



Moon to Mars Bingo



Moon to Mars

NASA is planning for a human return to the Moon and is developing new opportunities in lunar orbit to provide the foundation for human exploration deeper into the solar system. We will use the area of space around the Moon, known as cislunar space, to prepare for human exploration of Mars. NASA will develop complex robotic missions to the surface of the Moon with scientific and exploration objectives in advance of a human return, beginning with the Gateway. From there, humans and scientific and robotic explorers will pioneer Mars and the solar system.

The Space Launch System (SLS) and Orion spacecraft are critical backbone elements of our future in deep space. NASA is getting ready for Artemis 1, the first, uncrewed launch of SLS and Orion, around the Moon. A mission with astronauts will soon follow.

Space Launch System

NASA's Space Launch System, or SLS, is an advanced launch vehicle (rocket) that provides the foundation for human exploration beyond Earth's orbit. With its unprecedented power and capabilities, SLS is the only rocket that can send Orion, astronauts, and large cargo to the Moon on a single mission.

SLS can carry larger payloads – and carry them farther into space – than any other rocket existing today. SLS is designed to be flexible and will evolve into increasingly more powerful configurations, opening new possibilities for payloads, including robotic scientific missions to the Moon, Mars, and Jupiter.

SLS will send Orion or other cargo to the Moon, which is nearly 1,000 times farther than where the International Space Station, a large spacecraft and science laboratory, resides in low-Earth orbit. The rocket will provide the power to help Orion reach a speed of at least 24,500 mph needed to break out of low-Earth orbit and travel to the Moon.



Orion

NASA's Orion spacecraft is built to take humans farther than they've ever gone before. Orion will serve as the exploration vehicle that will carry astronauts to space, provide emergency abort capability, sustain the crew during space travel, and provide safe re-entry from deep space return velocities, or speeds.

Named after one of the largest constellations in the night sky and drawing from more than 50 years of spaceflight research and development, the Orion spacecraft is designed to meet the evolving needs of our nation's deep space exploration program for decades to come.

