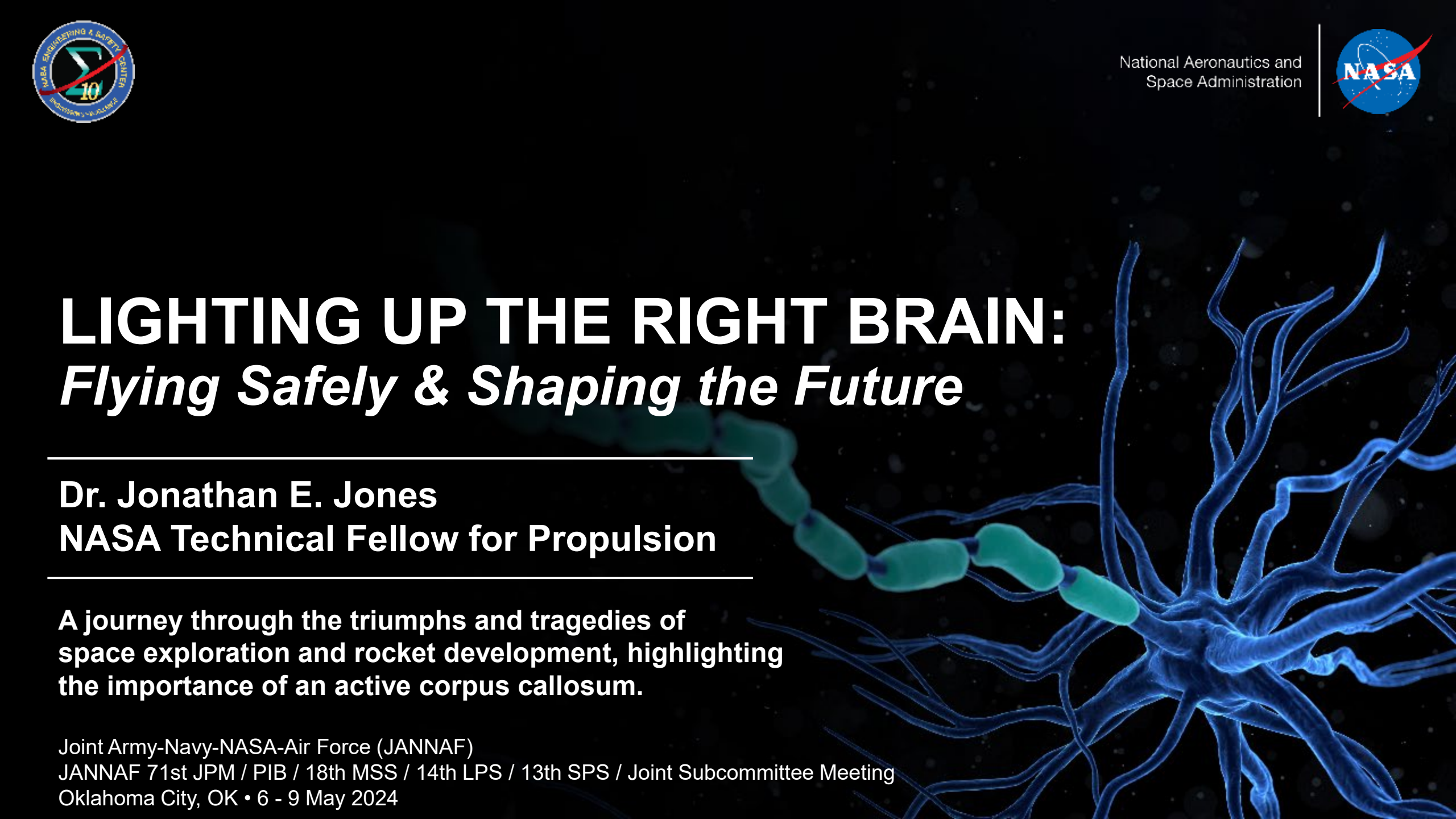
National Aeronautics and Space Administration

LIGHTING UP THE RIGHT BRAIN:
Flying Safely & Shaping the Future

Dr. Jonathan E. Jones
NASA Technical Fellow for Propulsion

A journey through the triumphs and tragedies of space exploration and rocket development, highlighting the importance of an active corpus callosum.

Joint Army-Navy-NASA-Air Force (JANNAF)
JANNAF 71st JPM / PIB / 18th MSS / 14th LPS / 13th SPS / Joint Subcommittee Meeting
Oklahoma City, OK • 6 - 9 May 2024



Keynotes are for old men to pontificate.
You have 6 mostly grown children and 3 grandchildren.
Perhaps you are an old man!







I woke up one morning with deep thoughts that I wanted to share.

NASA Engineering & Safety Center (NESC)

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Deneen M. Taylor
Structures


Jon B. Holladay
Systems Engineering


Steven L. Rickman
Thermal Control & Protection

LIAISONS: David Francisco, Office of the Chief Health and Medical Officer (OCHMO) and Glen W. Lockwood, Office of Safety and Mission Assurance (OSMA)

Why the NESC Exists:

In 2003, the Columbia Accident Investigation Board specified a need for a technically strong, program-independent resource to provide an alternative perspective on difficult technical issues and provide independent technical investigations for NASA programs and projects. In response the NESC was created.

NESC Mission:

To perform value-added independent testing, analysis, and assessments of NASA's high-risk projects to ensure safety and mission success. The NESC engages proactively to help NASA avoid future problems.

7 Elements of Good Flight Rationale

Solid Technical Understanding

Physics based or root cause understanding of issue, based on engineering data (perhaps using a fault tree)

1

Condition Relative to Experience Level

Experience base includes full-scale flight, ground test, or qualification level tests

2

Bounding Case Established

Using physics-based understanding, determine the bounding case (e.g., lower A-basis allowables, upper three sigma loads and environments, anchored with test data)

3

Self Limiting Aspects

Physical reasons why it can't get any worse than the bounding case or show the part is fail-safe

