Building more equitable spaces in STEM through game-based learning; the case of *Science in Space: How to Telescope*

Carolina Cruz-Vinaccia,

with Alice Curtin & Kim Metera

Trottier Space Institute at McGill

McGill Department of Physics

What is Science in Space: How to Telescope?

What

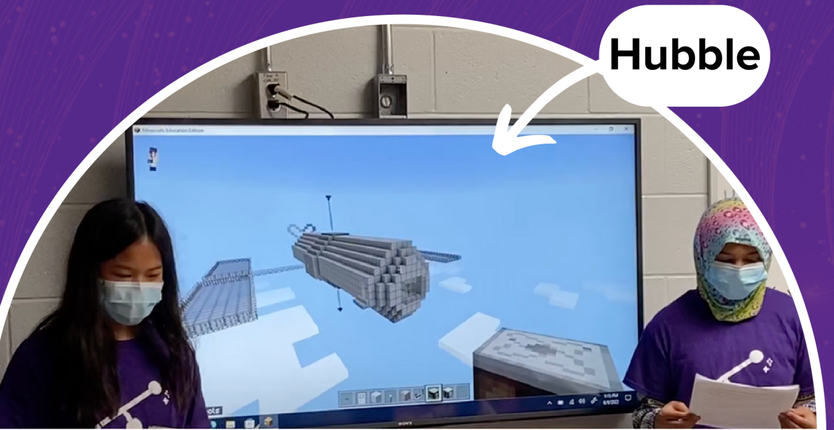
Informal science learning program where students learn about astronomy by building telescopes in Minecraft.

Audience

Girls & nonbinary youth ages 10 - 12 (grades 5-6) in Montreal

Partners

Partnership between TSI, McGill Physics & Dell



Why Science in Space?

Women are still underrepresented in STEM

28% Science & engineering jobs

25% Physics undergraduate degrees

20% Physics PhD degrees

Middle school (grades 6-8) is a crucial time in for girls' science identity (Calabrese Barton et al, 2013**)**

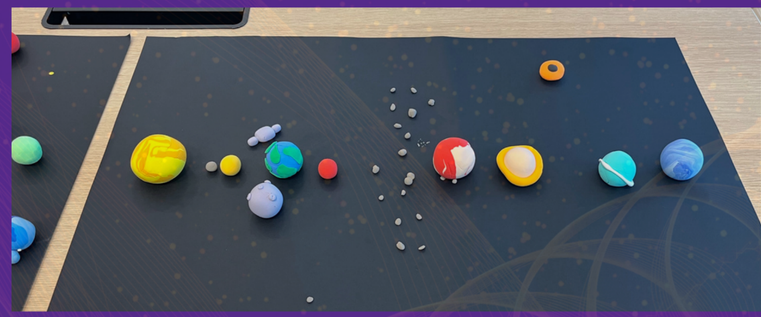
Achieving equity in STEM requires inclusive spaces that foster a sense of belonging (Johnson, 2020)

Informal science experiences can encourage interest, belonging, and persistence in STEM

Program in action

Weeks 1-3: context

- Intro to astronomy & telescopes
- Intro to Minecraft
- Build your own universe out of clay
- Build your own detector out of Legos



Weeks 4-8: Design + Building

- Telescope design
- Peer feedback
- Build in Minecraft
- Visit from a McGill professor
- Bring in a solar telescope

