Bringing Mars down to Earth

designing educational games with real science for low income students

Peter Slattery
Kate Schnippering

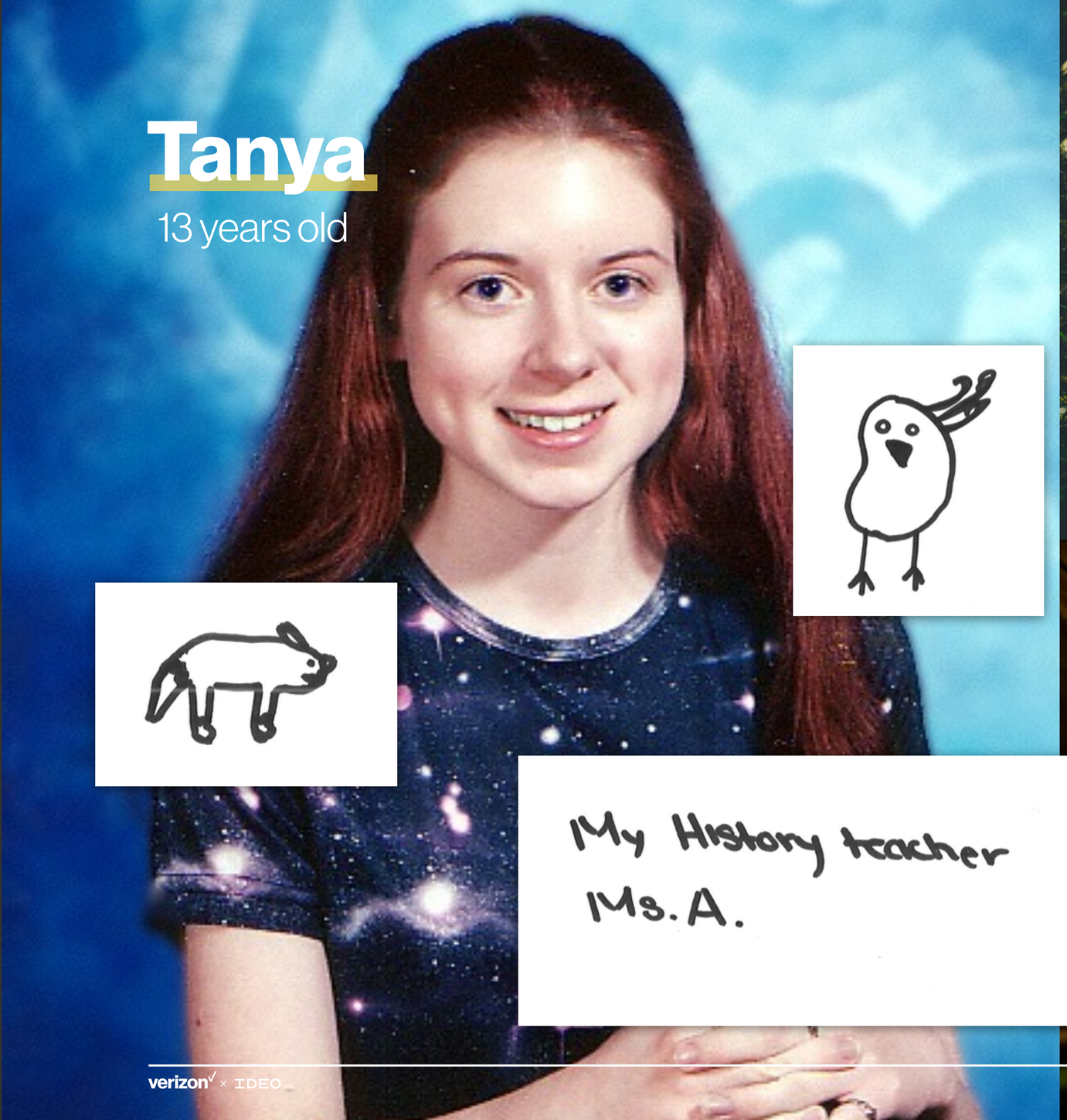
GDC 2018

verizon × IDEO

the year 1997

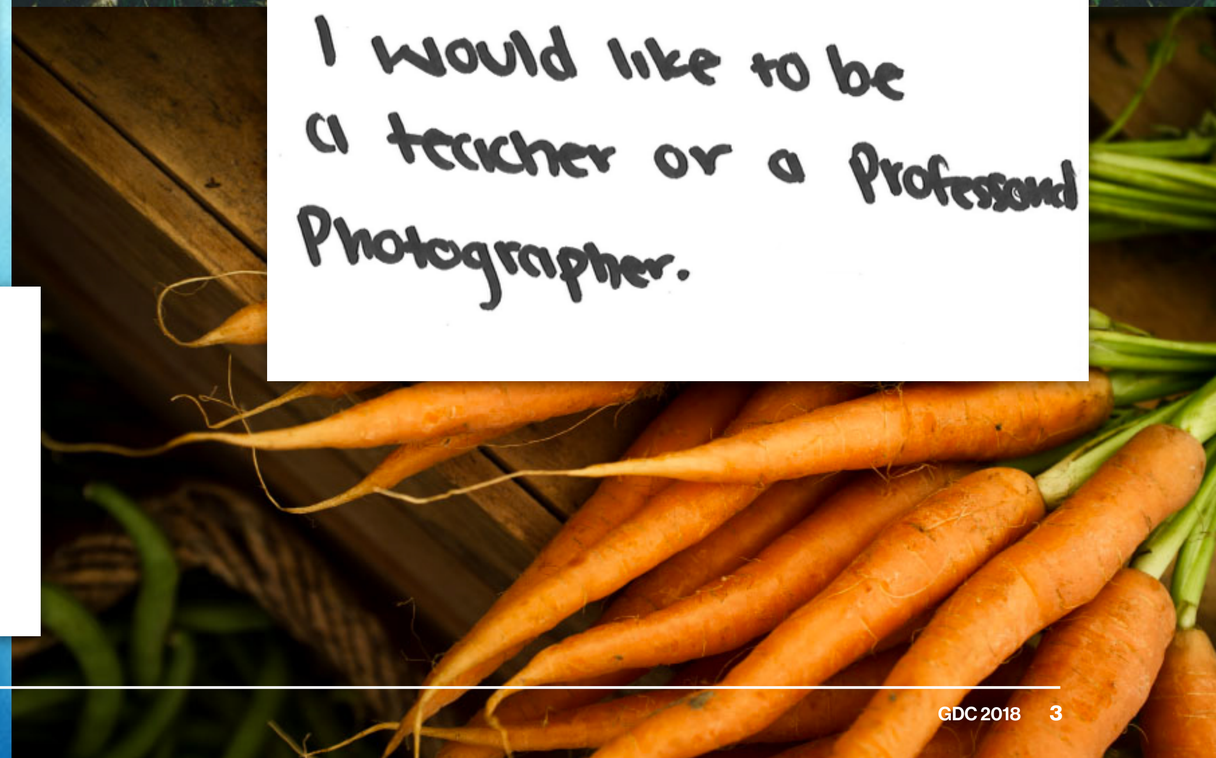
Tanya

13 years old



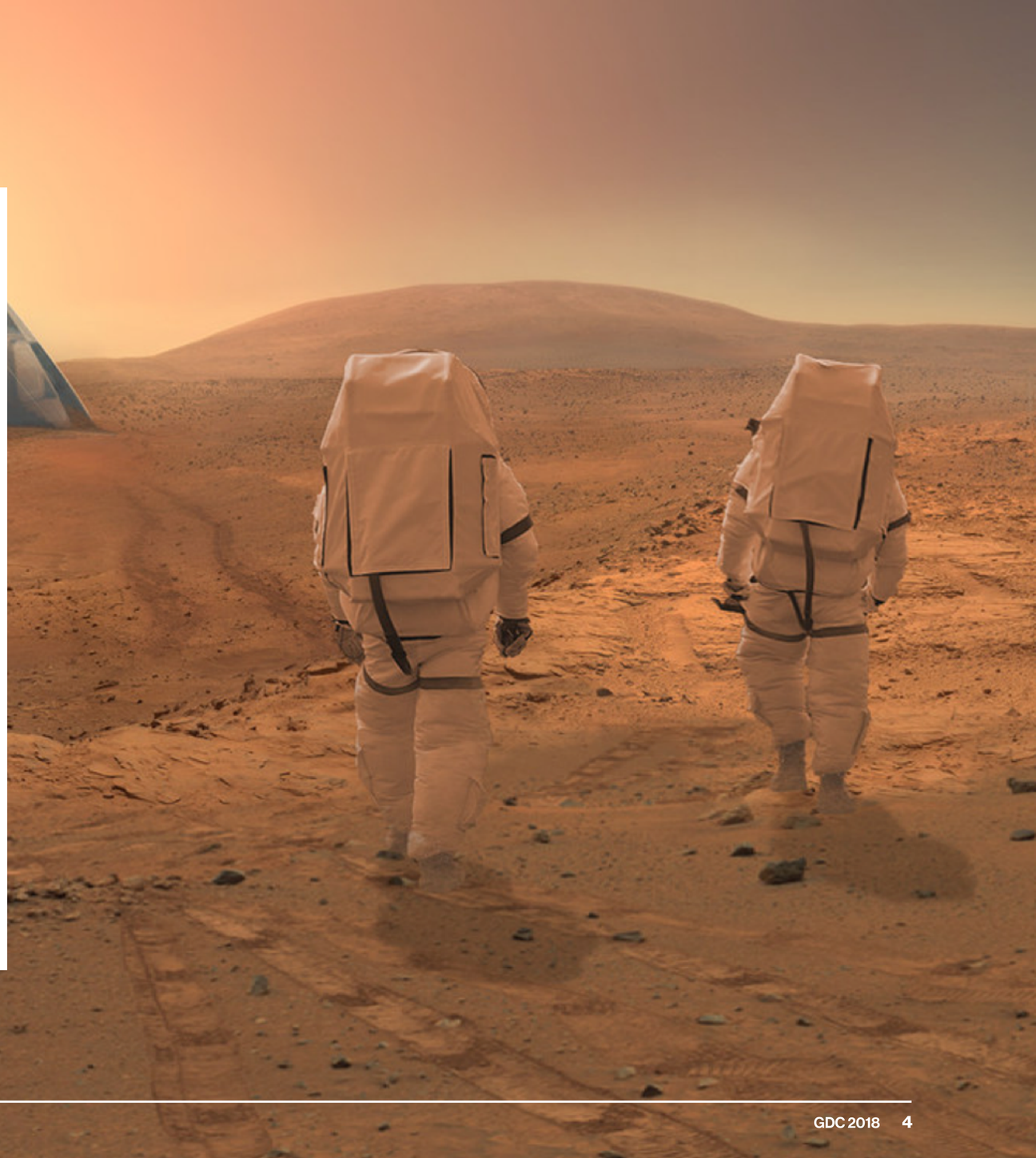
My History teacher
Ms. A.