4

Margins Understood

Adequate margins, ideally not substantially reduced from baseline

5

Assessment Based Data, Testing & Analysis

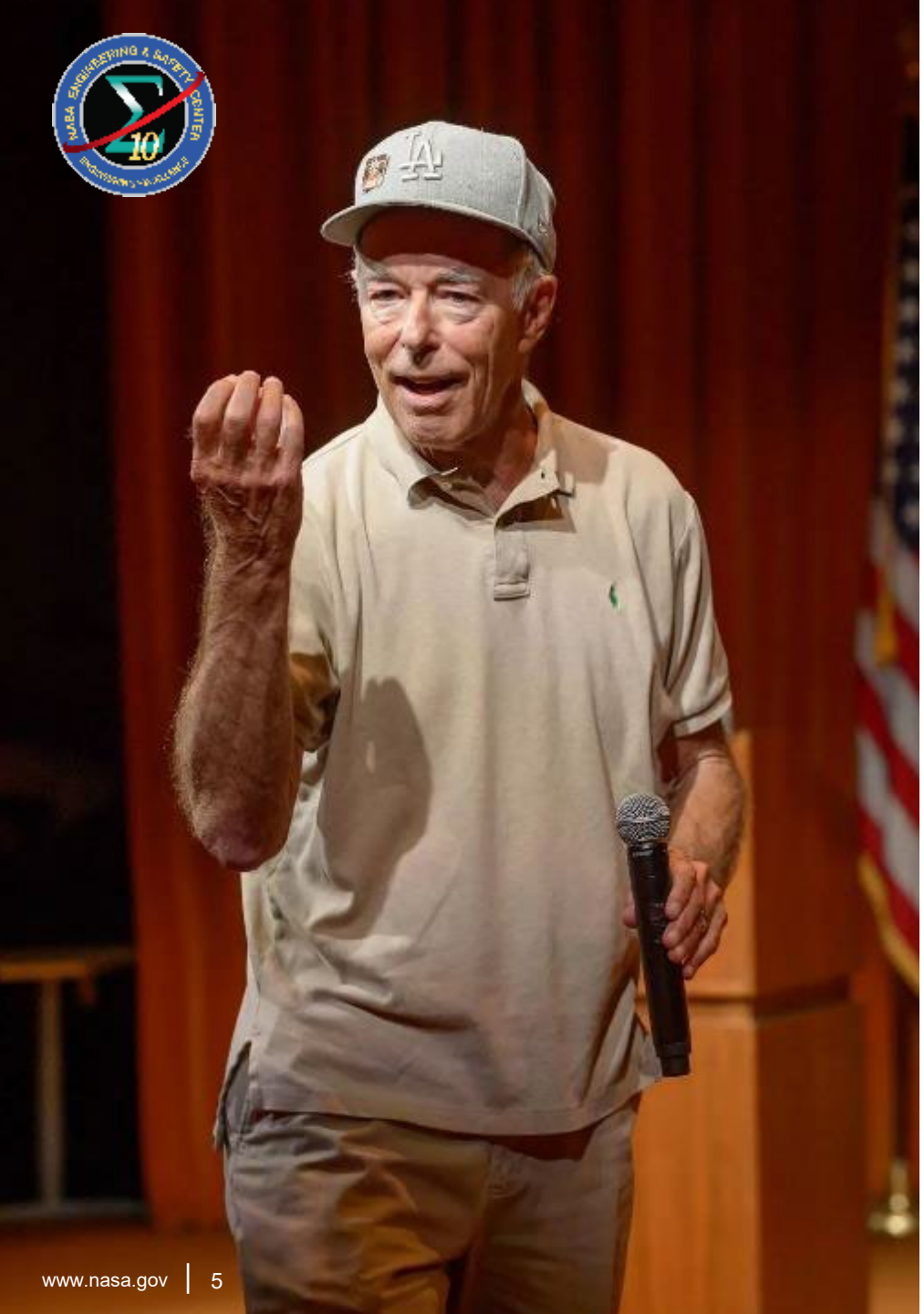
Final risk assessment based on test data and analysis, not gut feel or expert opinion

6

Interactions with Other Elements/Conditions Addressed

Address interactions with other conditions (MRB, changes, technical issues), and vehicle elements

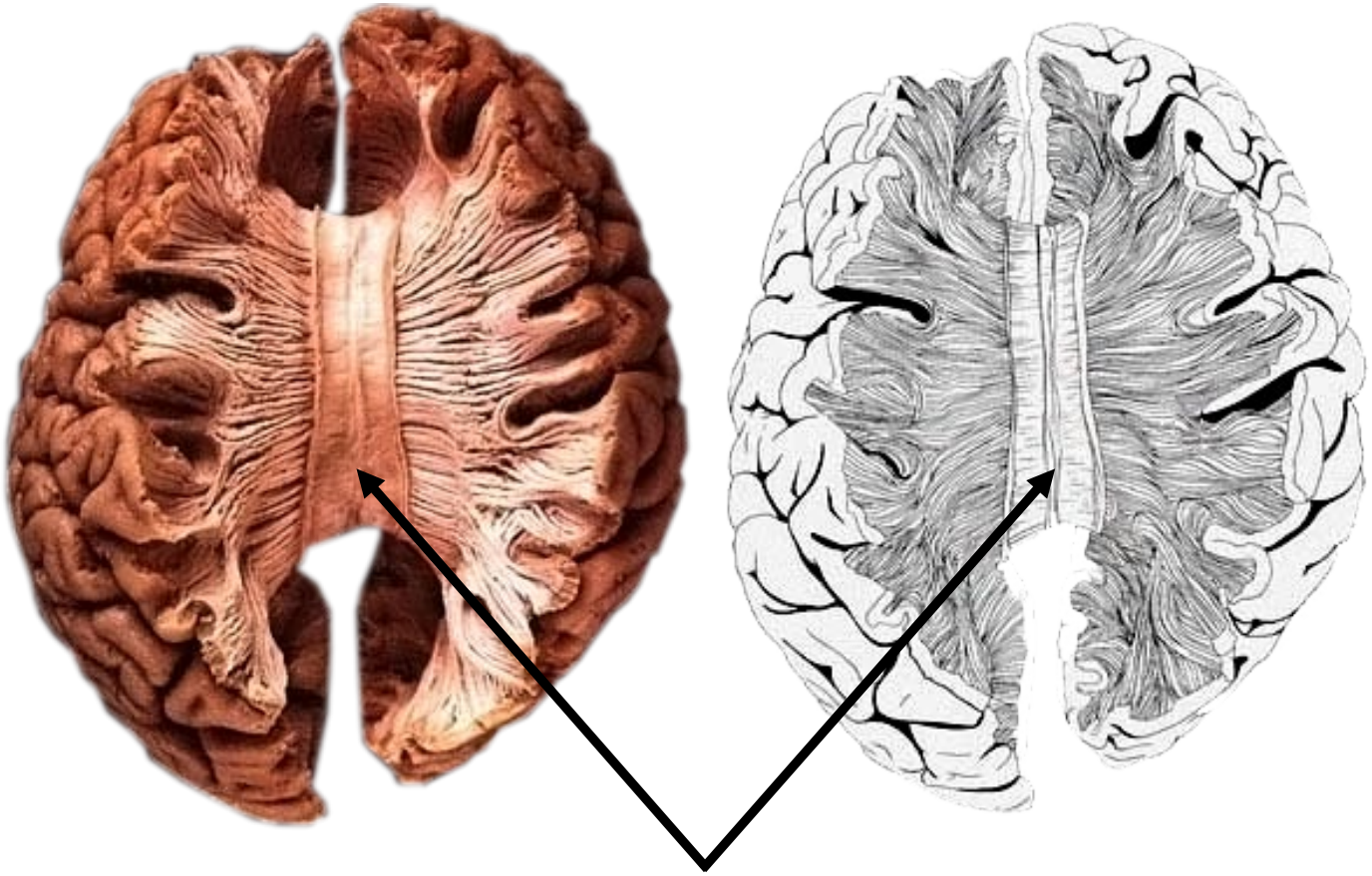
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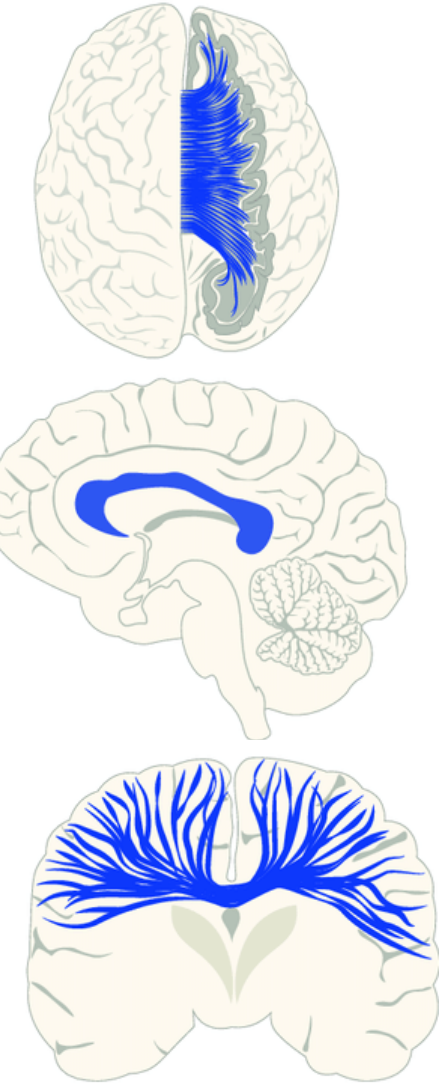