Weeks 9-10: Refine & Present

- Prepare final presentations
- Final showcase

Guiding Principles

We want a program that

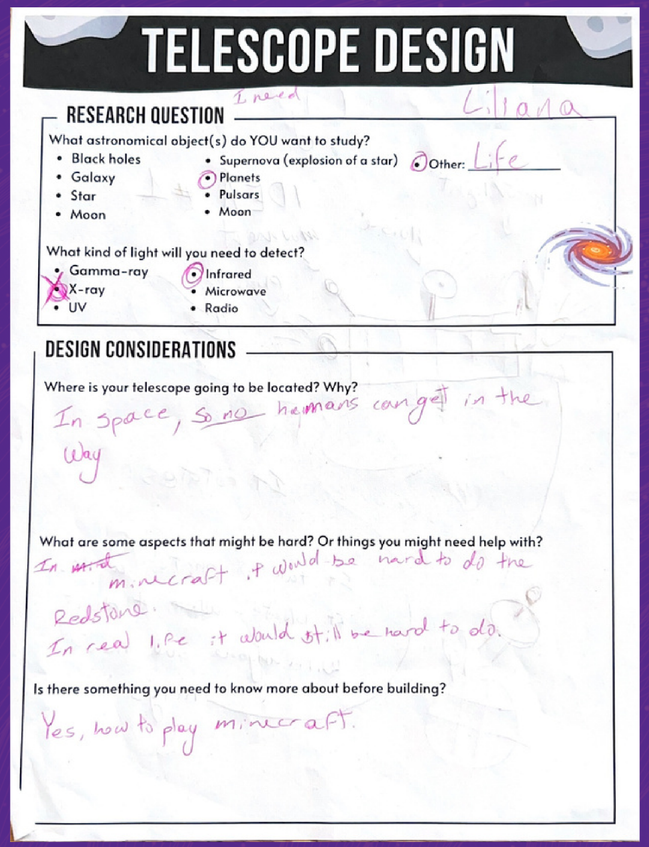
Engages students with astronomy

Empowers girls & nonbinary youth

Bolsters scientific thinking

Fosters a sense of belong and community

How do we empower students?



TELESCOPE DESIGN

I need Liliana

RESEARCH QUESTION

What astronomical object(s) do YOU want to study?

- Black holes
- Galaxy
- Star
- Moon
- Supernova (explosion of a star)
- (•) Planets
- Pulsars
- Moon
- (•) Other: Life

What kind of light will you need to detect?

- Gamma-ray
- (X) X-ray
- UV
- (•) Infrared
- Microwave
- Radio

DESIGN CONSIDERATIONS

Where is your telescope going to be located? Why?

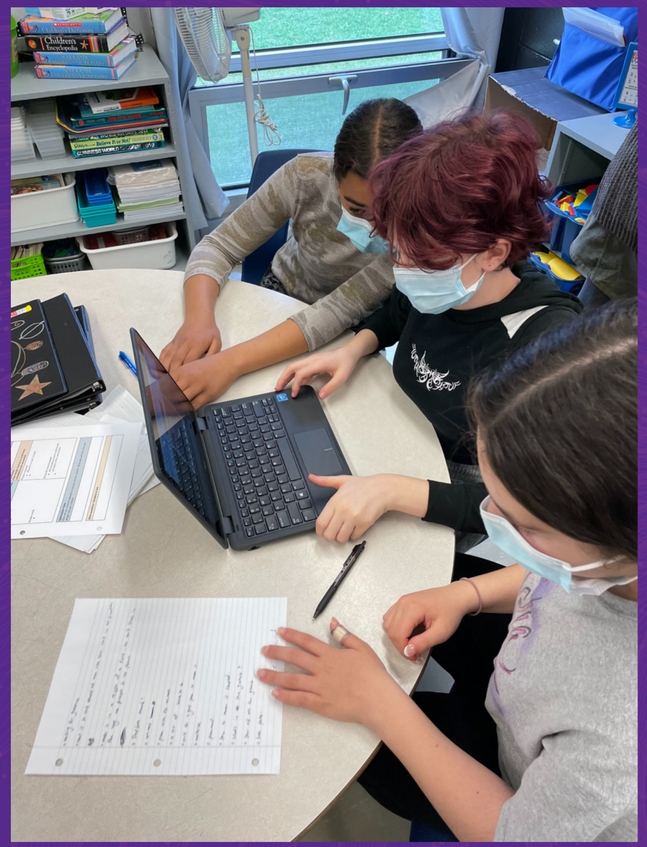
In space, So no humans can get in the way