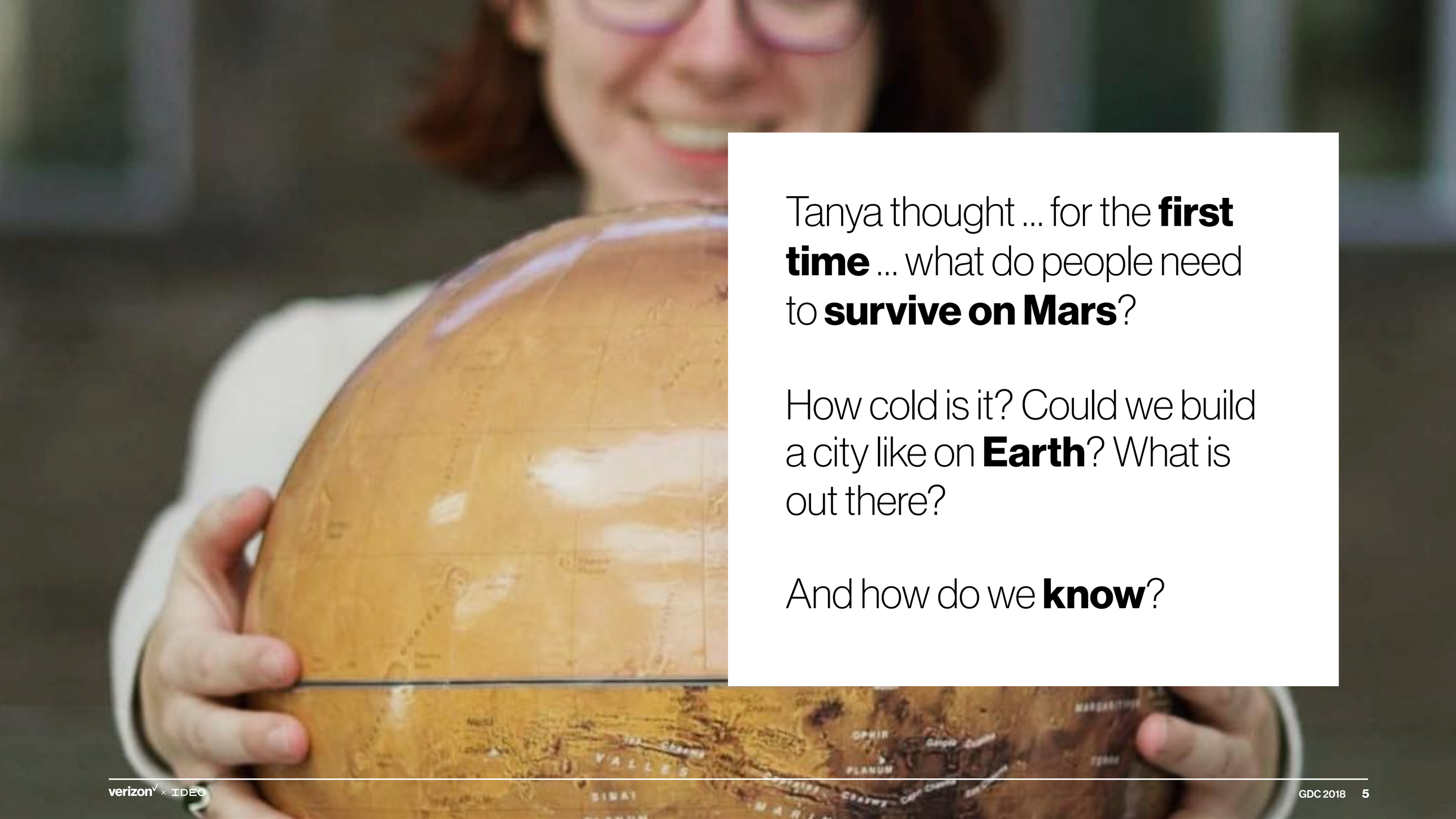
I would like to be
a teacher or a Professional
Photographer.



Tanya's 10th grade science class participated in the **Mars Millennium Project 2030**, a program which put her in touch with **NASA's JPL experts**.

Together they designed a **living environment** on Mars.





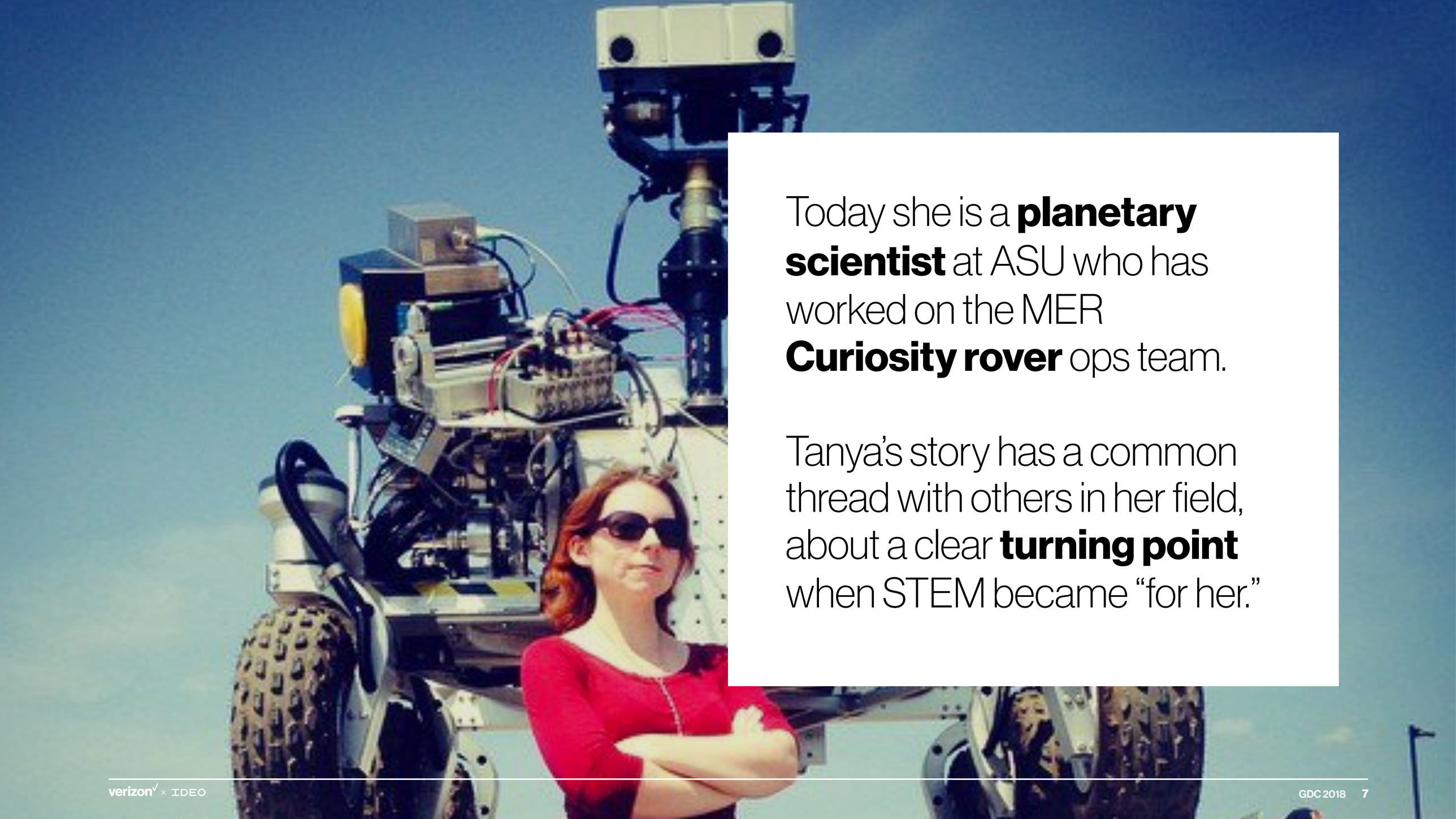
Tanya thought ... for the **first time** ... what do people need to **survive on Mars**?

How cold is it? Could we build a city like on **Earth**? What is out there?

And how do we **know**?

Tanya became **curious** that day.

Her curiosity sparked her **tenacity**, and guided her all the way through a **PhD** in **Martian geology**.



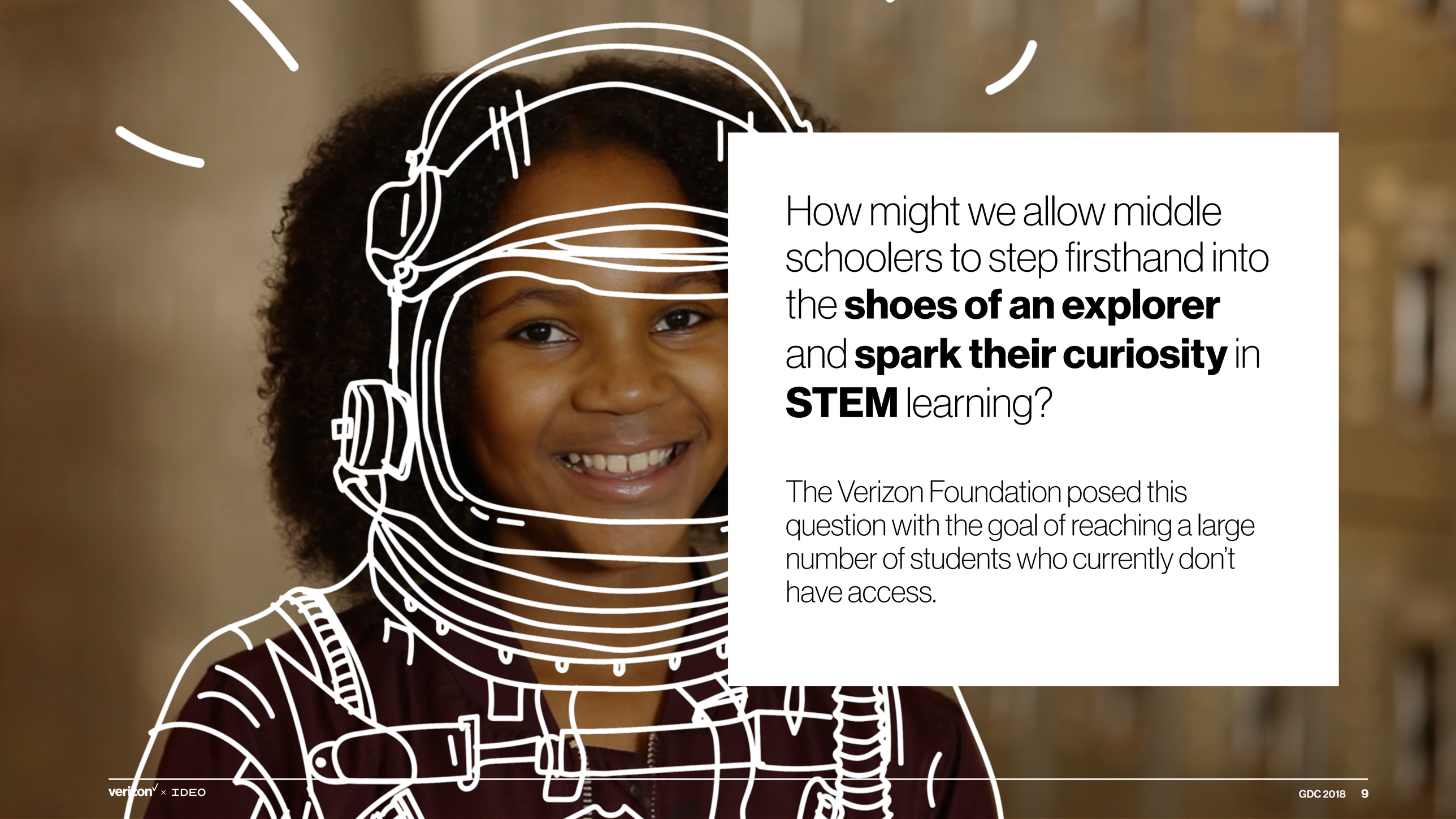
Today she is a **planetary scientist** at ASU who has worked on the MER **Curiosity rover** ops team.

Tanya's story has a common thread with others in her field, about a clear **turning point** when STEM became "for her."

Not every student has **access** to experiences like Tanya's to seed that spark.