Gentry Lee's "Systems Engineering – When the Canvas is Blank"

1. Science Smarts
2. Know ALL the Partials
3. ***Active Corpus Callosum…Visionary Skeptic***
4. Nearly Infinite Initiative Coefficient
5. Has Project Experience
6. A Consummate Juggler…Comfortable with Chaos
7. Separate the Wheat from the Chaff (Tares)
8. Multi-dimensional Risk Analyst
9. Master of Margins and Reserves
10. Understands the Complete Toolkit

Corpus Callosum

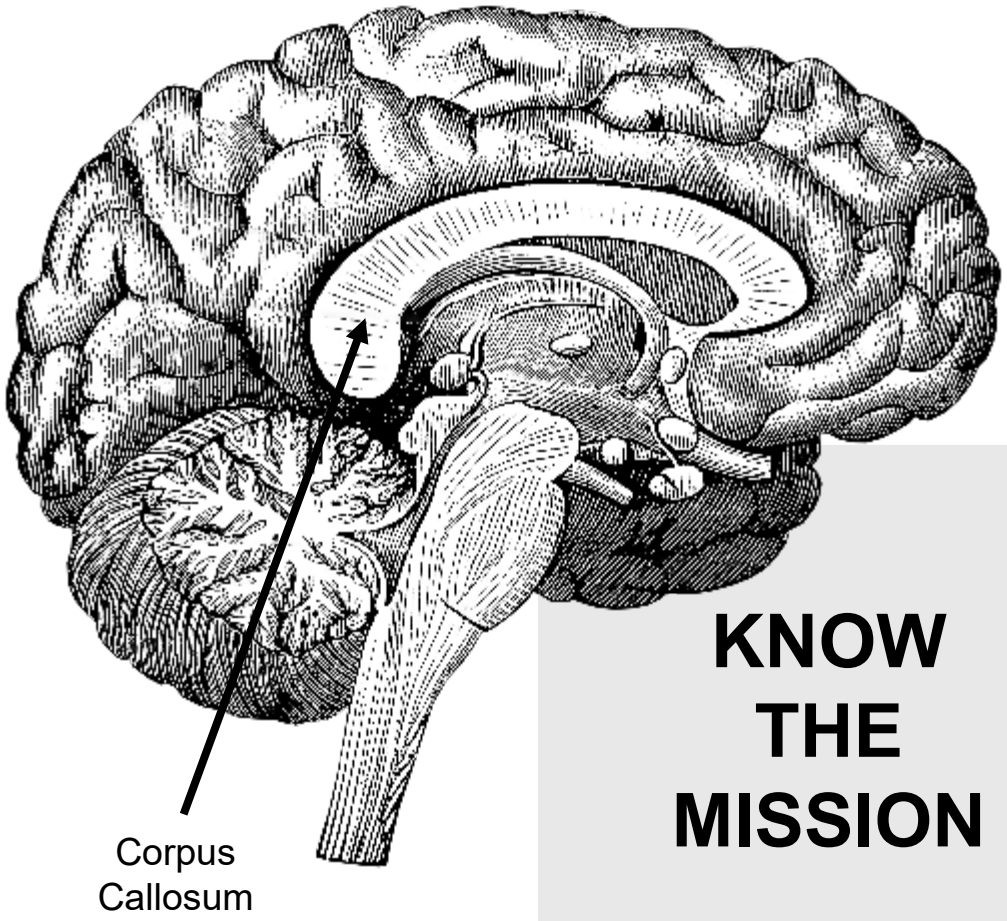




The corpus callosum is a thick bundle of nerve fibers that connects the two cerebral hemispheres, allowing them to communicate.

Images: researchgate.net

3 K³eys to Flying Safely and Shaping the Future



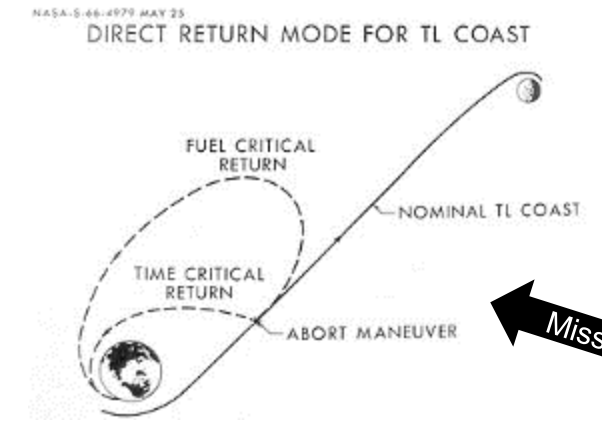
Activating the corpus callosum is an enabling skill for applying these k³eys consistently to fly safely and shape the future.