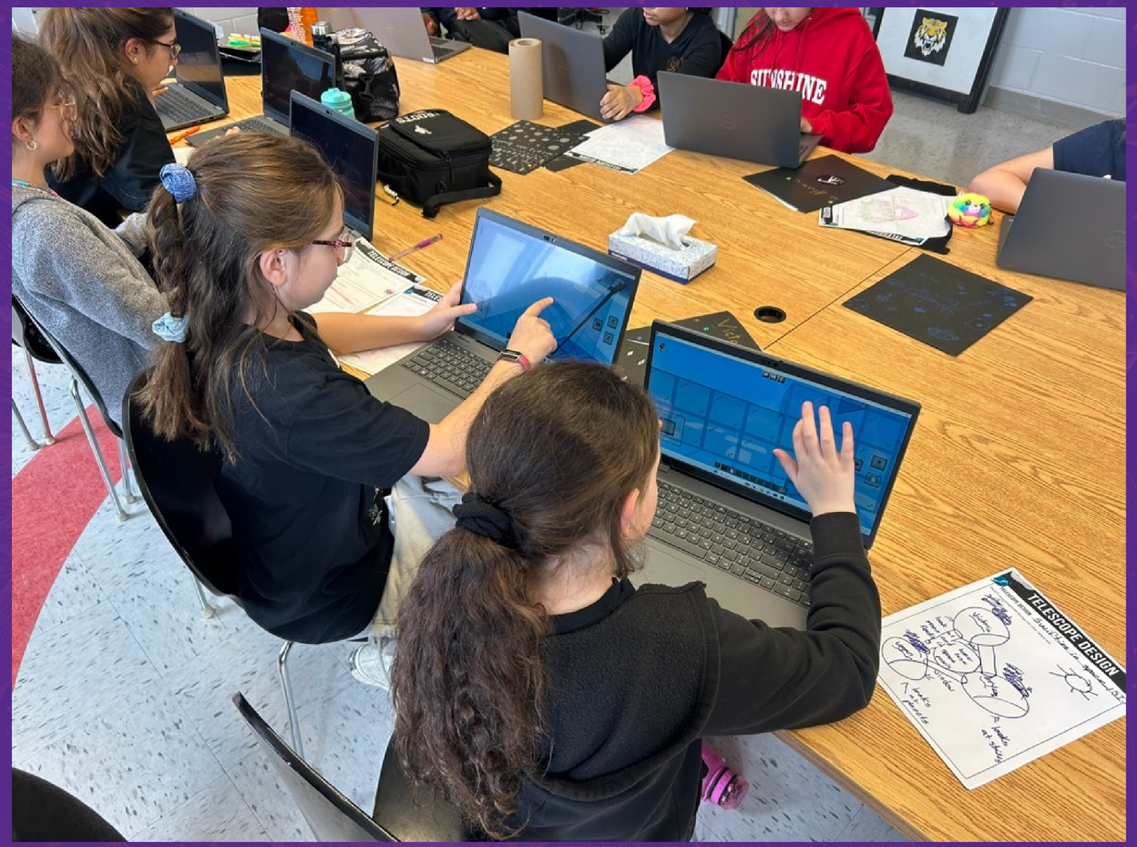
What are some aspects that might be hard? Or things you might need help with?

In ~~real~~ minecraft it would be hard to do the Redstone. In real life it would still be hard to do.

Is there something you need to know more about before building?