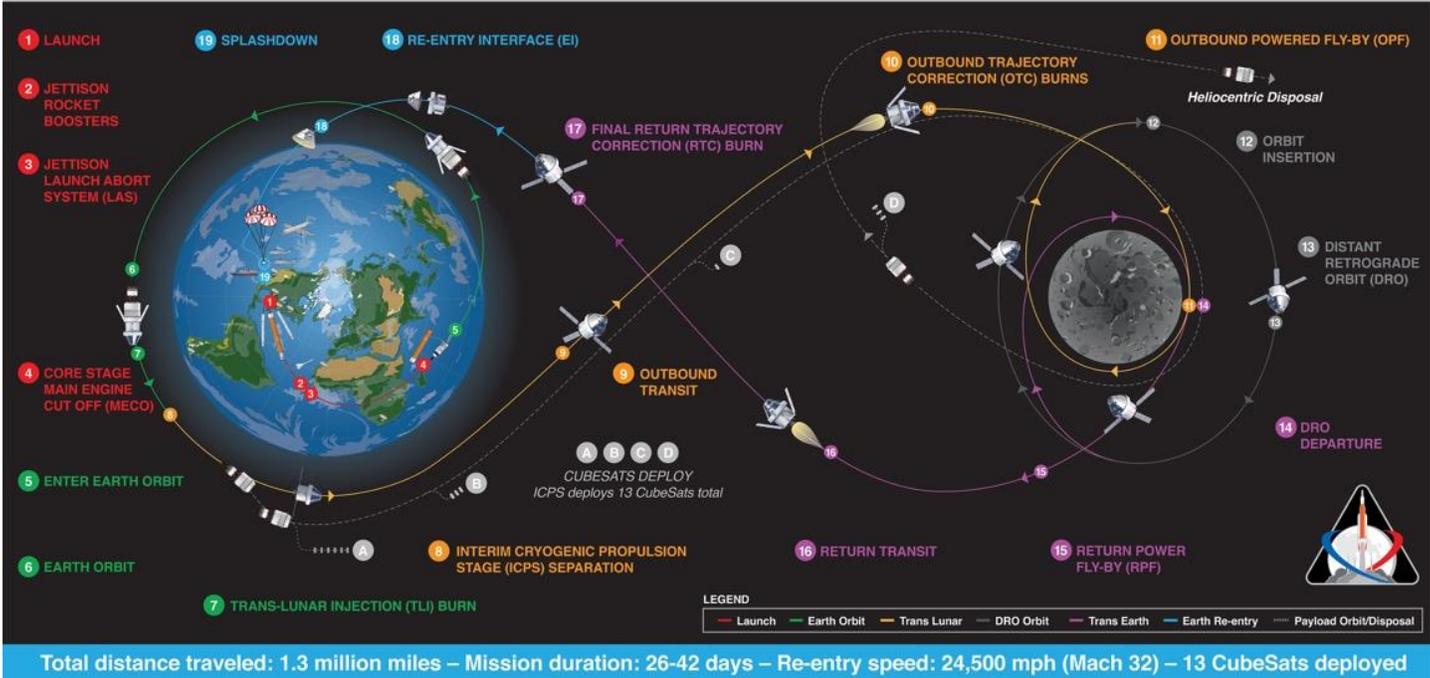


Artemis 1

Artemis 1 will be the first integrated test of NASA's deep space exploration systems: SLS, the Orion spacecraft, and the ground systems at Kennedy Space Center in Cape Canaveral, Florida. The first in a series of increasingly complex missions, Artemis 1 will be an uncrewed flight test that will provide a foundation for human deep space exploration and demonstrate our commitment and capability to extend human existence to the Moon and beyond.

Artemis 1

The first uncrewed, integrated flight test of NASA's Orion spacecraft and Space Launch System rocket, launching from a modernized Kennedy spaceport.



SLS and Orion will blast off from NASA's modernized spaceport at Kennedy Space Center and fly farther than any spacecraft built for humans has ever flown. It will travel 280,000 miles from Earth, thousands of miles beyond the Moon, over the course of about a three-week mission.

The SLS rocket is designed for missions beyond low-Earth orbit carrying crew or cargo to the Moon and beyond. It will produce 8.8 million pounds of thrust during liftoff and ascent to loft a vehicle weighing nearly six million pounds to orbit. Propelled by a pair of five-segment solid rocket boosters and four RS-25 engines, the rocket will reach the period of greatest atmospheric force within ninety seconds.