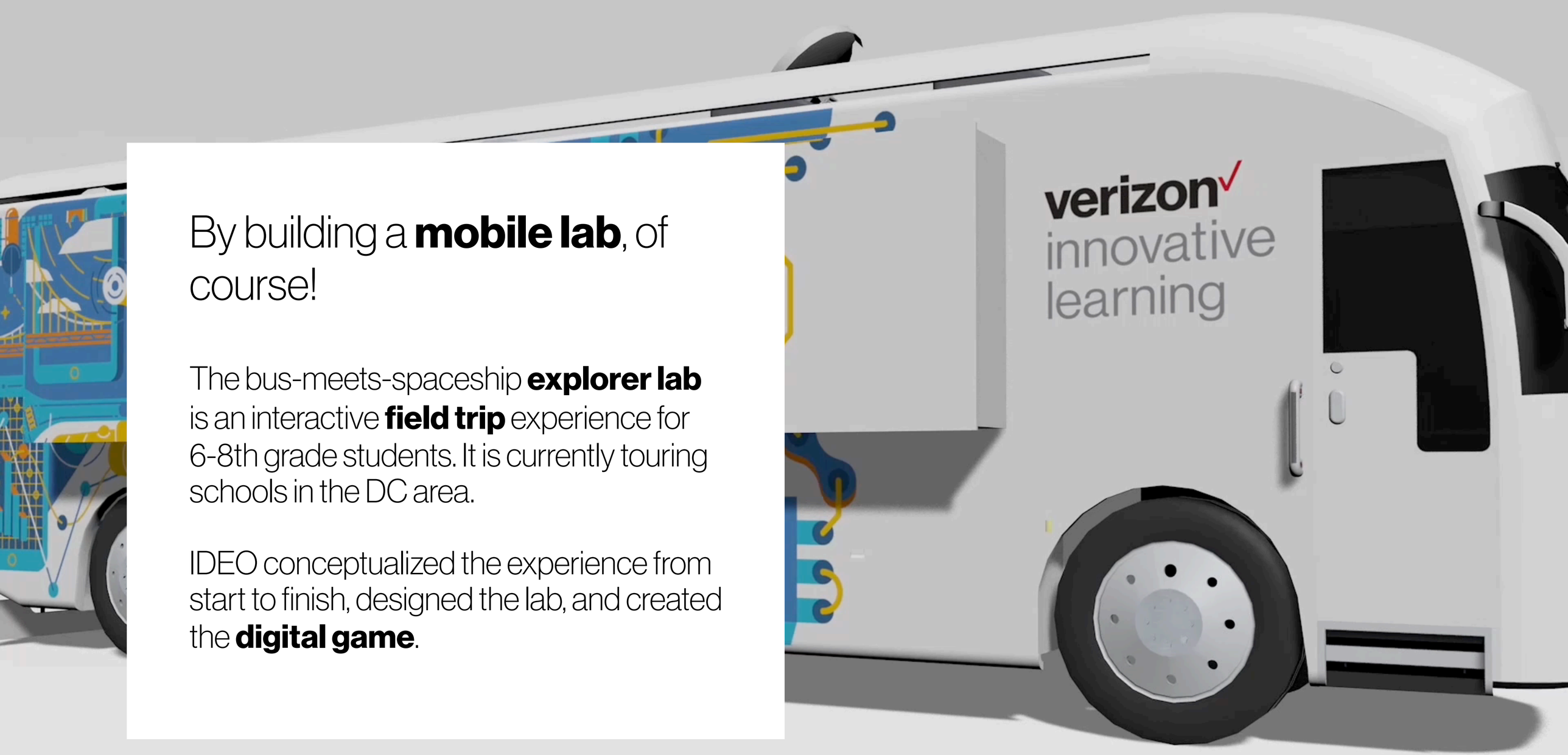
Schools in America are **falling behind** on STEM, and as a result we are closing doors on students to promising career opportunities.

"What is your least favorite class?"



How might we allow middle schoolers to step firsthand into the **shoes of an explorer** and **spark their curiosity** in **STEM** learning?

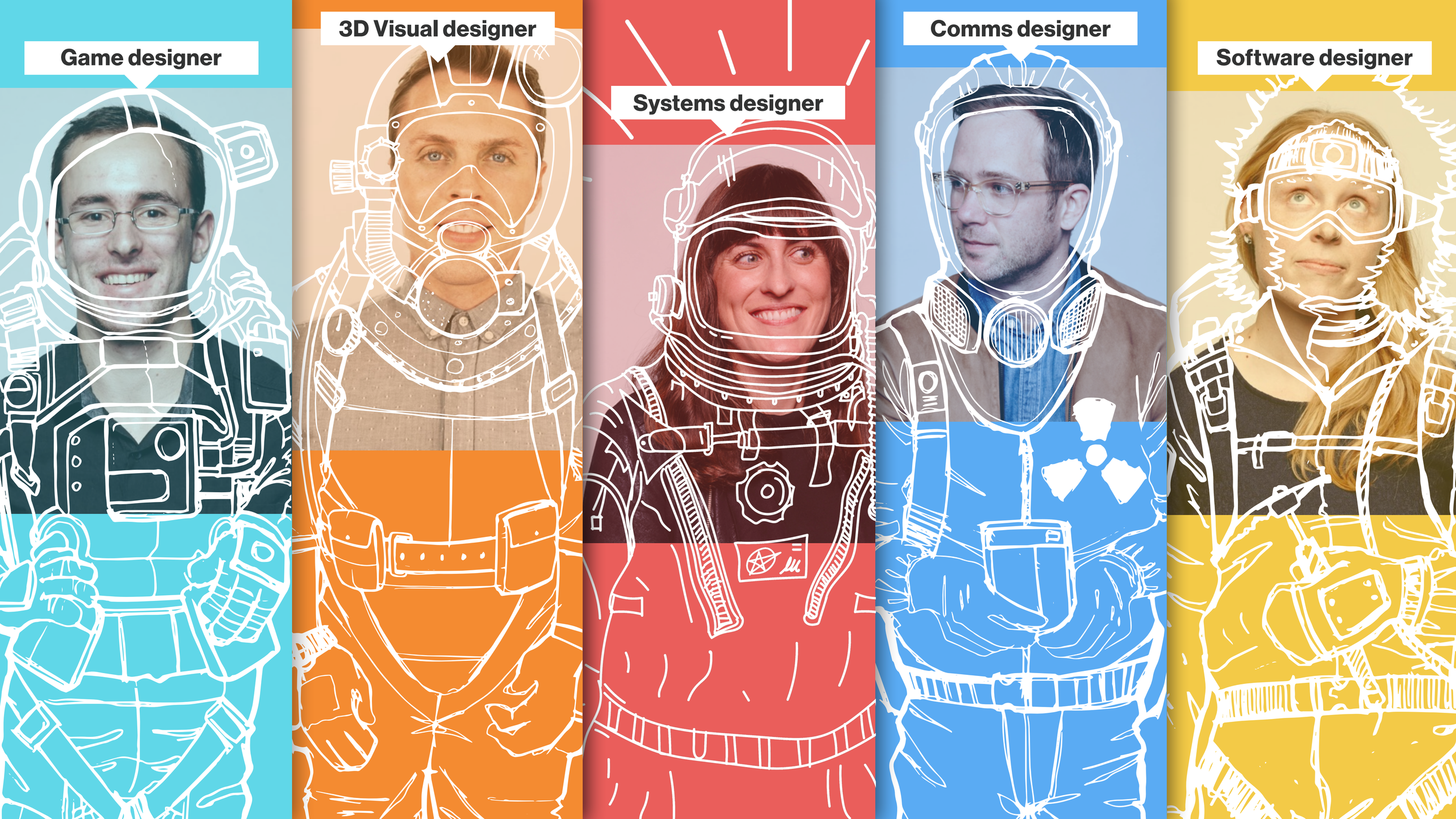
The Verizon Foundation posed this question with the goal of reaching a large number of students who currently don't have access.



By building a **mobile lab**, of course!

The bus-meets-spaceship **explorer lab** is an interactive **field trip** experience for 6-8th grade students. It is currently touring schools in the DC area.

IDEO conceptualized the experience from start to finish, designed the lab, and created the **digital game**.


Game designer
3D Visual designer
Systems designer
Comms designer
Software designer

lessons

Aa agreeing on a game mechanic

1 core concept + **4** takeaway insights

Bb reaching our unique audience

1 core concept + **4** takeaway insights

Cc personalizing play styles

1 core concept + **4** takeaway insights

Dd directing attention

1 core concept + **4** takeaway insights

Aa

agreeing on a game mechanic

Aa student experience

playtest one

Aa card game

fatal flaw

Aa the purple section on mars

01

Mechanics can mis-instruct.

Abstraction can **simplify** to bridge a knowledge gap, *but* it can **obfuscate** the truth.

Test To Validate

bring in **many core users**
they provide **nuanced reactions**
late in development
to **high-investment** ideas
resulting in **tweaks**
and reinforce **designers' bias**

Test To Learn

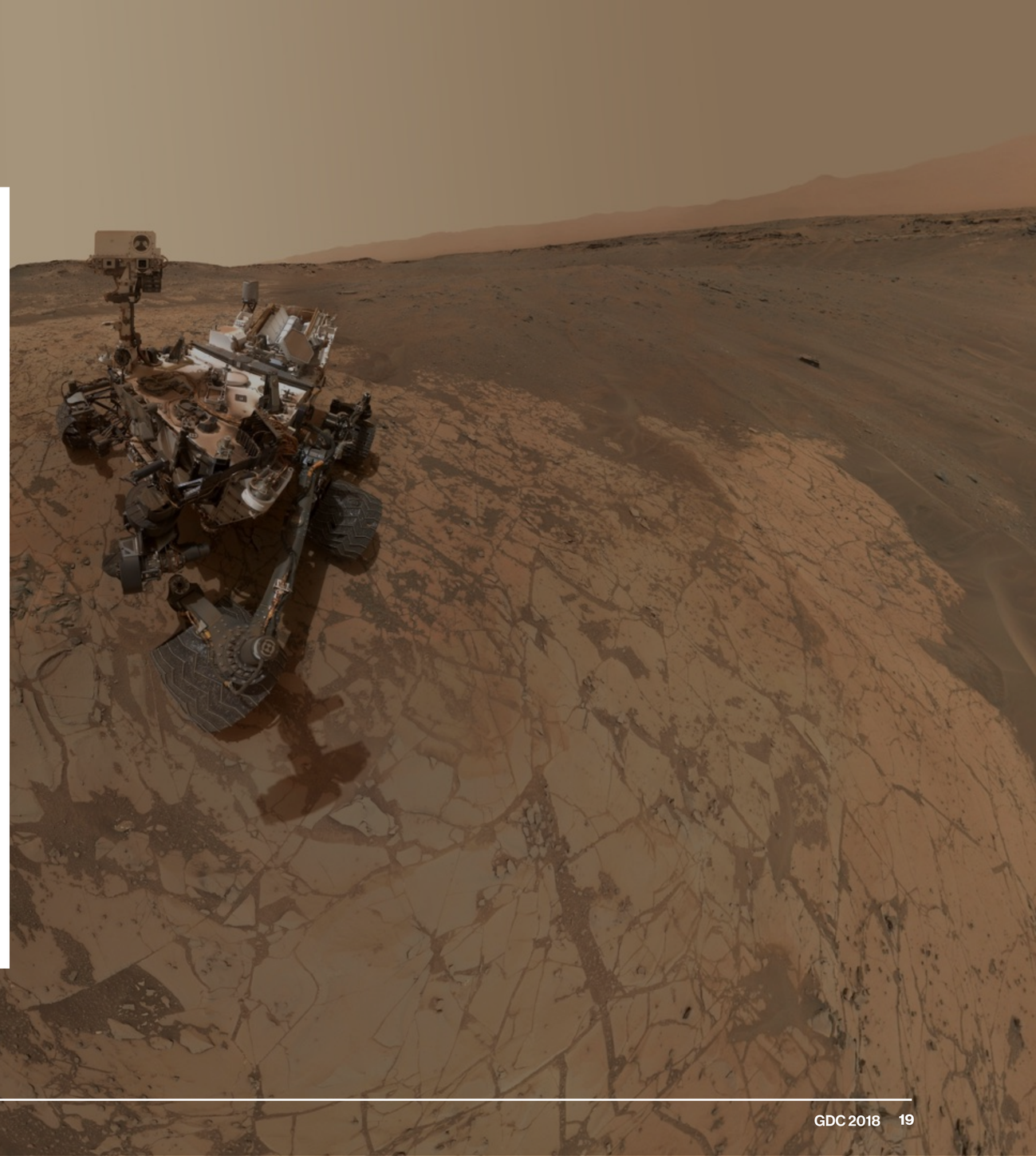
bring in **few extreme users**
they provide **strong reactions**
early in development
to **low-investment** ideas
resulting in **course changes**
and expose their **unmet needs**