KNOW THE MISSION 1

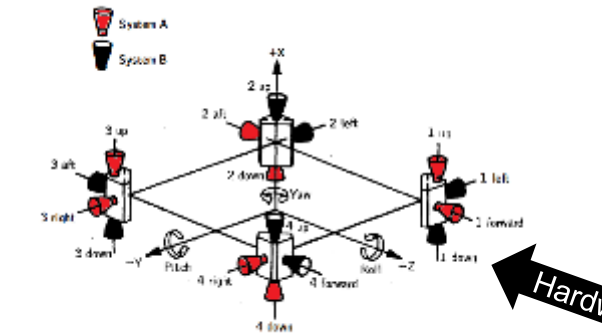
KNOW THE HARDWARE 2

KNOW THE PEOPLE 3

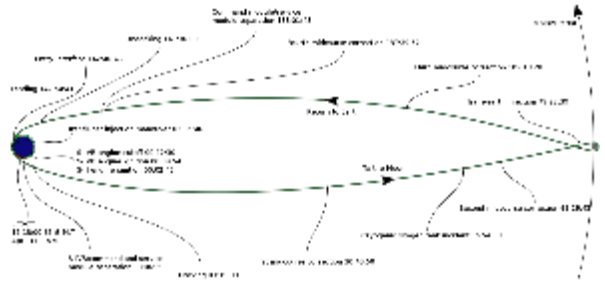
Apollo 13



Mission



Hardware



LEFT-BRAIN FUNCTION

Analytic Thought

Logic

Language

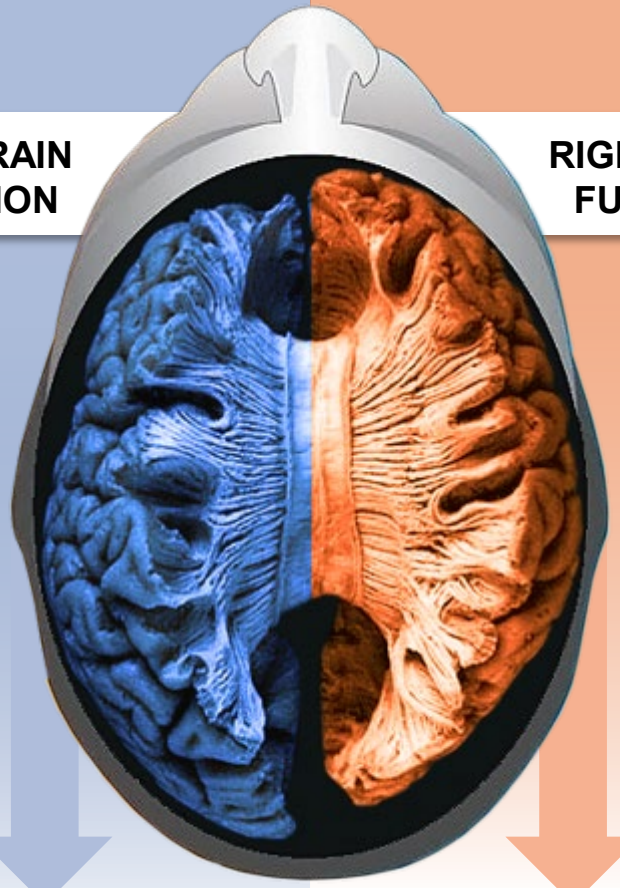
Reasoning

Science and Math

Written

Numbers Skills

Right-Hand Control



RIGHT-BRAIN FUNCTION

Art Awareness

Creativity

Imagination

Intuition

Insight

Holistic Thought

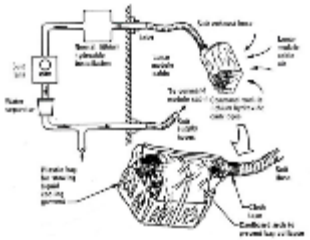
Music Awareness

3-D Forms

Left-Hand Control

Hardware







Trajectory Calculations
Analysis of Flight Data
Air Flow
Oxygen Calculations

The Crew
Back Up Crew
Simulator
Flight Spares

People



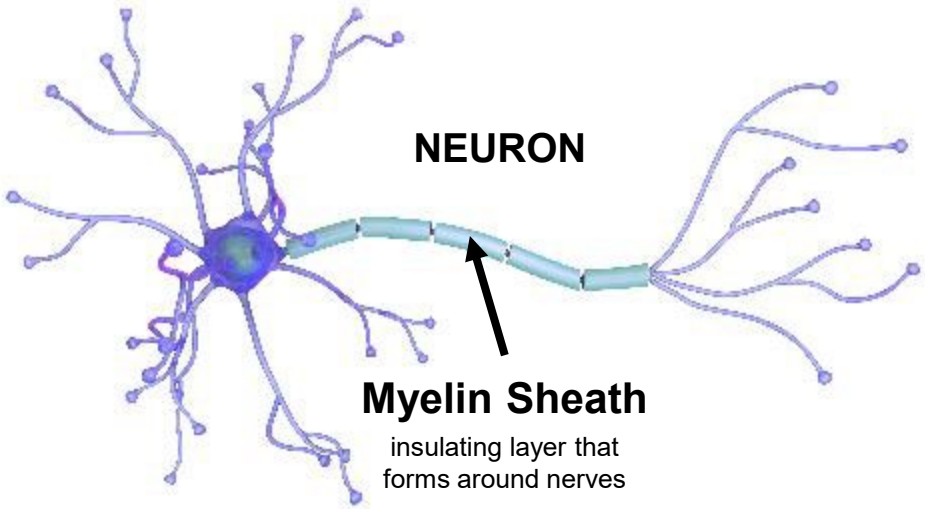
Creating Myelinated Pathways

> **“Trusting your intuition isn’t about replacing skills with hunches. It’s about listening to those hunches so that your skills can work better, more efficiently and faster.”** PDH Academy

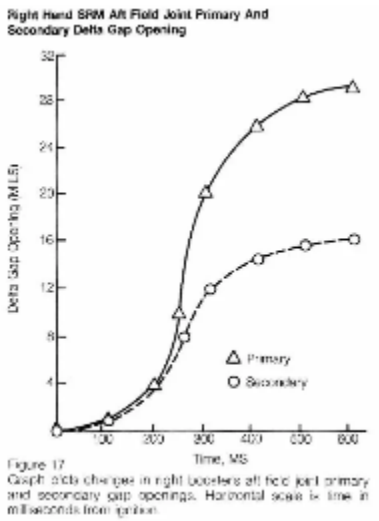
In his fascinating book ***The Talent Code,*** Daniel Coyle describes how the brain reacts when a person develops a new skill.

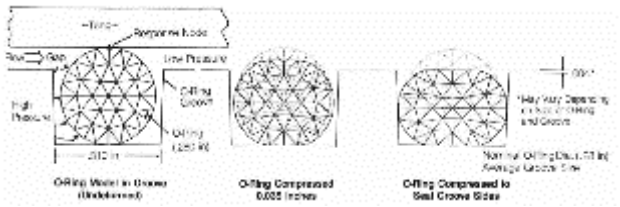
Performing an action involves firing an electrical signal through a neural pathway; each time this happens, it thickens the myelin sheath that surrounds nerve fibers like the rubber coating on electrical wires. The thicker the myelin sheath around a neural pathway, the more easily and effectively we use it.

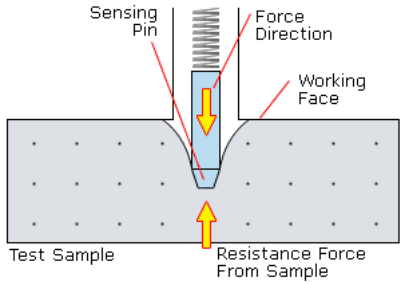
Heavily myelinated pathways equal mad skills.



Challenger





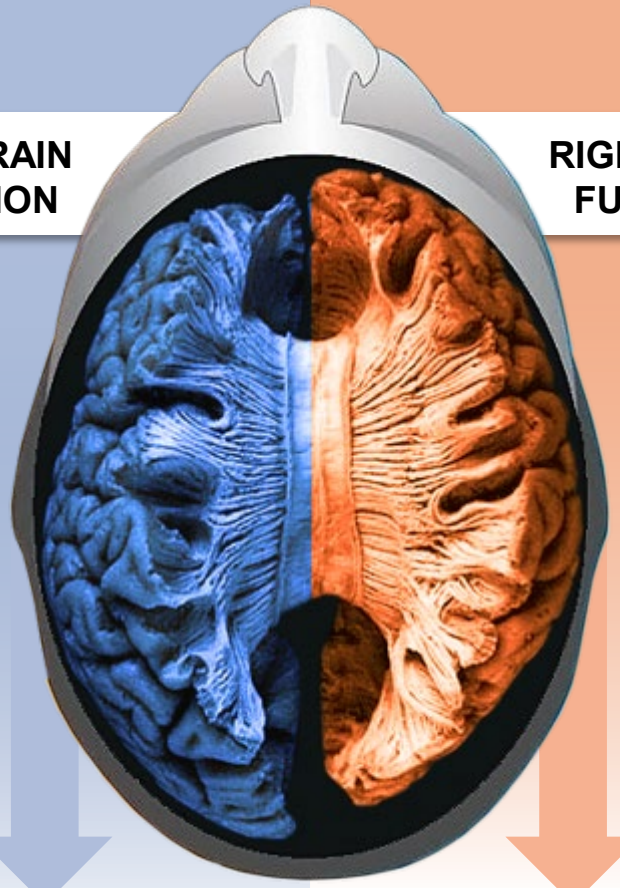


Hardware

Durometer Calculations
Weather Forecast
Joint Gap Analysis
Internal Flow Field Modelling