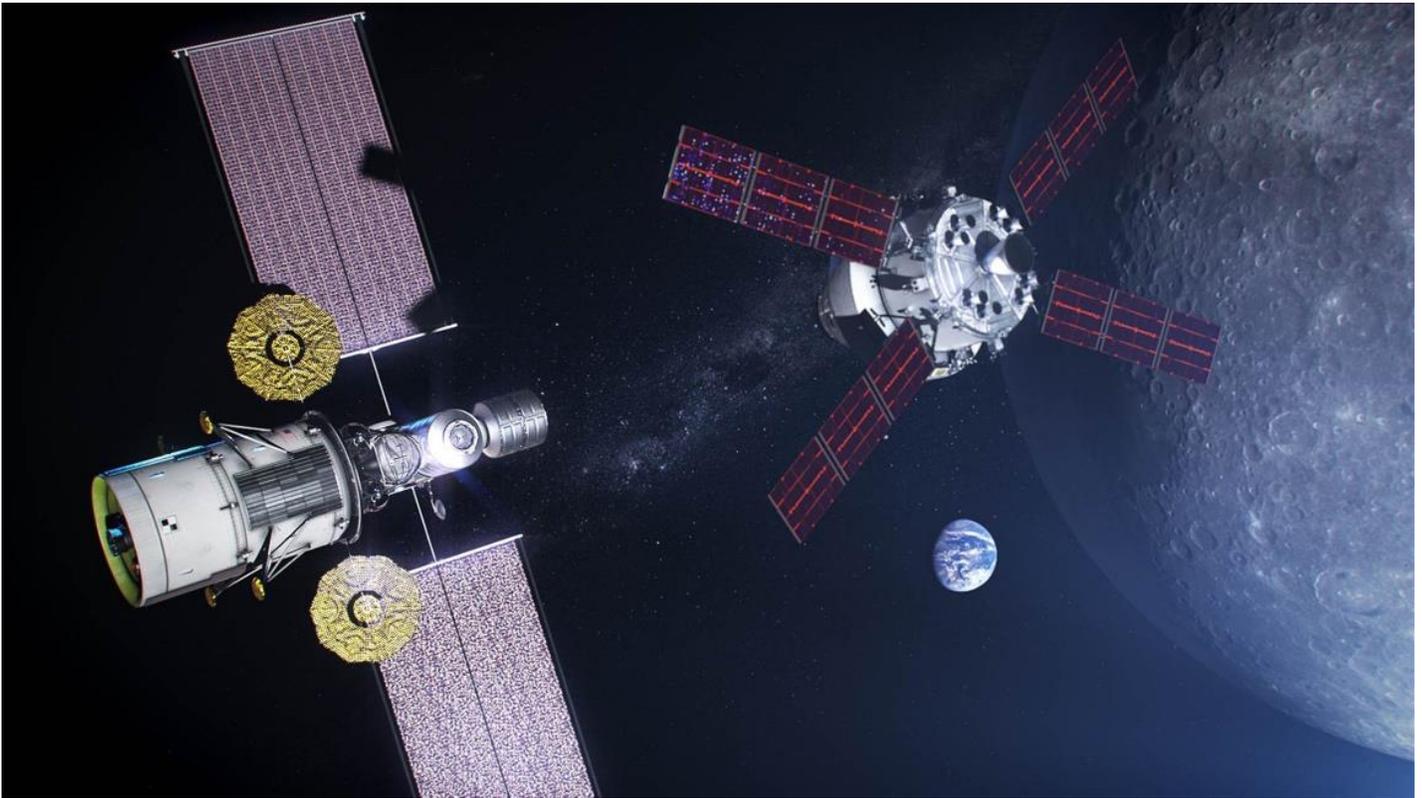
The outbound trip to the Moon will take several days. Orion will fly about 62 miles (100 km) above the surface of the Moon, and then use the Moon's gravitational force to propel Orion into a new deep retrograde, or opposite, orbit about 40,000 miles (70,000 km) from the Moon. The spacecraft will stay in that orbit for approximately six days to collect data and allow mission controllers to assess the performance of the spacecraft. During this period, Orion will travel in a direction around the Moon retrograde from the direction the Moon travels around Earth.

For its return trip to Earth, Orion will do another close flyby that takes the spacecraft within about 60 miles of the Moon's surface. The spacecraft will use a precisely timed engine firing of the service module in conjunction with the Moon's gravity to accelerate back toward Earth. This maneuver will set the spacecraft on its trajectory back toward Earth to enter our planet's atmosphere traveling at 25,000 mph (11 kilometers per second), producing temperatures of approximately 5,000 degrees Fahrenheit (2,760 degrees Celsius).

After about three weeks and a total distance traveled exceeding 1.3 million miles, the mission will end with a test of Orion's capability to return safely to the Earth as the spacecraft makes a precision landing within eyesight of the recovery ship off the coast of Baja, California. U.S. Navy divers will briefly inspect the spacecraft for hazards and hook up tending and tow lines, and then engineers will tow the capsule into the well-deck of the recovery ship to bring the spacecraft home.

To the Moon

The Moon is a fundamental part of Earth's past and future – an off-world continent that may hold valuable resources to support space activity and scientific treasures that may tell us more about our own planet.



Although Americans first walked on its surface almost 50 years ago, our explorers left footprints at only six sites, during a total of 16 days on the surface. The next wave of lunar exploration will be fundamentally different.