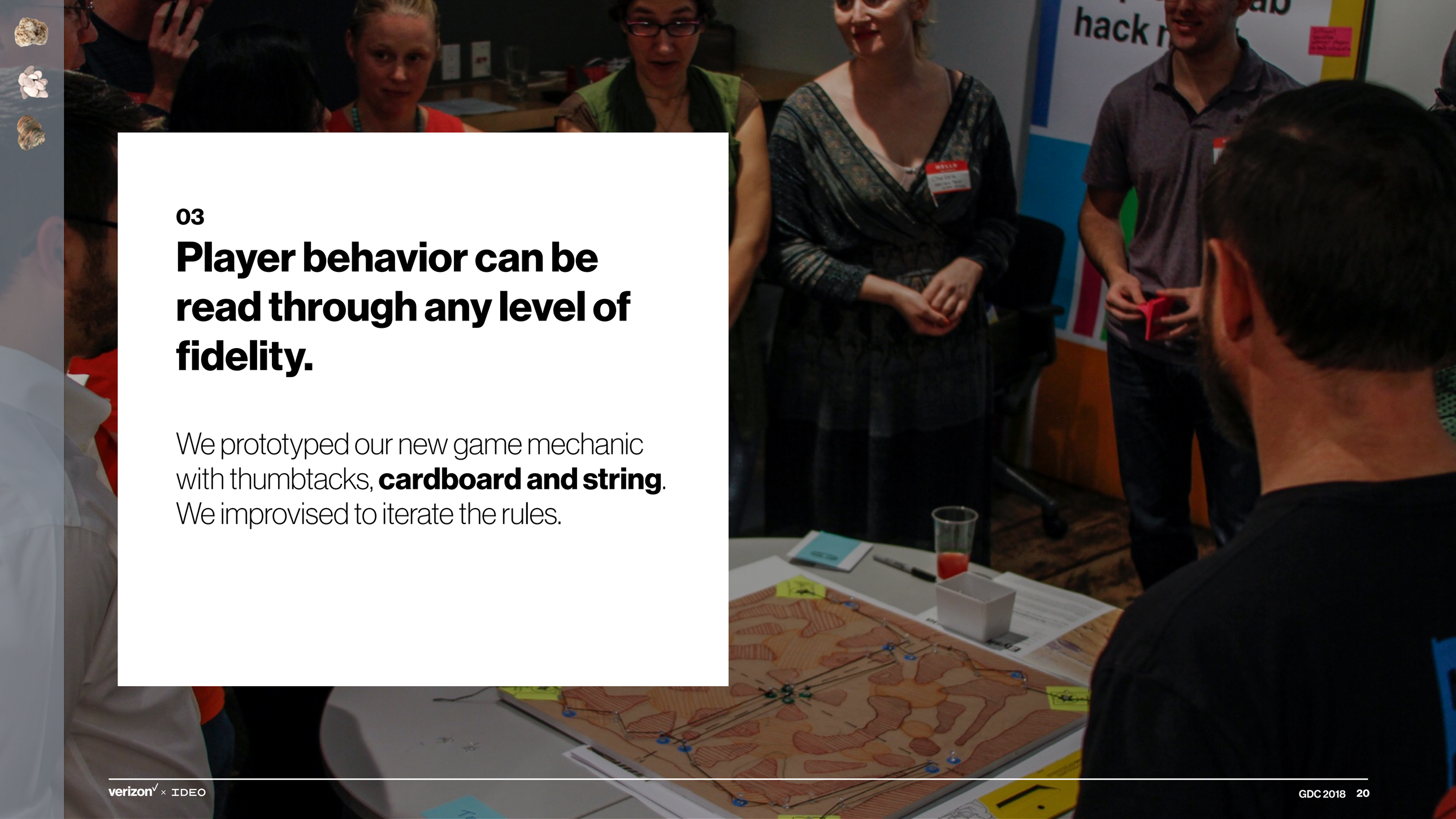
Aa core concept

02

Physical metaphors can compensate for a lack of digital/gaming literacy.

We brought in Tanya to help inform a **new mechanic** based on how real rovers are piloted on Mars.





03

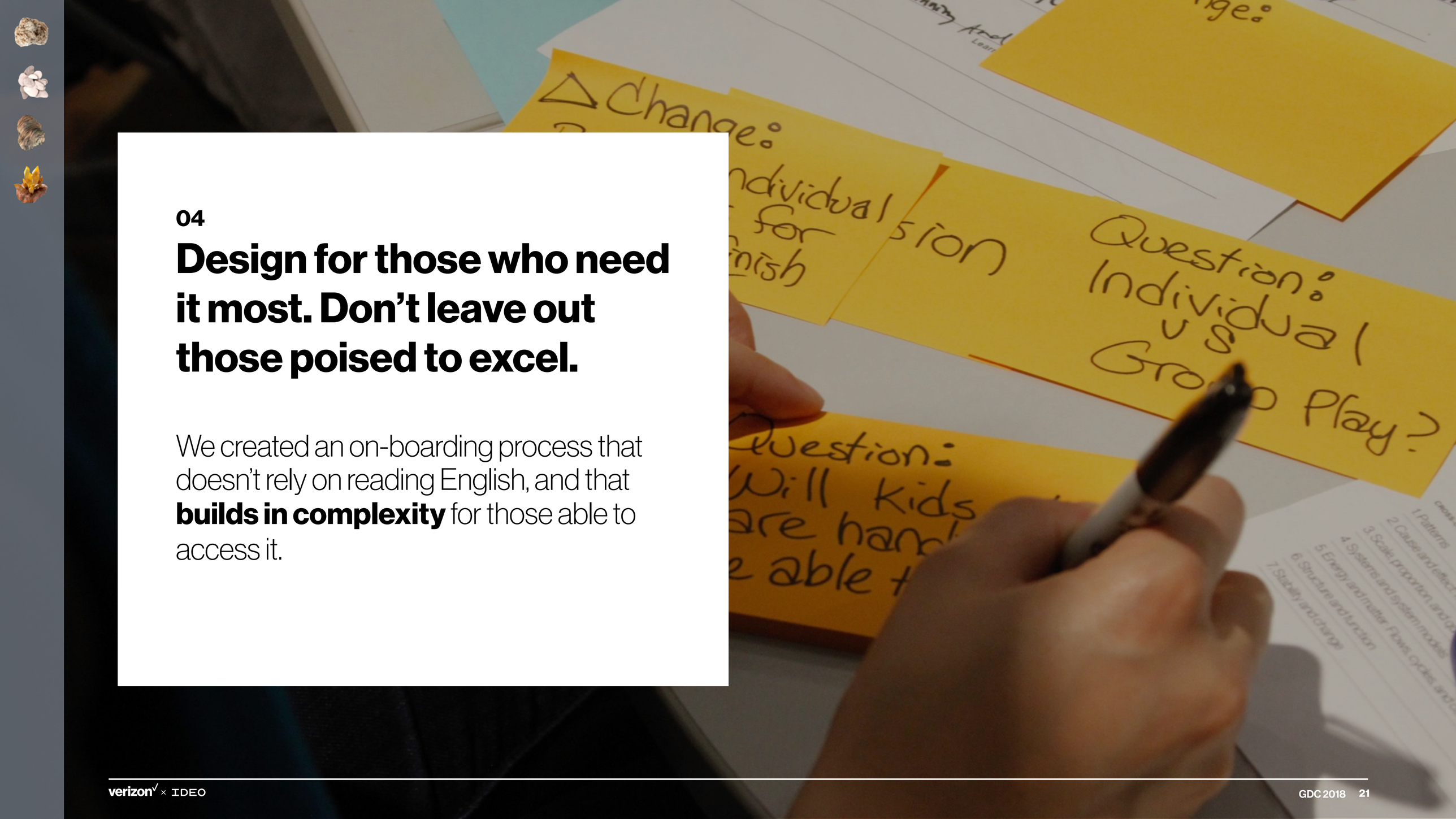
Player behavior can be read through any level of fidelity.

We prototyped our new game mechanic with thumbtacks, **cardboard and string**. We improvised to iterate the rules.

04

Design for those who need it most. Don’t leave out those poised to excel.

We created an on-boarding process that doesn’t rely on reading English, and that **builds in complexity** for those able to access it.