LEFT-BRAIN FUNCTION

Analytic Thought
Logic
Language
Reasoning
Science and Math
Written
Numbers Skills
Right-Hand Control



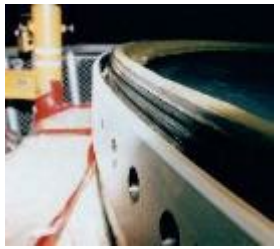
RIGHT-BRAIN FUNCTION

Art Awareness
Creativity
Imagination
Intuition
Insight
Holistic Thought
Music Awareness
3-D Forms
Left-Hand Control

People



Hardware



Mission



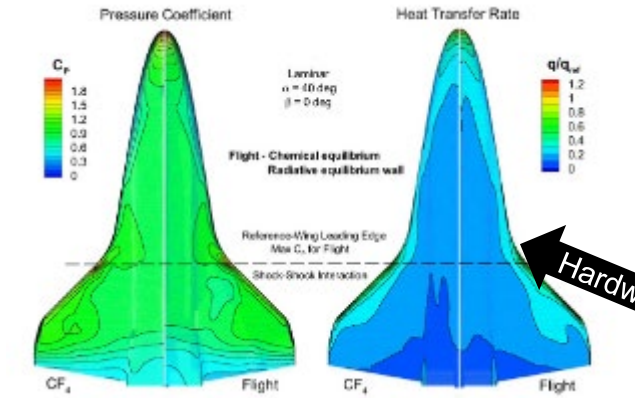
The Crew
Charred O-rings
Joint Models
A Walk Around the Stand



Turning On Your Right Brain, Martha Beck

1. Sign your name every which way.
2. Have a bilateral conversation.
3. Learn new moves.
4. Toss in the kitchen sink.

Columbia



$$P := \frac{0.0195 \cdot \left(\frac{L}{d}\right)^{0.45} \cdot d \cdot \rho_p{}^{0.27} \cdot (V - Vh)^{0.67}}{St^{0.25} \cdot \rho_t{}^{0.17}}$$

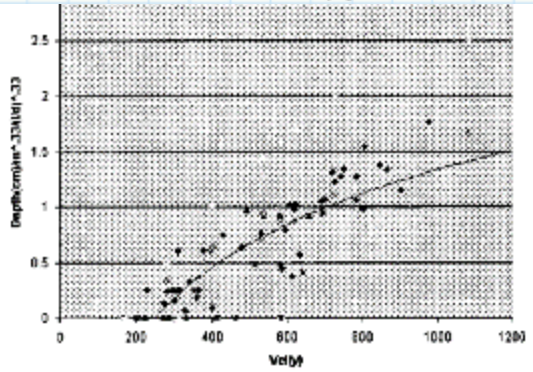
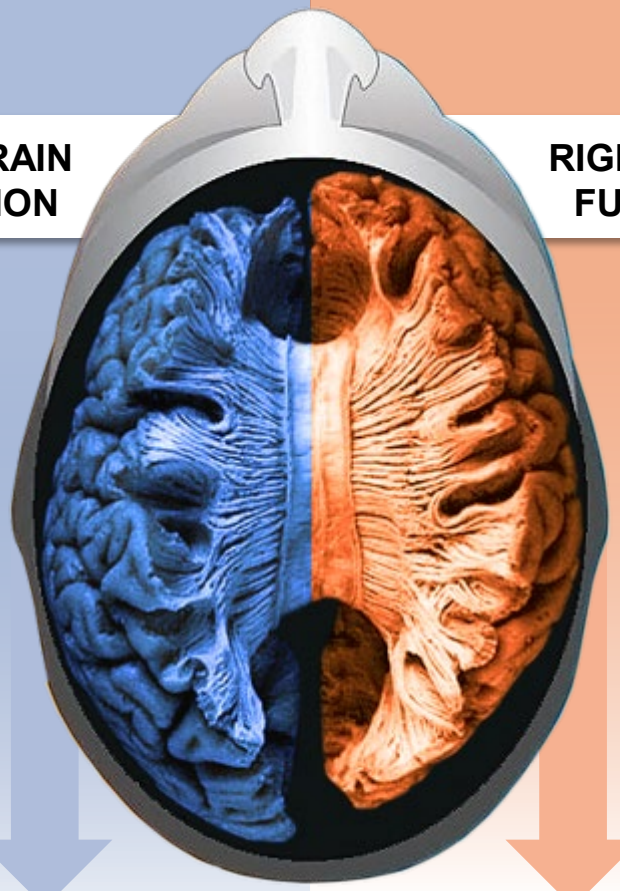


Figure 14. Plot of all cases showing experimental crater depths (diamonds), model results (squares), and "R&C" results (triangles).

Hardware

LEFT-BRAIN FUNCTION

Analytic Thought
Logic
Language
Reasoning
Science and Math
Written
Numbers Skills
Right-Hand Control



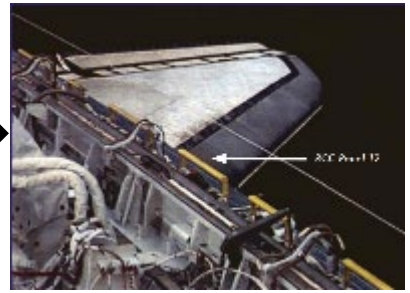
RIGHT-BRAIN FUNCTION

Art Awareness
Creativity
Imagination
Intuition
Insight
Holistic Thought
Music Awareness
3-D Forms
Left-Hand Control

People



Hardware



Mission



Impact Calculations
Analysis of Flight Data
Aerothermal Heating Calculations

The Crew
Foam
Shuttle Tile
Photographs





Columbia

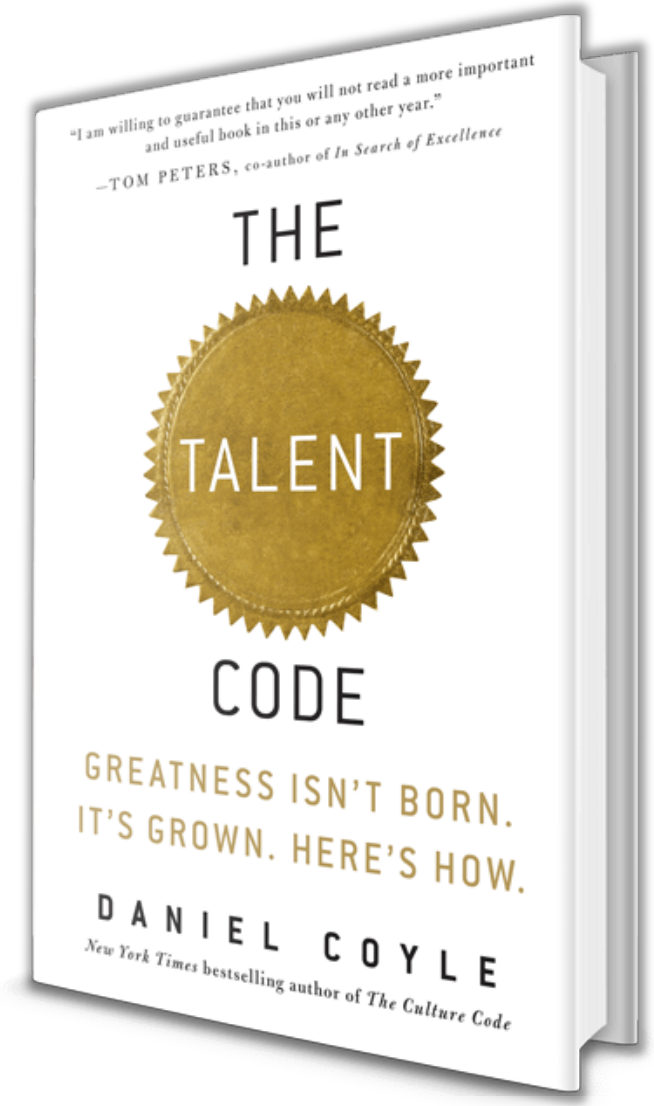
A failure to obtain pictures resulted in picking up the pieces in Texas and Louisiana, versus the opportunity for a second Apollo 13 moment.