A key component of establishing the first permanent American presence and infrastructure on and around the Moon is the Gateway, a lunar orbiting platform to host astronauts farther from Earth than ever before. On the Gateway, we will prepare to transit deep space, testing new technologies and systems as we build the infrastructure to support missions to the surface of the Moon and prepare for the mission to Mars. NASA also will study the effects of the deep space environment of the Gateway, learning how living organisms react to the radiation and microgravity of a deep space environment over long periods. The Gateway also will be assessed as a platform for the assembly of payloads and systems; a reusable command module for lunar vicinity and surface exploration; and a way station for the development of refueling depots, servicing platforms, and a sample return facility.

The lunar surface will serve as a crucial training ground and technology demonstration test site where we will prepare for future human missions to Mars and other destinations. Through an innovative combination of missions, robotic lunar surface missions will begin as early as 2020, focusing on scientific exploration of lunar resources and preparing the lunar surface for a sustained human presence.

Moon to Mars Bingo

Preparation:

1. A week or so prior to playing Moon to Mars Bingo, provide each student with a copy of the Vocabulary Study Sheet (pp. 6-7) to study.
2. Make copies of the BINGO card (pp. 13-14). Fill in the boxes using the words and numbers from the Vocabulary Study Sheet. You may wish to laminate the cards to make them last longer. Four completed sample cards are provided (pp. 11-12)
3. For covering the spaces on the card, a sheet of NASA symbols has been provided (p. 15) for you to copy, laminate if you wish, and cut for use by players. You may already have markers from another Bingo game or you may choose to use beans, pennies, or some other object.
4. Using the Vocabulary Clue Sheet (pp. 8-10), cut the clues into strips. Fold the strips and place them in a container (bowl, bag, hat, etc.). Another option is to laminate the sheet prior to cutting into strips. Obviously, you would not be able to fold them afterward but they will last longer.

Instructions:

1. Prior to beginning the game, select what constitutes a BINGO – a vertical row, a horizontal row, a diagonal row, any row, postage stamp (on the outer lines), etc. Make certain all players know what is considered a BINGO.
2. Draw a strip from the container and read the definition aloud. You can opt to have players call out the answer and then cover the word if it is on their card or simply have them cover the word on their card without calling out the answer for all to hear.
3. ALTERNATIVE – When Vocabulary Study Sheet has not been provided prior to playing: Draw a strip from the container and read the definition. Have students call out possible answers. If no one gets the correct answer, the clue reader should state the answer and have players cover the answer if it is on their card.
4. Using the Master Answer Sheet provided (p. 16), place a marker on each answer as the clues are read.

Moon to Mars Bingo Vocabulary Study Sheet

1/3 – amount of Earth’s gravity at the surface of Mars

1/6 – amount of Earth’s gravity at the surface of the Moon

12 – number of people, all American men, to walk on the Moon

18 – after modifications, number of pounds, in millions, one crawler-transporter can lift; two would be able to move the St. Louis Gateway Arch

1972 – the last time anyone walked on the Moon

212 – height, in feet, of the SLS core stage

40 – number of minutes that the Martian day is longer than an Earth day

45 – number of minutes it takes to completely open or close the Vertical Assembly Building’s doors

456 – height, in feet, of the Vertical Assembly Building’s high bay doors, the largest doors in the world

5 – tons of propellant a SLS solid rocket booster burns each second

8 – number of 747 jet aircraft that the 4 RS-25 engines could keep in the air

Apollo 11 – first NASA mission to land on the Moon

Artemis 1 – first integrated SLS and Orion flight test

Booster – produces 3.6 million pounds of thrust for SLS

Core Stage – SLS fuel tank

Curiosity – NASA rover that has been on Mars since 2012

Deep Space - space beyond the Earth’s atmosphere, especially that part lying beyond the Earth-Moon system