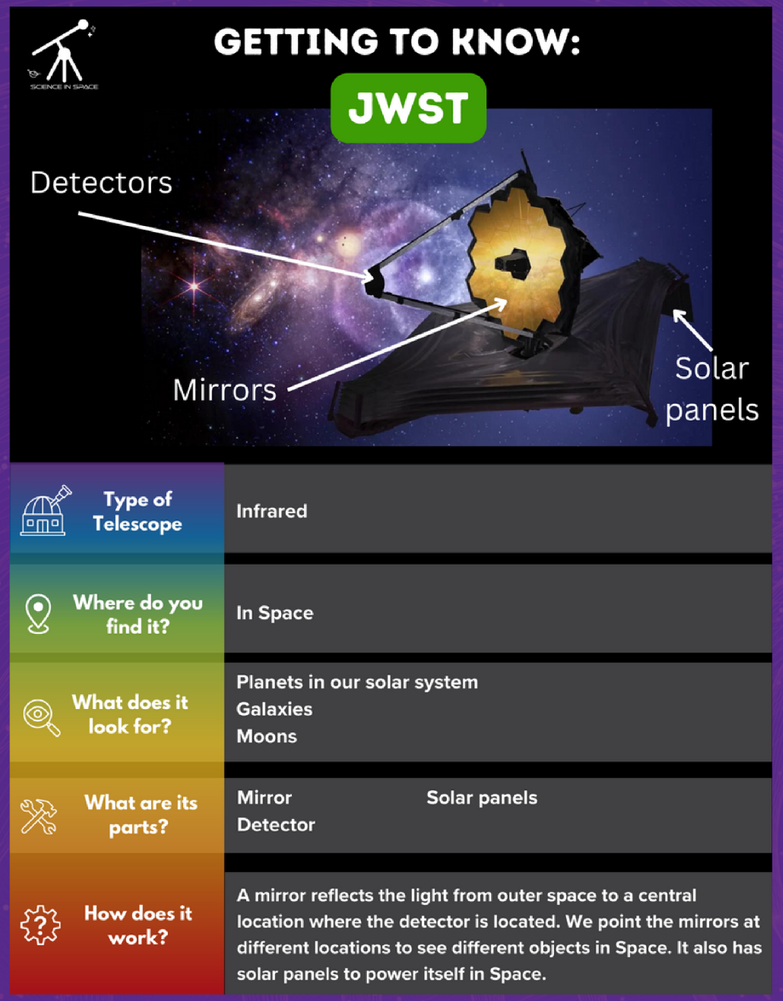
Yes, how to play minecraft.





Collaborate on a space-themed project that encourages active thinking, planning, communication and teamwork

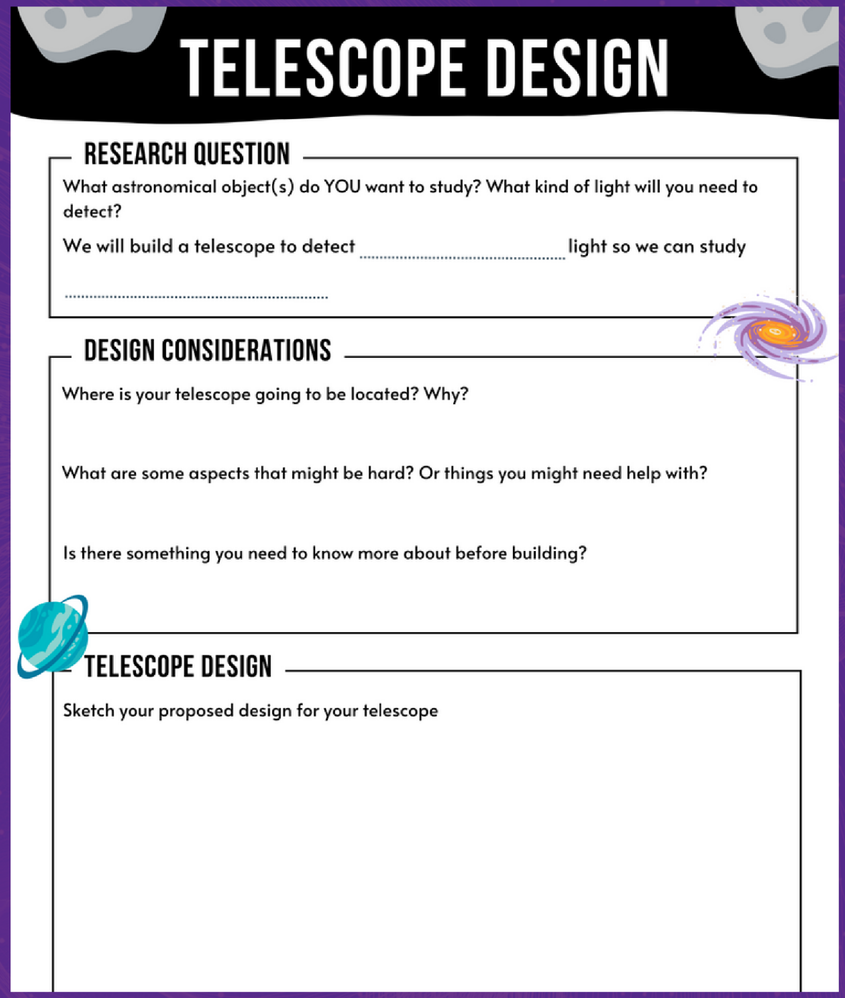
How do we bolster scientific thinking?