The Talent Code, Daniel Coyle

DEEP PRACTICE – Everyone knows that practice is the key to success. What everyone doesn't know is that specific kinds of practice can increase skill up to ten times faster than conventional practice.

IGNITION – We all need a little motivation to get started. But what separates truly high achievers from the rest of the pack? A higher level of commitment – call it passion – born out of our deepest unconscious desires and triggered by certain primal cues. Understanding how these signals work can help you ignite passion and catalyze skill development.

MASTER COACHING – What are the secrets of the worlds most effective teachers, trainers, and coaches? Discover the four virtues that enable these "talent whisperers" to fuel passion, inspire deep practice, and bring out the best in their students.





Shaping the Future

“In order to achieve the goal of returning to the moon … NASA understands we will have to leverage the experience, skills, facilities and tools in both the government and industry teams.”

Ralph R. Roe, Jr.
NASA Chief Engineer (2014-23)
NESC Director (2003-14)

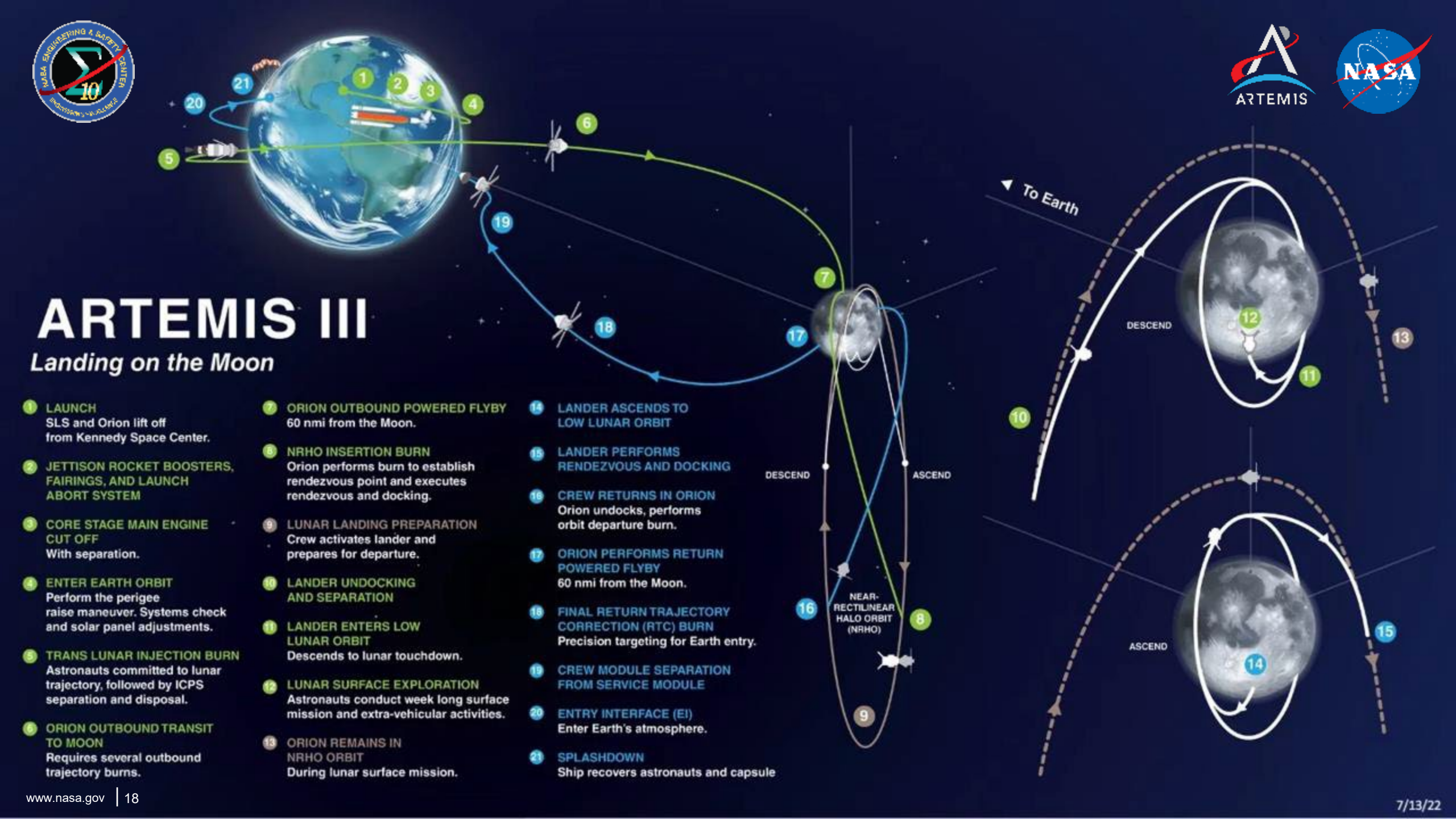

"Make everything you do a work of art,
if it looks like crap and does not work
then you have nothing, if it looks
fantastic and does not work
at least it looks fantastic."
SPACE IS
BUSINESS
NASA
ROCKET
ROCKET

Rocketlab



SpaceX

NASA astronauts, Robert Behnken and Douglas Hurley
“Bob and Doug are our astronauts!”
Aarti Matthews, SpaceX


ARTEMIS III
Landing on the Moon
1 LAUNCH
SLS and Orion lift off from Kennedy Space Center.
2 JETTISON ROCKET BOOSTERS, FAIRINGS, AND LAUNCH ABORT SYSTEM
3 CORE STAGE MAIN ENGINE CUT OFF
With separation.
4 ENTER EARTH ORBIT
Perform the perigee raise maneuver. Systems check and solar panel adjustments.
5 TRANS LUNAR INJECTION BURN
Astronauts committed to lunar trajectory, followed by ICPS separation and disposal.
6 ORION OUTBOUND TRANSIT TO MOON
Requires several outbound trajectory burns.
7 ORION OUTBOUND POWERED FLYBY
60 nmi from the Moon.
8 NRHO INSERTION BURN
Orion performs burn to establish rendezvous point and executes rendezvous and docking.
9 LUNAR LANDING PREPARATION
Crew activates lander and prepares for departure.
10 LANDER UNDOCKING AND SEPARATION
11 LANDER ENTERS LOW LUNAR ORBIT
Descends to lunar touchdown.
12 LUNAR SURFACE EXPLORATION
Astronauts conduct week long surface mission and extra-vehicular activities.
13 ORION REMAINS IN NRHO ORBIT
During lunar surface mission.
14 LANDER ASCENDS TO LOW LUNAR ORBIT
15 LANDER PERFORMS RENDEZVOUS AND DOCKING
16 CREW RETURNS IN ORION
Orion undocks, performs orbit departure burn.
17 ORION PERFORMS RETURN POWERED FLYBY
60 nmi from the Moon.
18 FINAL RETURN TRAJECTORY CORRECTION (RTC) BURN
Precision targeting for Earth entry.
19 CREW MODULE SEPARATION FROM SERVICE MODULE
20 ENTRY INTERFACE (EI)
Enter Earth's atmosphere.
21 SPLASHDOWN
Ship recovers astronauts and capsule
DESCEND
ASCEND
NEAR-RECTILINEAR HALO ORBIT (NRHO)
To Earth
DESCEND
ASCEND
ARTEMIS
NASA