Differentiated – composed of different layers with different compositions

Johnson Space Center (JSC) – home base for NASA astronauts

Kennedy Space Center (KSC) – NASA Center where rockets are launched

Launch Abort System (LAS) – protects astronauts if a problem arises during launch by pulling the spacecraft away from the launch pad

Luna 2 – first spacecraft to land on the Moon; it was a Soviet craft

Mars – the fourth planet from the Sun

Michoud Assembly Facility (MAF) – location where the core stage is being built

Moon – only celestial body beyond Earth visited by humans

Neil Armstrong – American astronaut and first person to walk on the Moon

New Moon – when the Sun and Moon are aligned, with the Sun and Earth on opposite sides of the Moon

Orion – NASA’s new spacecraft for carrying astronauts into deep space

Payload – the cargo carried by a rocket

Pegasus – name of the NASA barge that will ferry the core stage

Red Planet – nickname of Mars; given because of the red “rusty” dust that covers the planet

RS-25 Engine – weighs 7,775 pounds and used to power the core stage of SLS

Space Launch System (SLS) – NASA’s new rocket for launching humans and large payloads to deep space

Thomas Harriot – first person to make a drawing of the Moon in 1609

Vehicle Assembly Building (VAB) – one of the largest buildings in the world, covering 8 acres

**Moon to Mars Bingo
Vocabulary Clue Sheet**

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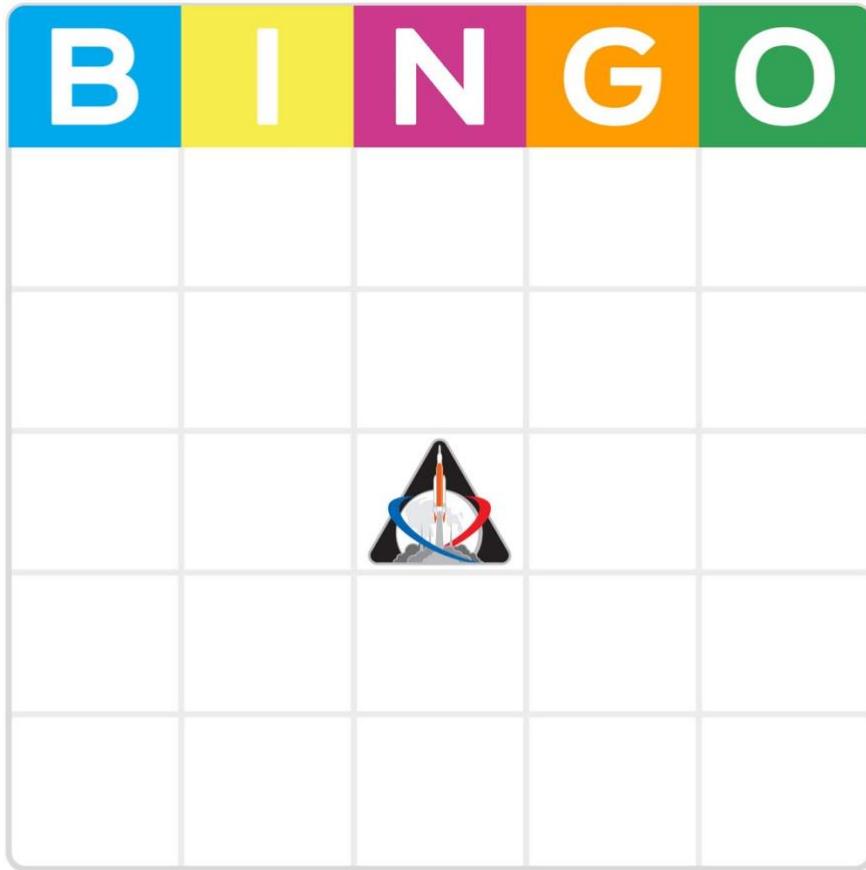
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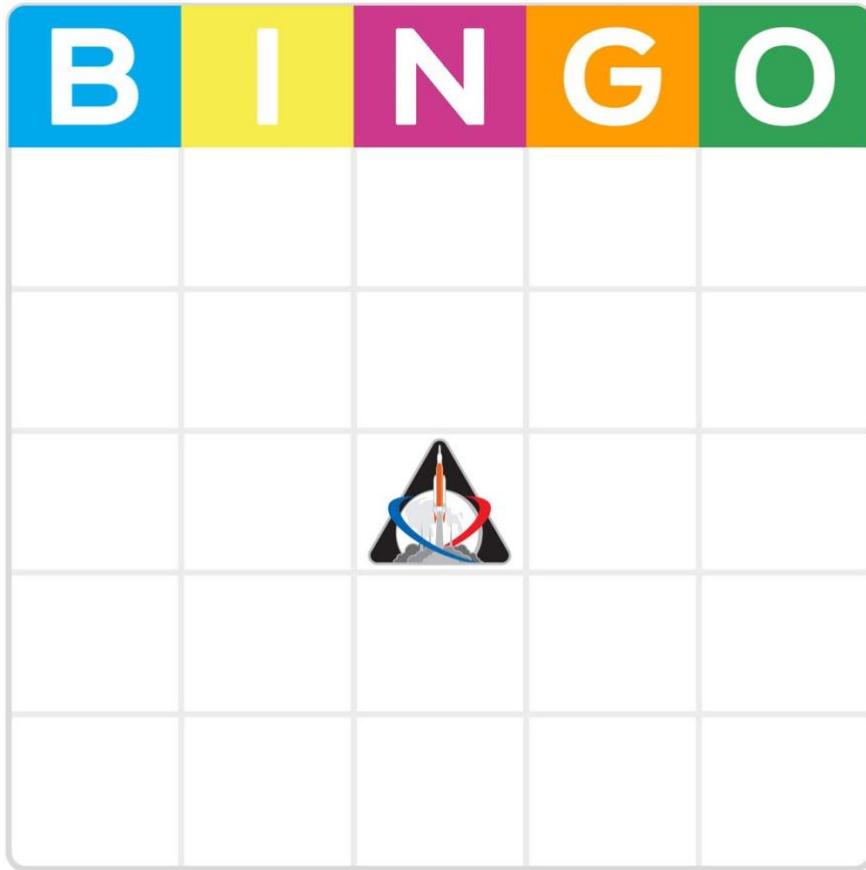
B	I	N	G	O
VAB	Artemis 1	Neil Armstrong	1/6	RS-25 Engine
1/3	Orion	Luna 2	Core Stage	Pegasus
Red Planet	Mars		5	Moon
Deep Space	MAF	Payload	JSC	18
SLS	12	Booster	Apollo 11	Thomas Harriot

