Facilitated | Audience | Compete for Attention
Visualizations for Communication

Grab Attention
Illustrate a Basic Concept
Lead Audience to Article
The Data-Art Continuum

Pure Data — Pure Aesthetics
Visual Engagement

Science Content
Science Content

Visual Engagement
The AstroViz “Trinity”

Science

Communication

Art
Best Practices Approach

- Topic 1
  - Detail A
  - Detail B
  - Detail C
- Topic 2
  - Detail D
  - Detail E
- Topic 3
  - Detail F
  - Detail G
  - Detail H

Science
Communication
Art
Best Practices Approach

- Identify audience,
- Narrow focus,
- Craft narrative

Science

Communication

Art

• Topic 1
  • Detail A
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Best Practices Approach

- **Topic 1**
  - Detail A
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Identify audience, Narrow focus, Craft narrative

Identify visual concepts, Visual appeal

Science

Communication

Art
Best Practices Approach

- **Identify audience, Narrow focus, Craft narrative**
  - Topic 1
    - Detail A
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    - Detail D
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    - Detail F
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    - Detail H

- **Validate narrative**

- **Identify visual concepts, Visual appeal**
  - Topic 1
    - Detail A
    - Detail B
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    - Detail H

- **Validate visuals**

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Science

Communication

Art
Visualizing the Visualization Process

Known Facts
Known Facts

Known Falsehoods
Known Facts

Known Falsehoods

Possibilities
Sometimes we include falsehoods in the service of clarity! (e.g. exaggerated scale)
Art

Known Facts

Known Falsehoods

Possibilities
Art + Possibilities = Hypotheses
Case Study

The Milky Way
Why Do We Need to Illustrate the Milky Way?
Times Square, NYC
Spiral Galaxy

Size and Orientation of Bar

Location of Sun

Spitzer Release 2005
It showed up EVERYWHERE...
Features Discovered after 2008!

Spitzer Release/AAS Workshop 2008
Features Discovered after 2008!

The Milky Way’s basic structure involves two large spiral arms believed to originate at either end of an elongated central bar. But only parts of the arms can be seen — gray segments indicate portions not yet detected.

*Thomas Dame*
Art as Hypothesis
Case Study

Black Holes
Pop Culture Black Holes through the Years...


The Black Hole (1979)

Stargate SG-1 (2006)

Cosmos 2 (2014)

Star Trek (2009)
Typical Black Hole Categories

- Bowling Balls
- Bathtub Drains
- Flat Swirly Things with Lens Flares
Classic Astro Viz? Kind of the Same…

Bowling Balls

Bathtub Drains
But we’ve known for over 100 years that black holes WARP LIGHT!
Why So Rare in Viz?

- Gravitational lensing is harder to create
- It is not what people expected to see
Getting the Warps into Black Holes
2014: Then Came “Interstellar”…
Director: Chris Nolan  Scientist: Kip Thorne

Intermediate “research” version including doppler effects

Final “movie” version
...And Now Even Star Trek Gets It Right!

Star Trek Lower Decks (2020)

Star Trek: Strange New Worlds (2022)
Refractive
“funnel lens”
Light refraction mimics gravitational deflection

Never bends more than 90°
Light paths should constantly bend and even wrap around.
Nested spherical lenses can do this!
“Open Source” Black Holes in Blender

Blender is a free, open source solution for 3D models & animations.

Its features rival top commercial packages, and it has a vibrant open support community.

Simple Optics Node Tree
Short Blender black hole renders are now (qualitatively) in the same ballpark...
...as full general relativistic ray traced black hole simulations using supercomputer clusters!
Never. Again.
Case Study

Exoplanets
Circling a Star Not Far Away, 7 Shots at Life

By KENNETH CHANG

Not just one, but seven Earth-size planets that could potentially harbor life have been identified orbiting a tiny star not too far away, offering the first realistic chance to search for extraterrestrial life.

Uber's Culture Of Cutsineness Under Review

By MIKE ISAAC

SAN FRANCISCO — When new employees at Uber were asked to subscribe to 11 core company values, including making bold bets, being "obsessed" with growth and treating others with respect, the real company culture was less than perfect.

Migrants Hide, Fearing Capture on 'Any Corner'

By YVIANNE SEE

No going to church, no going to the store. No doctor's appointments for some, no school for others. No driving, period — not when a broken taillight could deliver the driver to Immigration and Customs Enforcement.

It's happening in the Central Valley of California, where undocumented workers are living in fear.

IMMIGRATION A police department worries a crackdown will harm efforts to fight gang crime. PAGE A5

MEXICO The secretary of state pays a visit at a time of rising tensions. PAGE A4

PHOENIX Power in the school district, where 33 Latino students have been deported but no others have been taken.

If deportation has always been a threat on paper for the 11 million people living in the country illegally, it rarely imperiled those who did not commit serious crimes. But with the Trump administration on curbing illegal immigration — two memos outlining the federal government's plans to accelerate deportations were released Tuesday — schools are worried.

That directive, they said, was improperly and arbitrarily devised, "without due regard or recognition of the primary role of the states and local school districts in establishing educational policy."

The question of how to address the "bathroom debate," as it has become known, opened a rift in the "Trump administration's efforts to unite the country."

TRUMP RESCINDS OBAMA DIRECTIVE ON BATHROOM USE

Question of Transgender Rights Spits DeVos and Sessions

This article is by Jeremy W. Peters, Jo Becker and Julie Hirshfield DuVin.

WASHINGTON — President Trump on Wednesday rescinded protections for transgender students that had allowed them to use bathrooms corresponding with their gender identity, overruling his own education secretary and placing his administration firmly in the middle of the culture wars that many Republicans had tried to leave behind.

In a joint letter, the top civil rights officials from the Justice Department and the Education Department rejected the Obama administration's position that nondiscrimination laws require schools to allow transgender students to use the bathrooms of their choice.

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Planet Hop from TRAPPIST-1e

Voted Best "Hab Zone" Vacation within 15 parsecs of Earth
55 Cancri e (2011)
55 Cancri e

(2017)
55 Cancri e

lava life

Skies sparkle above a never-ending ocean of lava