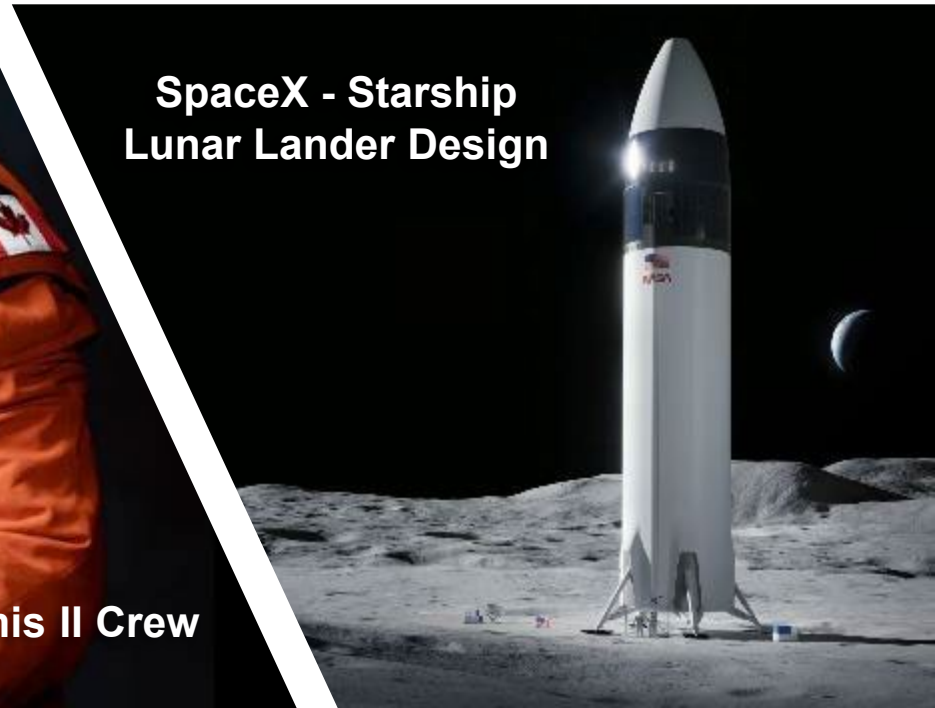
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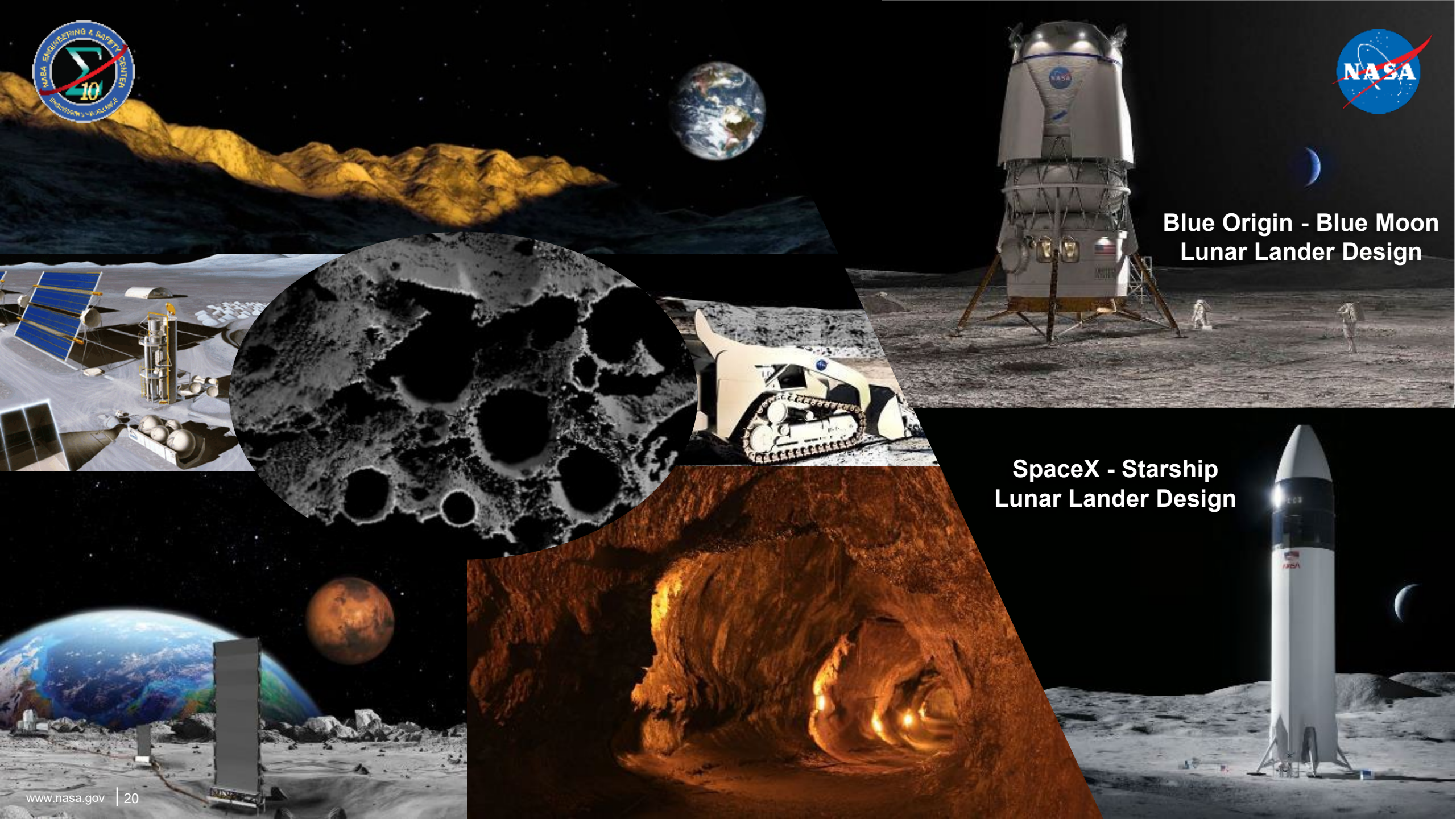
Artemis II Crew



