KNOX GRAMMAR SCHOOL

STATE

DA VINCI DECATHLON 2021

CELEBRATING THE ACADEMIC GIFTS OF STUDENTS IN YEARS 5 & 6

da Vinci Decathlon® EXCITE CHALLENGE ENRICH An initiative of Knox Grammar School

ENGINEERING

TEAM NUMBER _____

Question Booklet	Design Model	Total	Rank
/15	/30	/40	

SPACEFLIGHT: A GAME OF CHANCE

BACKGROUND

Romanticised as "conquering the final frontier", the marvels of spaceflight have captured the intrigue and imagination of generations. From Kennedy's impassioned 1961 speech, *"We choose to go to the moon"*, to Neil Armstrong's broadcast of *"One small step for man, one giant leap for mankind"* from the lunar surface, humanity has been inspired to push the bounds of knowledge and technology to forge a deeper understanding of the universe.

But these achievements did not come without disaster and despair…

NASA Astronaut, Navy Test Pilot and Aeronautical Engineer Lisa Nowak, encapsulated this, saying *"Of course risk is a part of spaceflight. We accept some of that to achieve greater goals in exploration and find out more about ourselves and the universe"*.

The American-Soviet space race of the 1960's saw the neglect of many fundamental engineering principles, such as testing, prototyping and other safety precautions in an attempt to win the race and be the first country to land on the moon. In the 60's going to space was like rolling a dice. This resulted in the destruction of spacecraft and the deaths of Astronauts.

Moving further through history, with each new technological development comes greater challenges and more risks. The Challenger Space Shuttle disaster in 1986 saw the shuttle explode 73 seconds into its flight, killing all 7 crewmembers on board. This was the result of a simple technical error in the right rocket booster.

WHAT CAUSES THESE DISASTERS?

NASA has identified the three primary causes of space flight disasters:

- Propulsion system malfunction: rocket boosters produce thrust using a controlled explosion, which can easily get out of control if the explosive reactants are not balanced correctly. For example, too much or too little fuel is injected, too much or too little oxygen is injected etc.
- Extreme heat and cold: outside of earth's atmosphere, rockets experience extreme temperature changes. When in direct sunlight, temperatures reach more than 2000 centigrade and less than -250 centigrade when shielded by the earth.
- Cabin depressurisation: as altitude increases the cabin of a spacecraft is put under extreme pressure. Any fault in the spacecraft's structure would lead to the rapid escape of air from the cabin, suffocating its occupants.

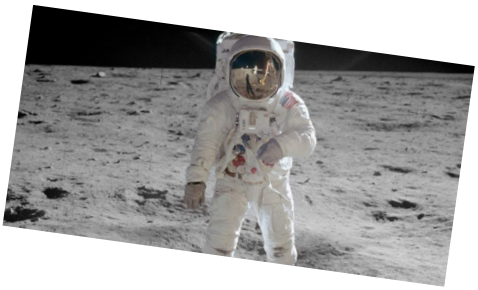
THE TASK

Your task is to create a spacecraft that solves a problem with spaceflight. Choose **ONE** of the three primary causes of disasters outlined above and design a spacecraft that mitigates that challenge. You must construct a model of your spacecraft out of the materials provided and answer the design questions to reflect upon your construction. Your spacecraft can, but does not have to be a rocket. You may choose a winged design like a space shuttle, or devise a completely new method of space travel. Be sure to consider both preventative and remedial measure to solve the challenge. Creativity is key, so take a chance on a new idea!

DESIGN PARAMETERS

You will have **eighty minutes** to create and reflect upon your spacecraft. Your spacecraft will be marked based on its:

- Ability to solve the challenge you picked,
- Ability to represent your idea (e.g. if your design involves movement, does your model have moving parts?),
- Creativity and originality,
- Design aesthetics,
- Structural build quality,
- Use of materials.



You will be provided with various materials. It is up to you to decide what materials to use to construct your spacecraft. The materials available are as follows:

- 6 pieces of A4 paper,
- 2 pieces of A4 cardboard,
- 8 popsicle/ paddle pop sticks,
- 8 plastic straws,
- 100 grams of plasticine,
- 6 elastic bands,
- Your own sticky tape (use sparingly).

Glue and staples are prohibited and will result in disqualification from the task.

SUBMISSION DETAILS

At the conclusion of the task, you will take your spacecraft and question paper to the marking area. If you are competing virtually, your time to answer the design reflection questions will cease after the allocated 80 minutes, but you will have an extra 10 minutes upload images and a video of your spacecraft. The images must capture all angles of your spacecraft and the video must show the functionality of your spacecraft.

DESIGN REFLECTION

QUESTION 1: STATE YOUR CHALLENGE (3 MARKS)

Clearly state which of the three causes of space flight disaster you have chosen. In your own words, explain why this is a problem and why you have chosen to solve it.

QUESTION 2: EXPLAIN YOURSELF! (4 MARKS)

Outline the elements of your spacecraft design and explain how they solve the problem you have chosen.

QUESTION 3: HOLDING UP A MIRROR... (4 MARKS)

Reflect on your spacecraft's ability to solve the problem you chose. Identify key flaws in your design and propose solutions to these challenges.

QUESTION 4: WHAT ABOUT THE REAL WORLD? (4 MARKS)

Critique your design for its viability in the real world. Consider criteria including, but not limited to technological capability and environmental impact.

END OF PAPER

MARKING CRITERIA

QUESTION BOOKLET

Question	Skilful	Sound	Limited
Question 1	3	3-2	1
Question 2	4	3-2	1
Question 3	4	3-2	1
Question 4	4	3-2	1
Total	/15		

MODEL SPACECRAFT

Criteria	Skillful	Effective	Sound	Basic	Limited
Ability to solve challenge	10-9	8-7	6-5	4-3	2-1
Ability to represent idea	6	5	4-3	2	1
Creativity and originality	5	4	3	2	1
Design aesthetics	3	2		1	
Structural build quality	3	2		1	
Use of materials	3	2		1	
Total	/30				

TOTAL

/45