Bb

reaching our unique audience

Bb student experience

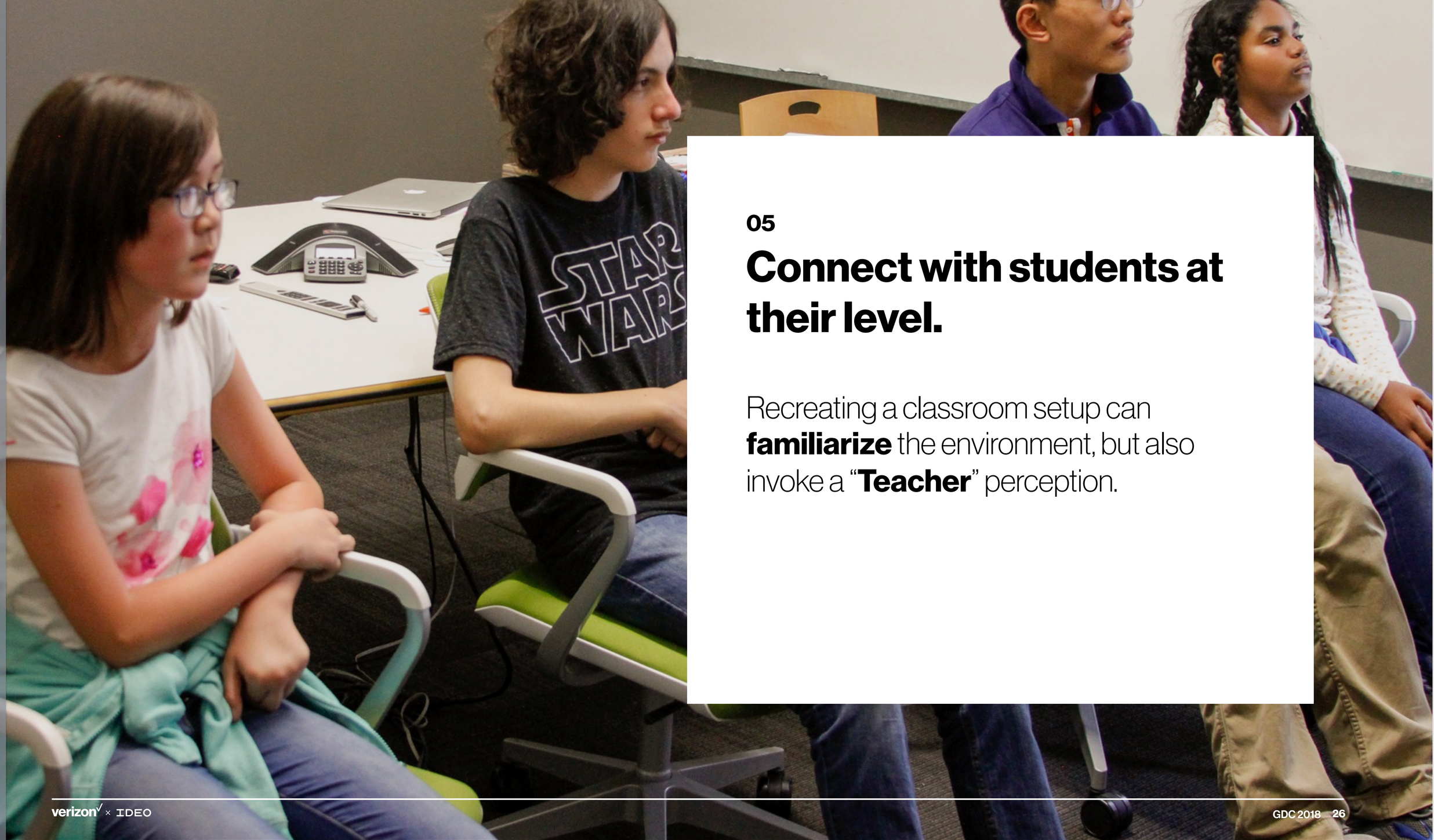
playtest two

Bb

piecewise digital experience

sabotage

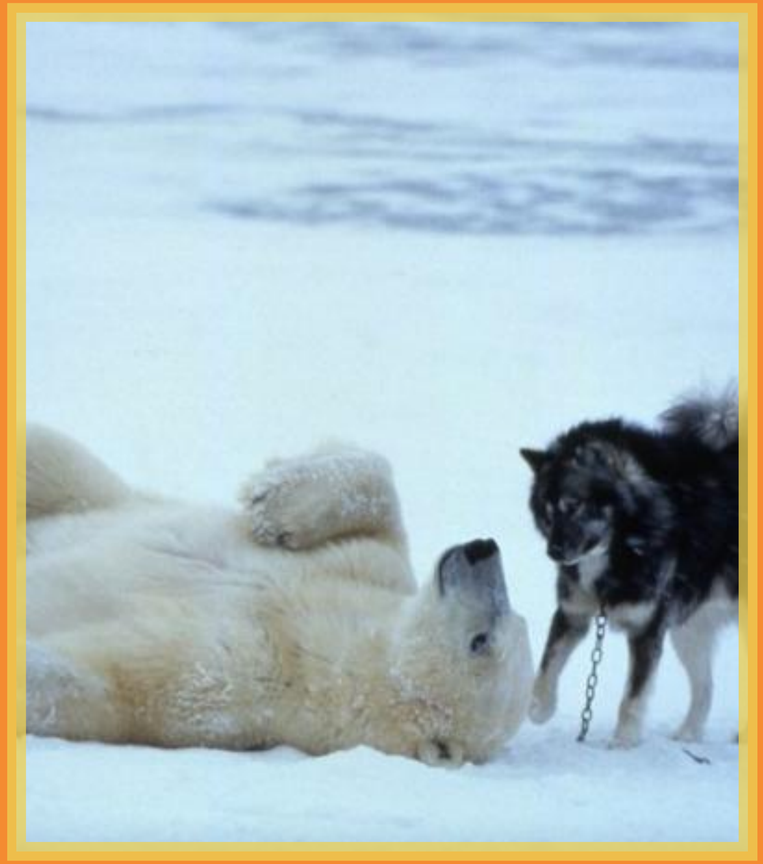
Bb negative ten out of ten



05

Connect with students at their level.

Recreating a classroom setup can **familiarize** the environment, but also invoke a "**Teacher**" perception.



Play Posture

to set the tone when working with kids, try to:

sit **backwards** on your chair

start with **warmup** activities

follow their **tangents**

laugh at their jokes

don't talk down to them

Bb core concept

06

Put kids in the driver's seat.

We think of kids as adults with less experience. To meet players at their level and have the experience feel real, we made **kids the heroes** and had adults depend on their help: Curiosity is **lost** and NASA needs ***you***!

07

Players remember the Emotional Journey, not the hard facts.

We designed for a one-time play experience where **the group always succeeds**, regardless of individual performance. Invest in sound design to **direct the mood** of the experience.

08

Kids love high stakes.

We learned from Tanya about active research on the **magnetic field** of Mars, and raised the stakes in the game with a **geomagnetic storm** that causes players to lose connection to their rovers.

“Can you suck the oxygen out of the bus?!”

Cc

personalizing play styles

Cc student experience

playtest three

Cc core game loop

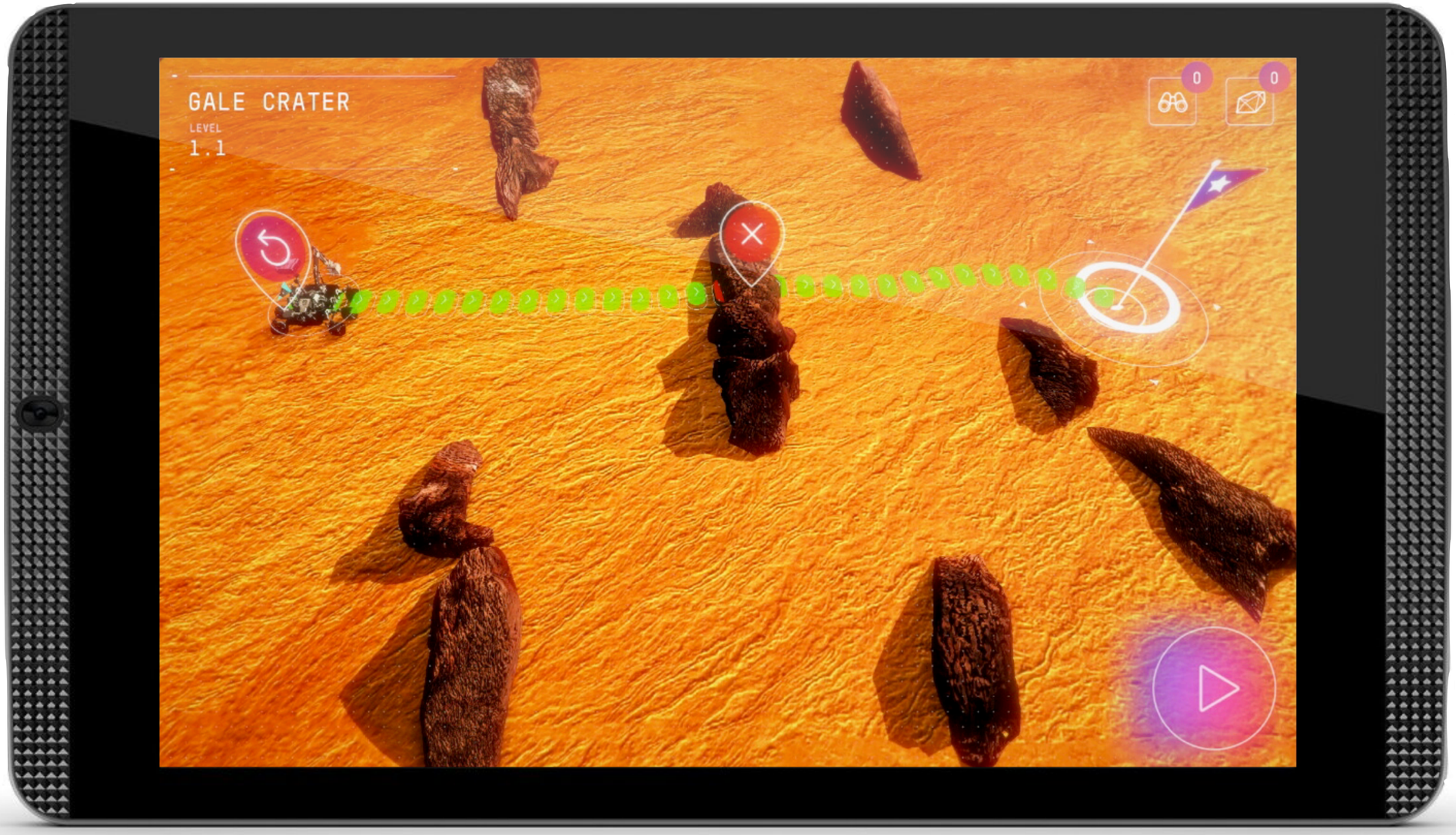
man overboard

Cc **tablet as projectile**

09

If a player gets lost, the game needs to bring them back in.

Real engineering requires understanding the **problem constraints**. Understanding the problem requires not missing a step in learning to read the problem.


GALE CRATER
LEVEL
1.1
0
0

Qualitative Signs of Engagement

observe what can't be seen from a screen-recording

body language

frustration (too hard)

checked out (too easy)

working with others

Observations to Design For

look for important play signals like

cheating

workarounds

tradeoffs

focus

experimentation

Cc core concept

10

Middle school students, unlike adults, try stuff without waiting for instruction.

Leave out the rules and encourage **trial and error**. Make problems open-ended and multi-solution.

11

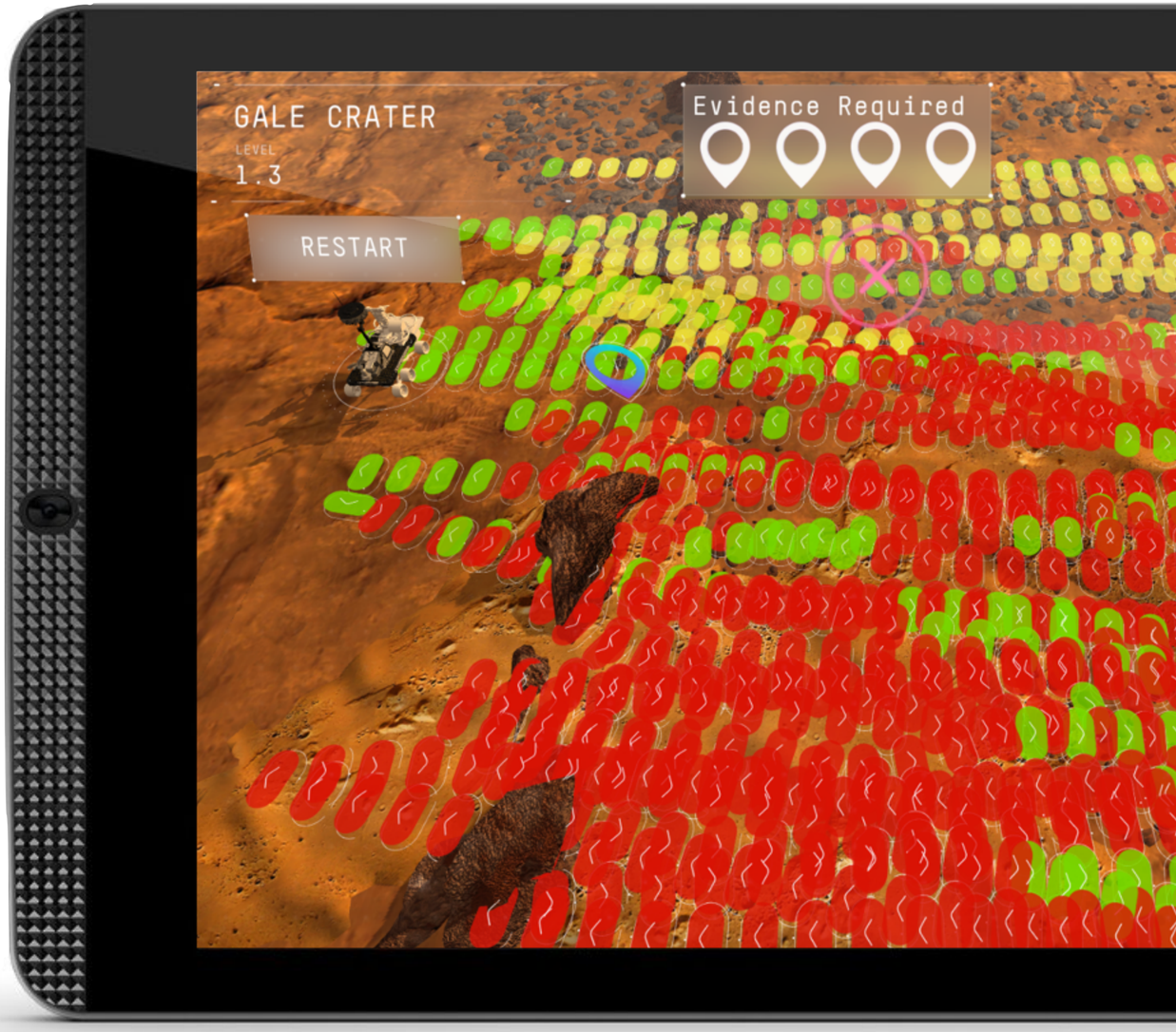
No one learns the same way or at the same pace.