Blue Origin - Blue Moon
Lunar Lander Design

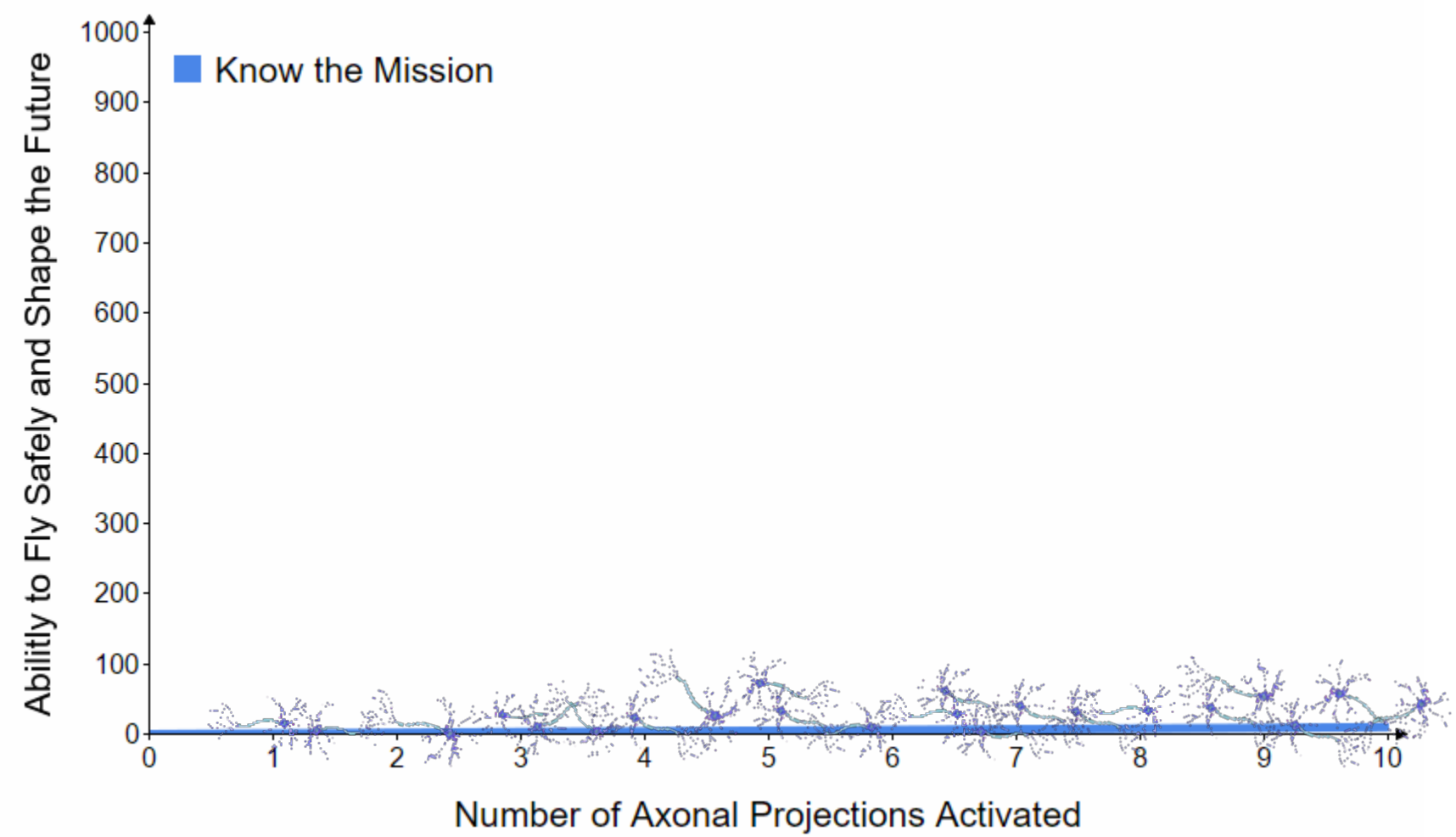


SpaceX - Starship
Lunar Lander Design

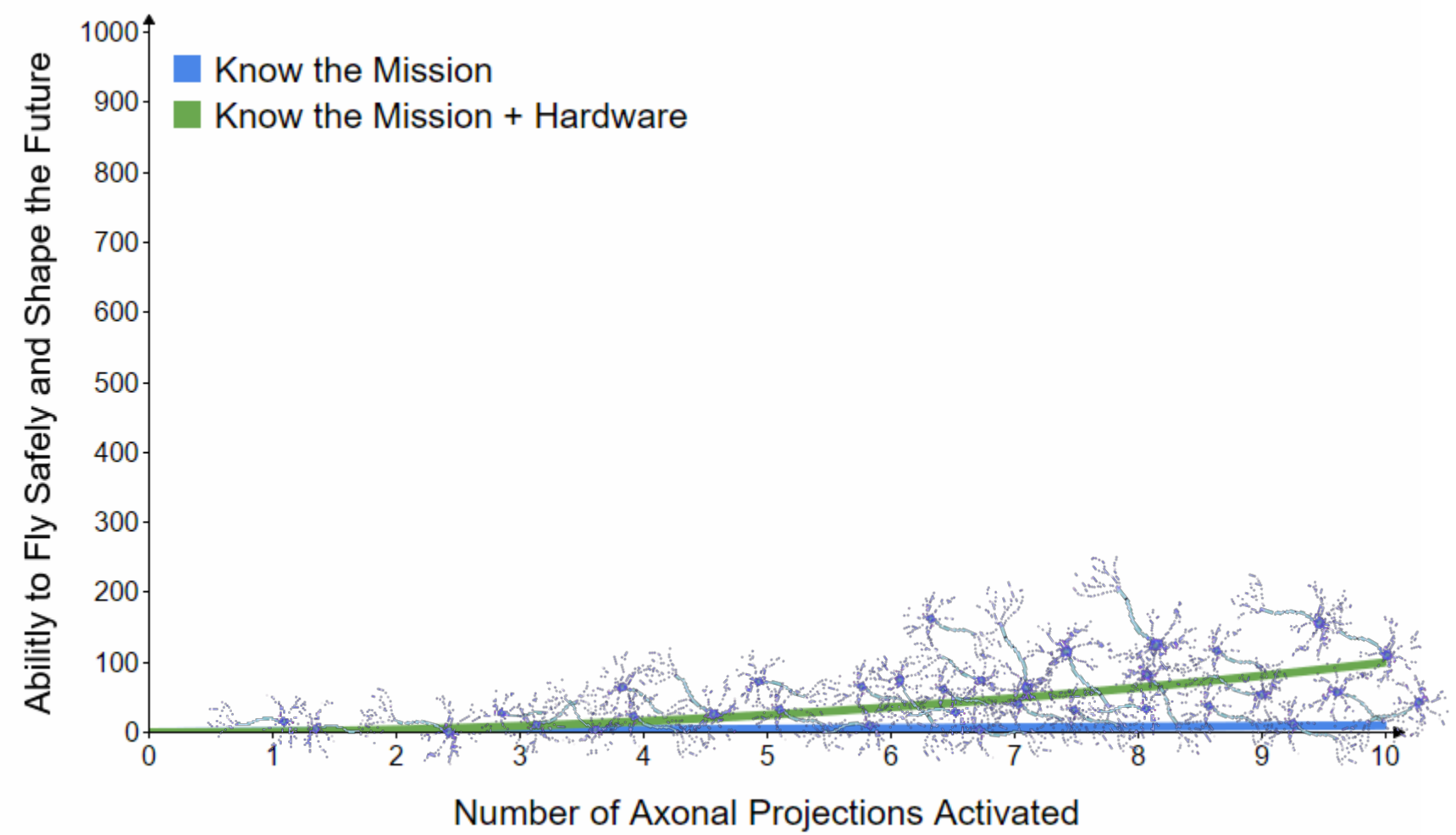

Blue Origin - Blue Moon
Lunar Lander Design
SpaceX - Starship
Lunar Lander Design



3 K³eys to Flying Safely and Shaping the Future



3 K³eys to Flying Safely and Shaping the Future



3 K³eys to Flying Safely and Shaping the Future