GETTING TO KNOW:

JWST

Type of Telescope	Infrared
Where do you find it?	In Space
What does it look for?	Planets in our solar system Galaxies Moons
What are its parts?	Mirror Detector Solar panels
How does it work?	A mirror reflects the light from outer space to a central location where the detector is located. We point the mirrors at different locations to see different objects in Space. It also has solar panels to power itself in Space.



TELESCOPE DESIGN

RESEARCH QUESTION

What astronomical object(s) do YOU want to study? What kind of light will you need to detect?

We will build a telescope to detect ..... light so we can study .....

DESIGN CONSIDERATIONS

Where is your telescope going to be located? Why?

What are some aspects that might be hard? Or things you might need help with?

Is there something you need to know more about before building?

TELESCOPE DESIGN

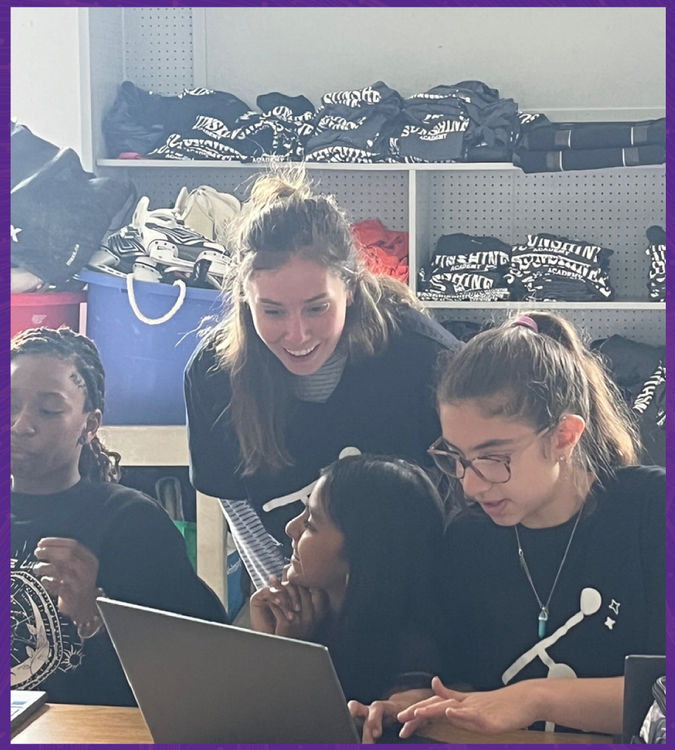
Sketch your proposed design for your telescope

Planning, designing, and building telescopes in Minecraft

How do we engage students with astronomy?

Fun astronomical activities and workshops

How do we foster a sense of belonging and community?



Working with peers supported by Astronomy and Physics graduate mentors

How do we develop lasting relations?

Repeated visits to given schools

Incorporating feedback & iterating

Considerations for an evaluation strategy:

- Audience & stakeholders
- Nature of the outcomes
- Who defines success
- Characteristics of participants
- Limited follow-up
- Burden: what & on whom

Collect data through:

- Exit tickets
- Peer feedback
- Activity worksheets
- Final presentations

SCIENCE IN SPACE MISSION LOG
23-FEB-2024

Something that was fun or exciting today:

Something that was hard or challenging today:

Favourite thing you learned today

What's your vibe today? Pick an emoji (or draw one if none of these fit!)

Impact of Science in Space

On Students

- Increased sense of community with peers and mentors
- Finding a space of their own (“girls club”)
- Increased interest in science
- Had fun with the activities
- Interest in participating again
- Able to express their creativty

On Mentors

- Gained confidence and autonomy taking on central role in an outreach program
- Community
  - Within outreach
  - Within astronomy
  - Within Montreal
- Re-affirmed interest in Outreach
- Learned how to communicate astronomy outside of academia

Where do we go from here?

5	Schools in Montreal
7	Runs of the program
~95	Students reached
1	One-off in Toronto
~70	Sessions/visits
8	Grad student mentors involved

Looking to the future

- Continue to build connections & return to schools
- Develop an alternate lesson plan
- Train more volunteers and facilitators