We created an **adaptive learning platform** and removed any requisite science understanding to find common ground with the **engineering**.

12

Players derive immense pleasure from breaking the game.

We observed a student scribbling all over the game board to see our underlying **logic map**. To encourage exploration for **unusual solutions**, we've left in several such cheats.



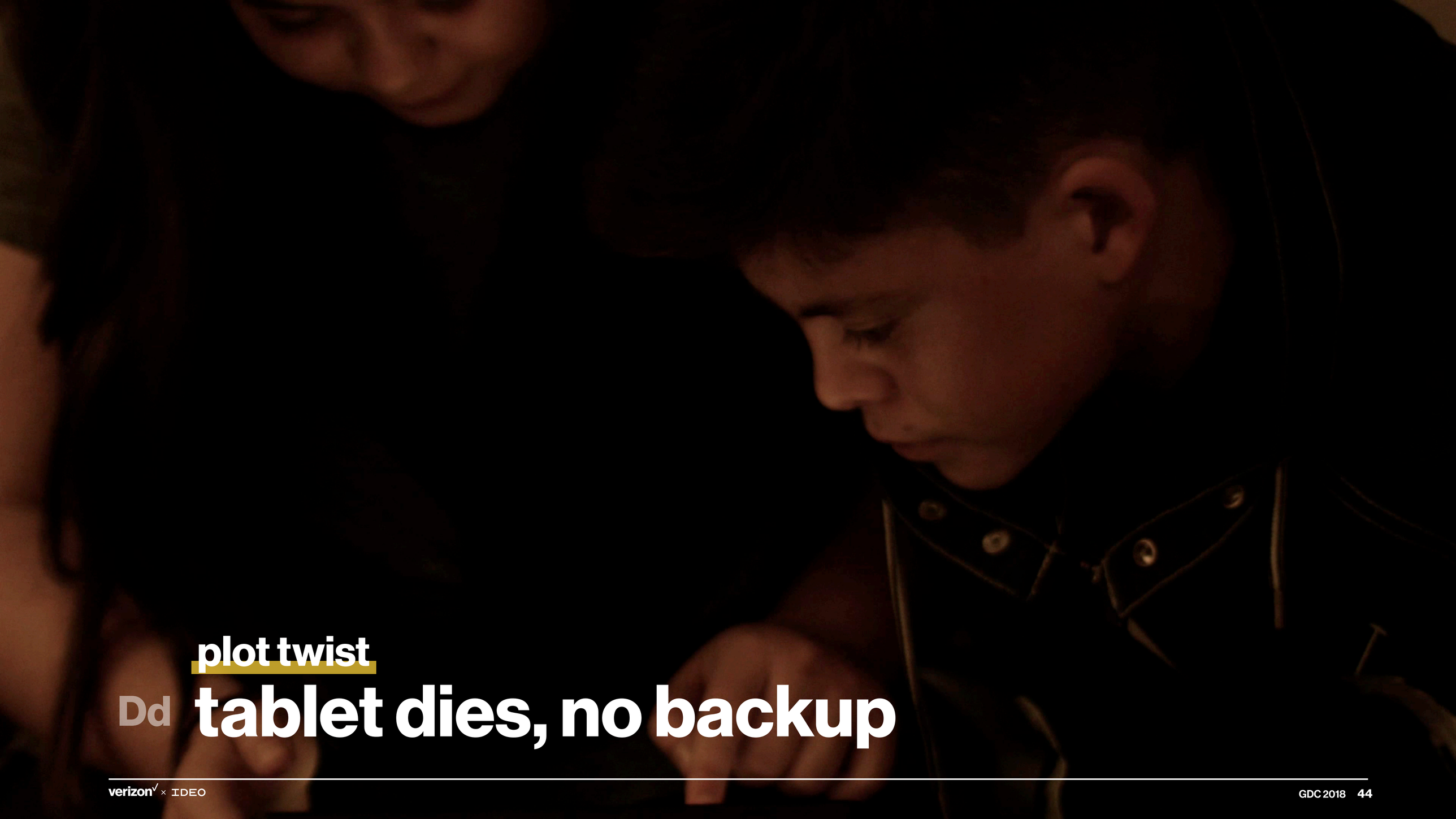
Dd

directing attention

Dd student experience

playtest four

Dd end-to-end game



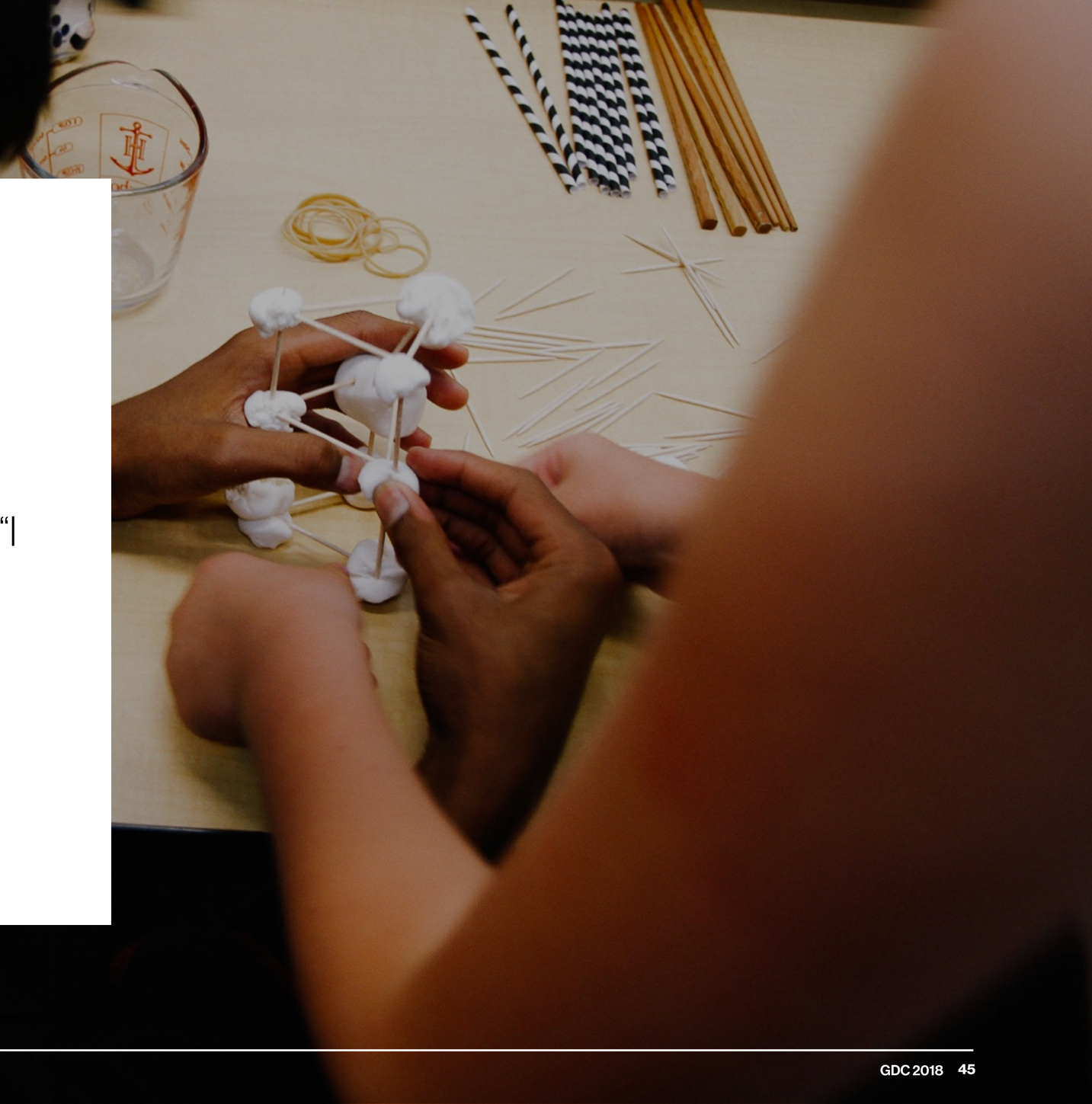
plot twist

Dd tablet dies, no backup

13

Collaboration can lead to metacognitive learning.

Solo play focuses on intuitive learning — “I know.” Collaboration can lead to **metacognitive learning** — “I know what I know.”



Offload Technical Challenges into Meatspace

context-aware tooltips
vs. facilitator voiceover

tablet peer-to-peer networking
vs. cues to offline collaboration

Parameterize rather than Optimize

facilitator controls to lengthen or shorten **playtime**

increase or decrease **difficulty**

step thru key moments

Dd core concept

14

Foreshadow important play patterns with early precedents.

We forced collaboration **early** so that players willingly work together **through out** the experience. A morse code puzzle — left by Curiosity's **morse code** tracks — reveals the direction it headed.