B	I	N	G	O
Differentiated	Apollo 11	JSC	Red Planet	45
New Moon	Curiosity	212	SLS	Moon
KSC	MAF		Deep Space	Core Stage
1972	Mars	Orion	Artemis 1	VAB
Payload	Neil Armstrong	LAS	Pegasus	12

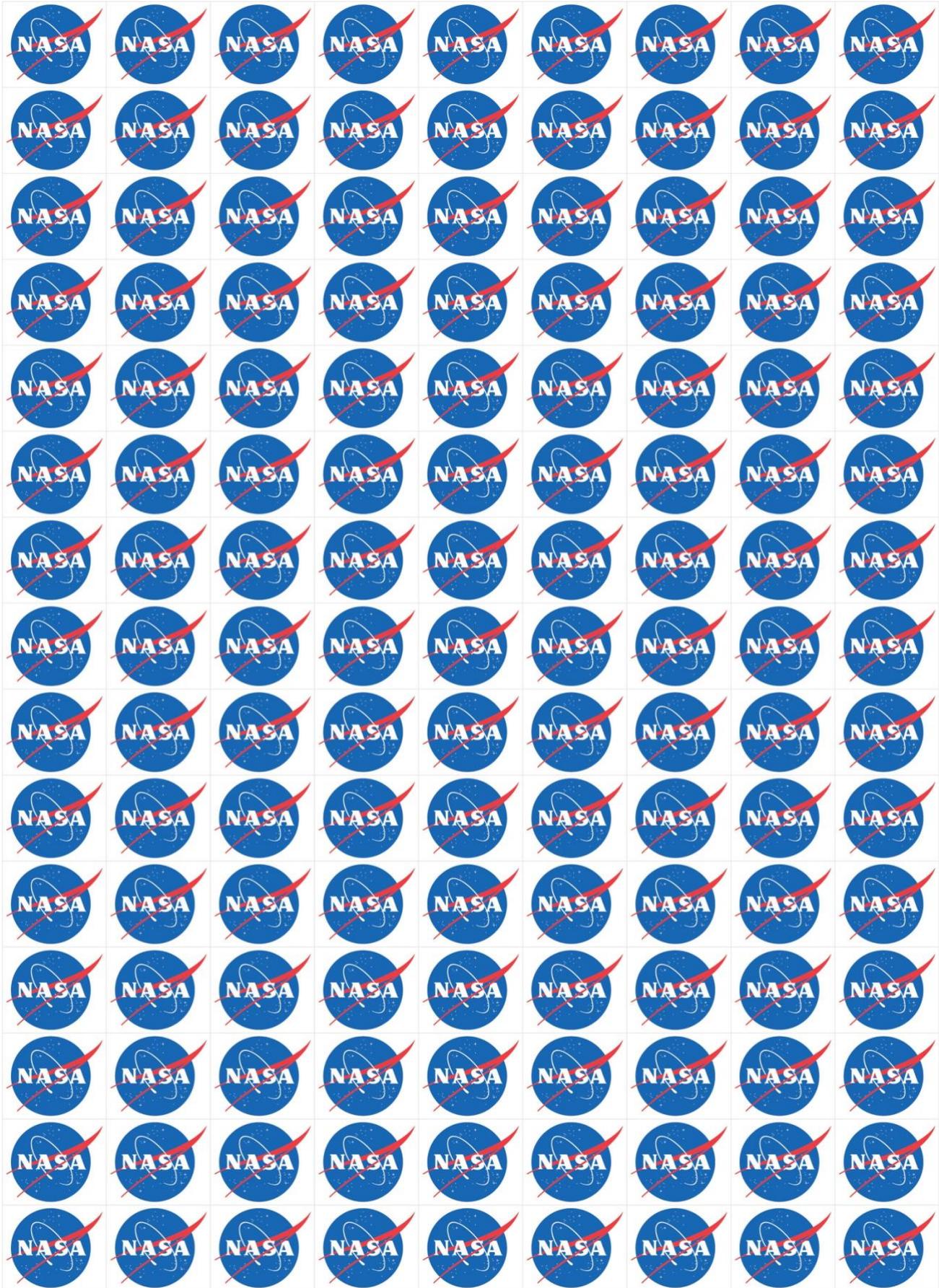
B	I	N	G	O
1/3	Apollo 11	MAF	Artemis 1	18
12	Booster	New Moon	Core Stage	LAS
1972	Deep Space		VAB	Curiosity
456	JSC	Pegasus	Mars	Orion
8	Luna 2	SLS	KSC	40

B	I	N	G	O
Thomas Harriot	Core Stage	212	Differentiated	8
Payload	Curiosity	Red Planet	JSC	456
RS-25 Engine	Mars		Payload	LAS
Moon	SLS	45	Luna 2	Pegasus
1/6	KSC	Neil Armstrong	New Moon	Orion





Card Markers



Master Answer Key

1/3	1/6	12	18	1972
212	40	45	456	5
8	Apollo 11	Artemis 1	Booster	Core Stage
Curiosity	Deep Space	Differentiated	JSC	KSC
LAS	Luna 2	Mars	MAF	Moon
Neil Armstrong	New Moon	Orion	Payload	Pegasus
Red Planet	RS-25 Engine	SLS	Thomas Harriot	VAB

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