15

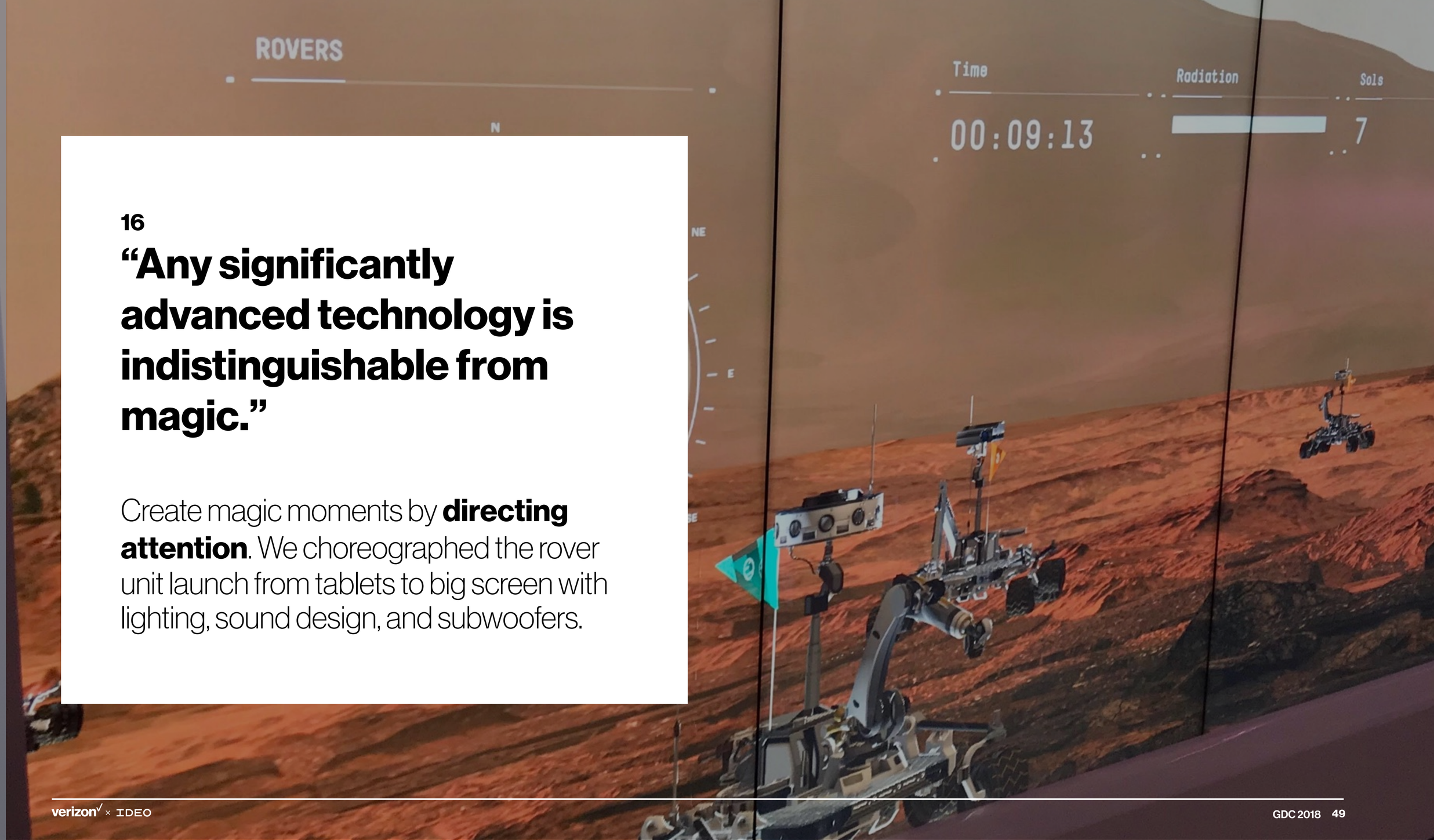
Display player impact to increase investment.

Students select a non-binding rover blueprint and customize a flag and name. They see their **recognizable** rover on the big screens on the bus, as well as their live game play stats.

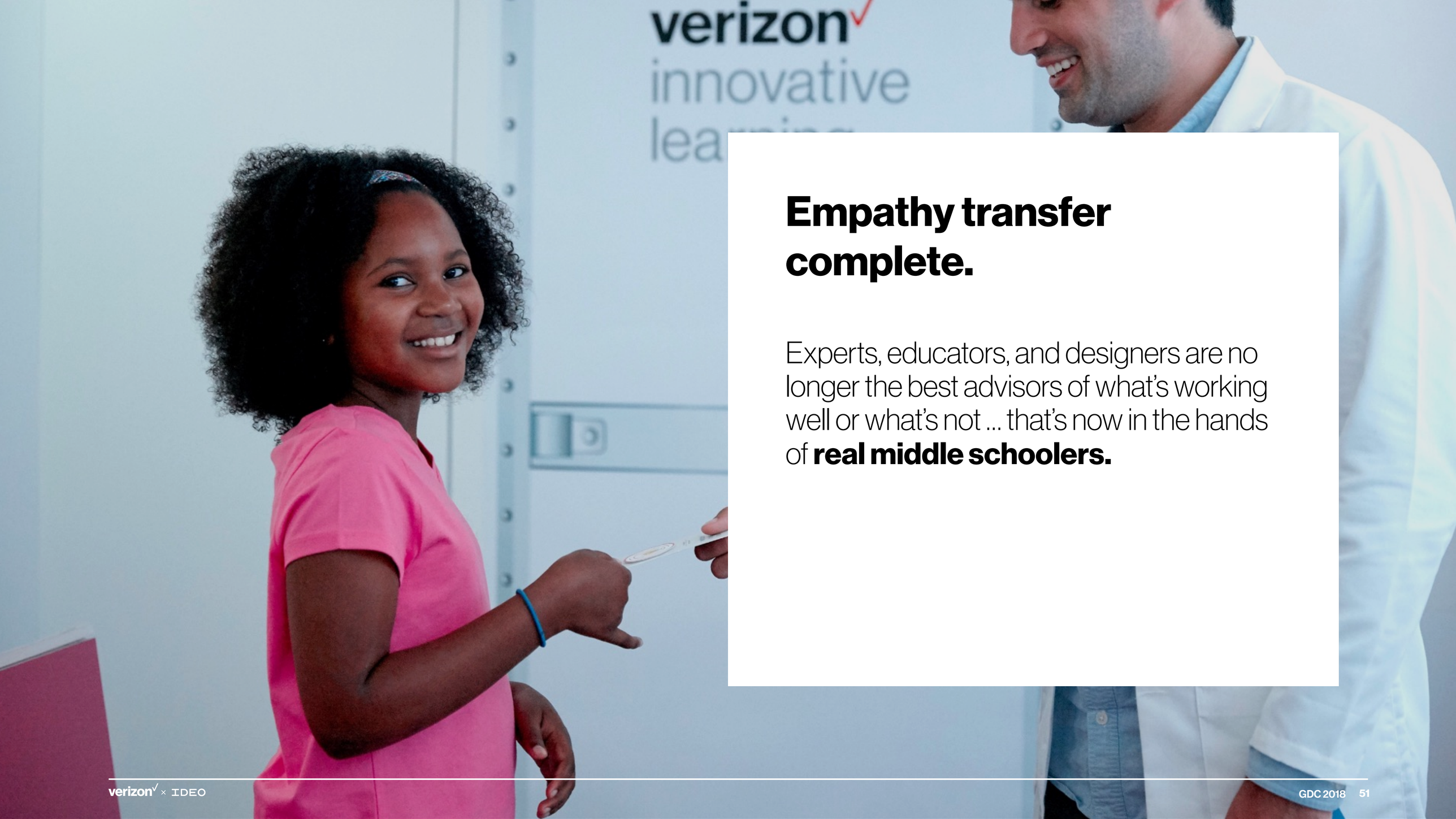
16

“Any significantly advanced technology is indistinguishable from magic.”

Create magic moments by **directing attention**. We choreographed the rover unit launch from tablets to big screen with lighting, sound design, and subwoofers.



in the end



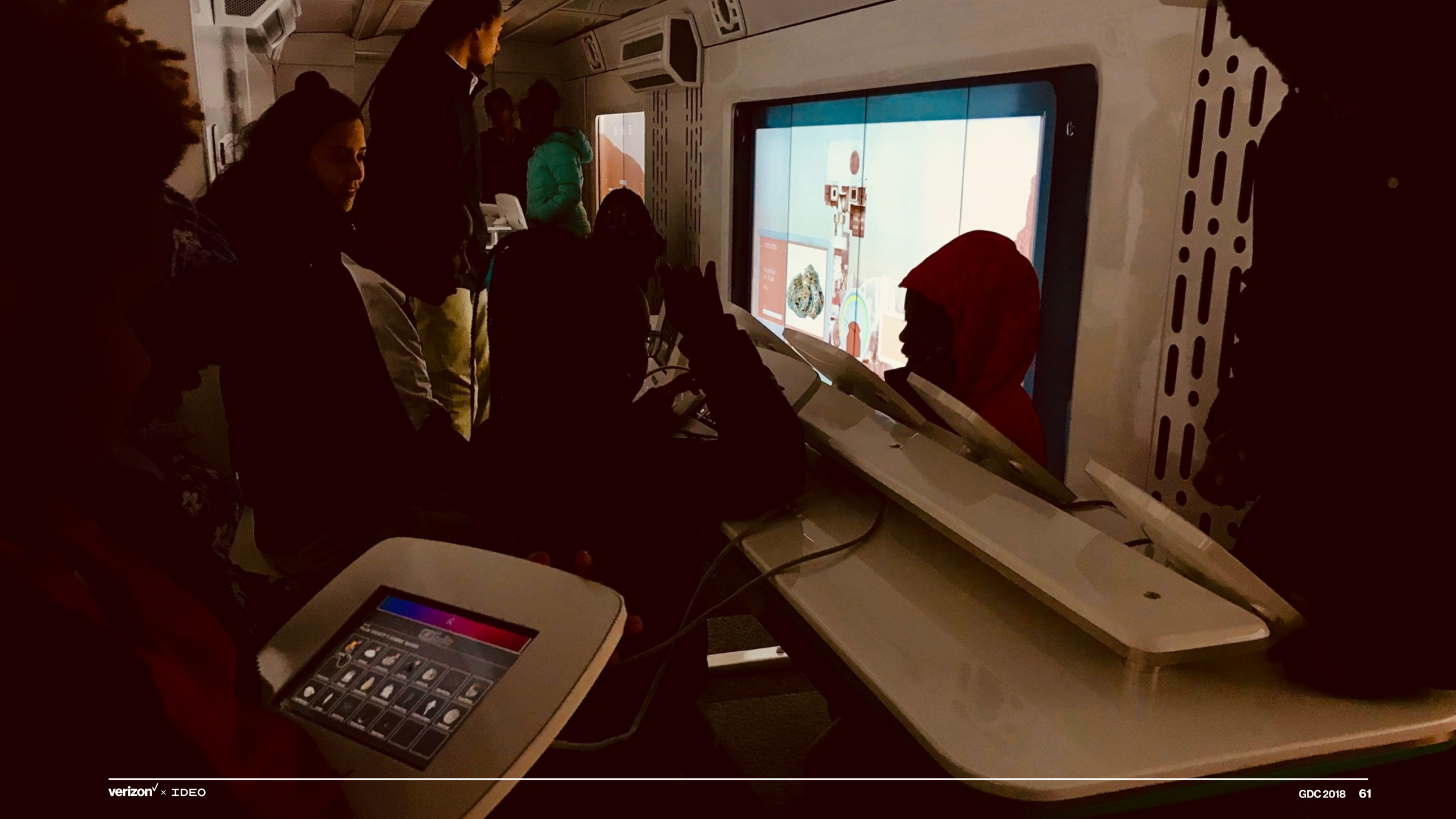
Empathy transfer complete.

Experts, educators, and designers are no longer the best advisors of what's working well or what's not ... that's now in the hands of **real middle schoolers.**

verizon
innovative
learning
40

N
R
N
D
Fn

Today, you'll be joining that grand tradition
of Space Exploration.



COMMUNICATOR
IN CHIEF
verizon

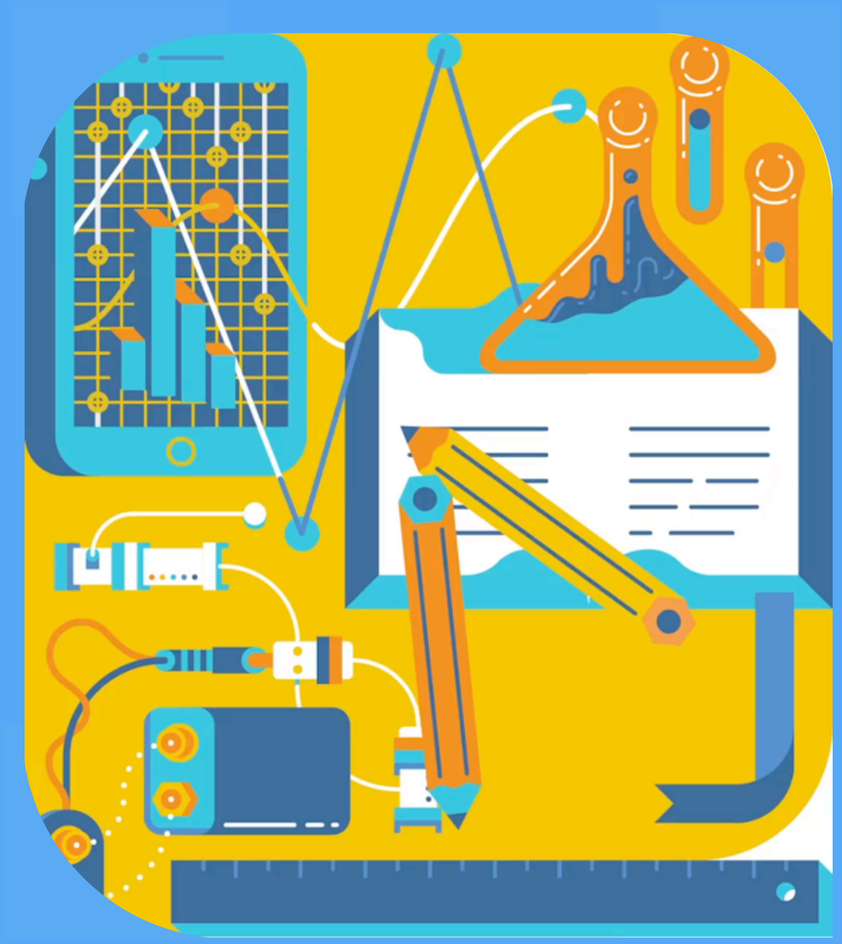
Mission Report

of **200** students at **3** schools

79% non-white, **54%** female

78% have a stronger interest in completing high school

63% have a stronger belief they can be successful in a STEM career

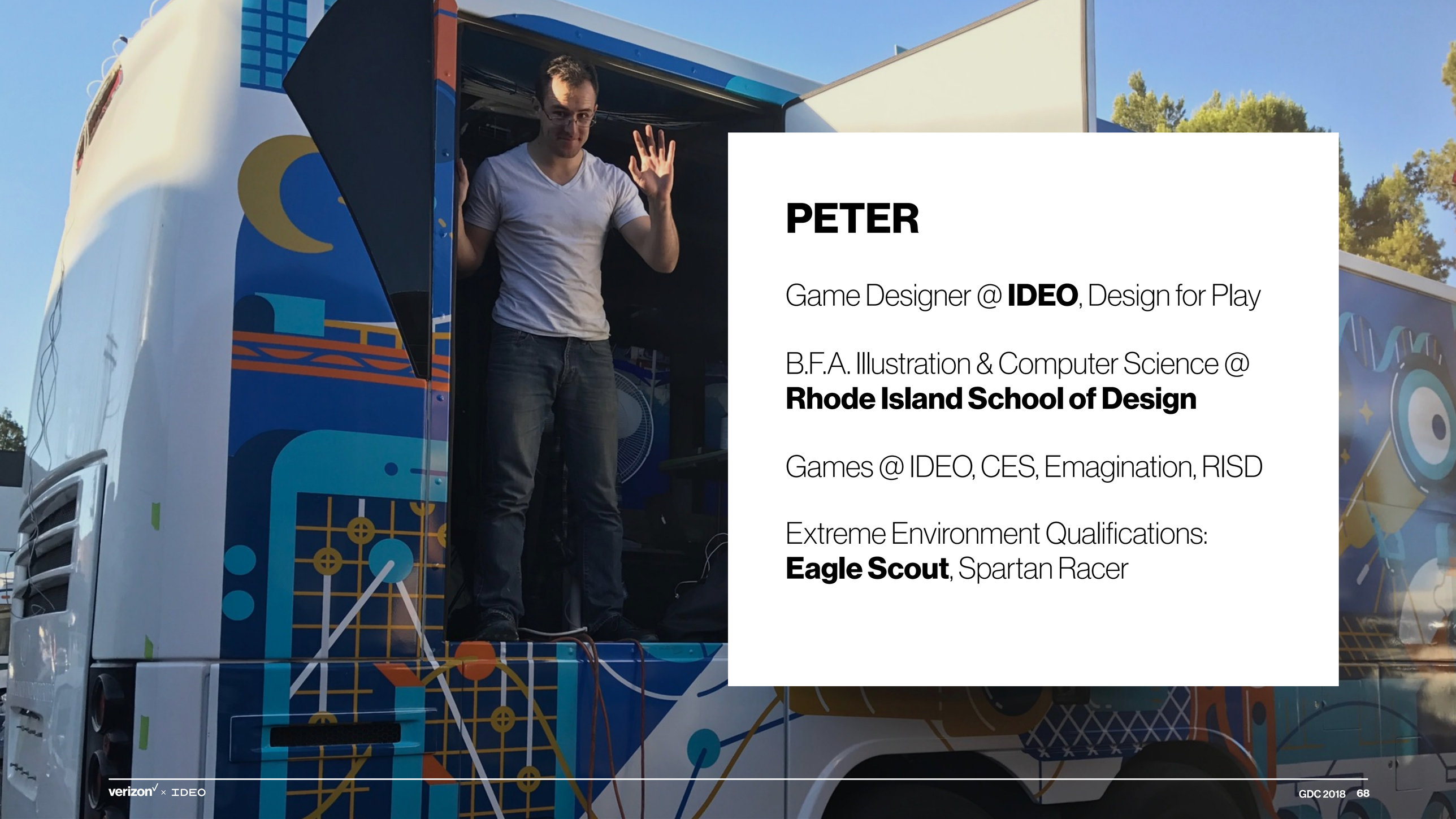


over 2500 people reached

How might we link education and play to make meaningful change in students' access to opportunities?

How might we step into someone else's shoes when we design games, rather than making games that appeal to ourselves?

credits



PETER

Game Designer @ **IDEO**, Design for Play

B.F.A. Illustration & Computer Science @
Rhode Island School of Design

Games @ IDEO, CES, Emagination, RISD

Extreme Environment Qualifications:
Eagle Scout, Spartan Racer

KATE

Software Design Lead @ **IDEO**

B.A. Computer Science & Studio Art @
Dartmouth College

Games @ IDEO, gTar, Hide & Seek,
Cleverbot, Tiltfactor Lab

Extreme Environment Qualifications:
Divemaster, 6000m Mountaineer

verizon
innovative
learning
IDEO
West Coast
CUSTOMS
WHISKYTREE®
Master Crafted Computer Graphics
MdBio
MATT
HUTCHINSON
COMPOSER

thank you ;)

Aa **agreeing on a game mechanic**
Test to Validate vs. Test to Learn

Bb **reaching our unique audience**
Play Posture

Cc **personalizing play styles**
Qualitative Signs of Engagement
Observations to Design For

Dd **directing attention**
Offload Technical Challenges into Meatspace
Parameterize rather than Optimize

Summary of Core Concepts

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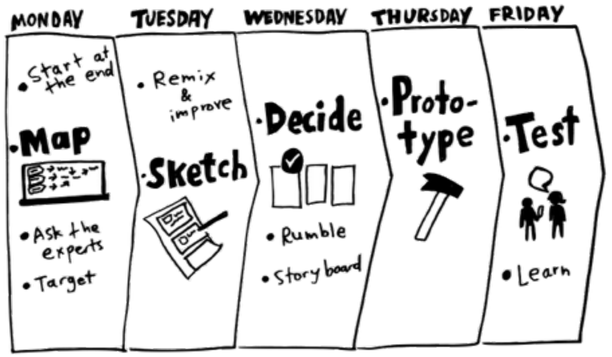


Google Ventures 5-day design sprint

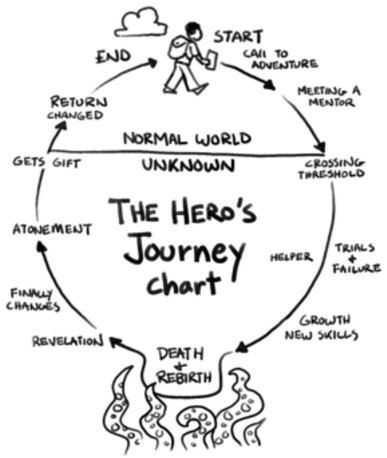
Bringing in on-topic and analogous experts for inspiration

Human-centered qualitative research methods

Aa Toolkit

NEXT GENERATION SCIENCE STANDARDS

Nationally recommended science curriculum

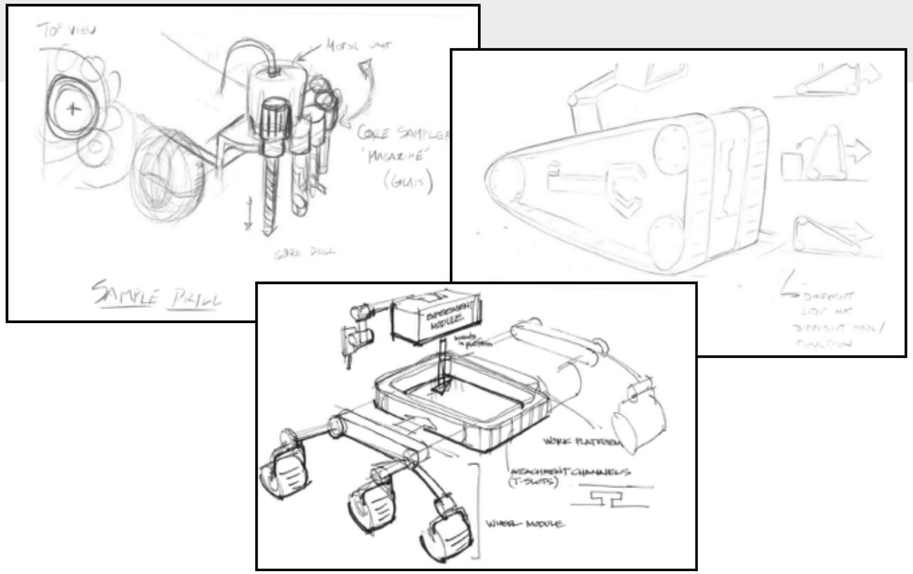


Hero's journey framework

IDEO research recruiting process

Bb Toolkit

Unity 3D game engine

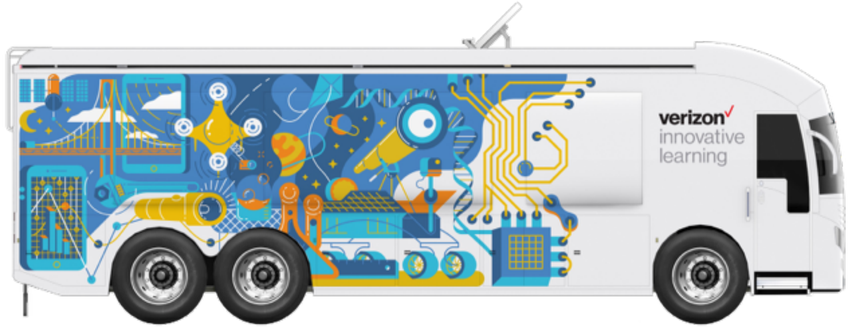


Rover design sketchstorm with IDEO experts

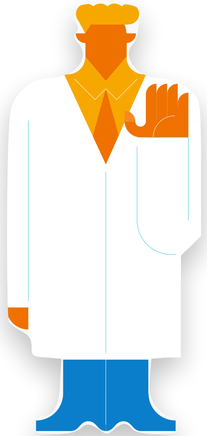
Bringing in on-topic and analogous experts for critique

Cc Toolkit

Full working tech stack of tablets, network, bus computer, and hardware infrastructure



Constraints of our new gaming platform



In-experience tools for the facilitator

Dd Toolkit

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