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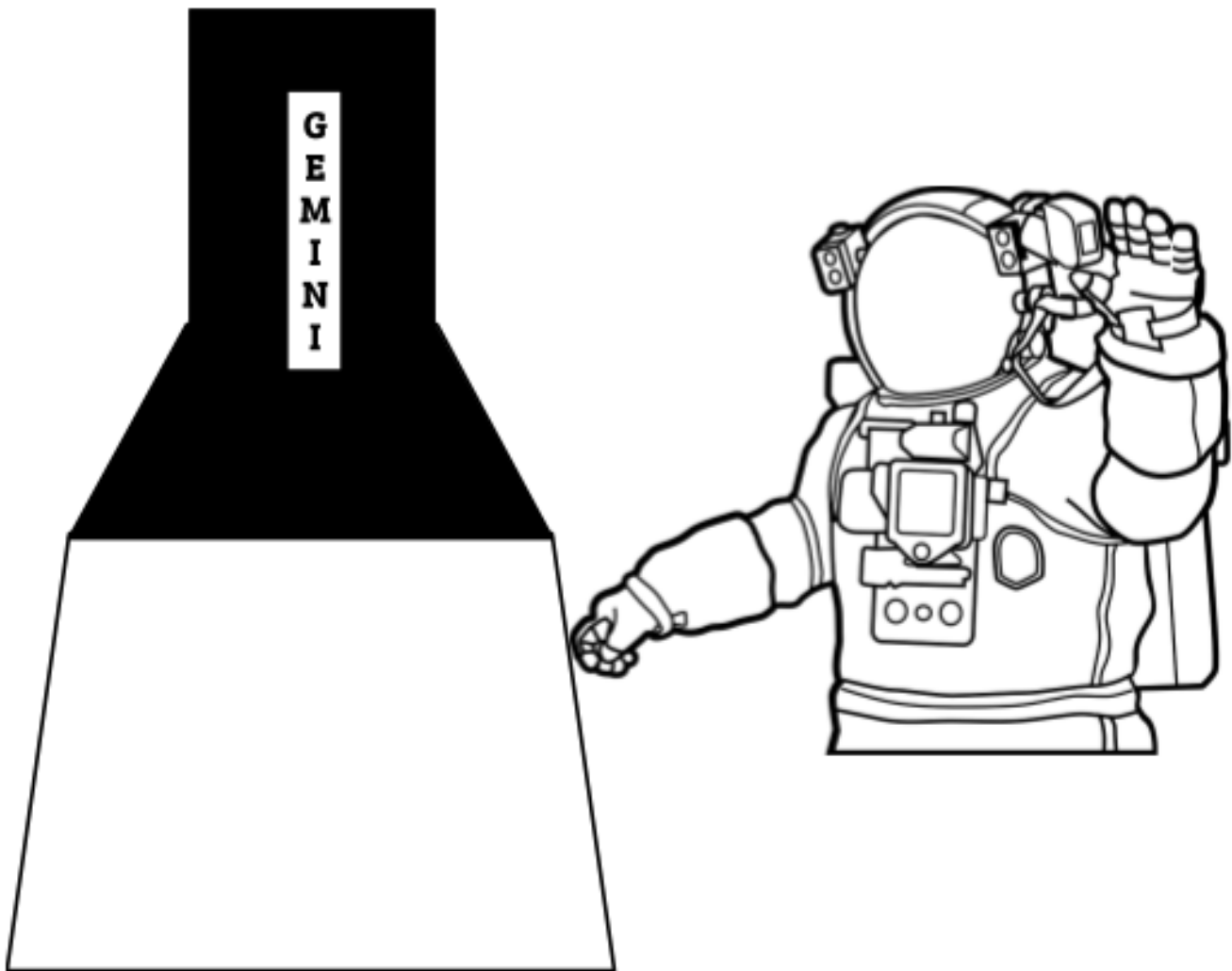
7.1.2 Assessment

Standard 7.1.2: I can design a solution that reduces the impact of two colliding objects.

Task 1

At the beginning of this standard, you were shown a video about astronaut Gene Cernan. During his difficult spacewalk, Cernan would try to push or turn a valve and was repelled from the spacecraft. If Cernan tried to put a hand on the spacecraft to steady himself, he went flying away from spacecraft, the opposite of what he wanted. First, draw the forces, using arrows, in this system between the astronaut and the spacecraft.

Write a description of the effects of Newton's Third Law in this system.



Task 2

Use Newton's Third Law to explain why Gene Cernan was repelled from his spacecraft after trying to push a button but we are not repelled from an elevator after we push an elevator button.

Task 3

You are on NASA's engineering team. After Gene Cernan's disastrous spacewalk, you have been given the task of designing a solution to keep the astronaut from flying away from the spacecraft every time they touch it or push or twist a valve. How would you keep the astronaut close to the spacecraft and make it easier for them to do work in space? First, design a solution and then sketch your solution in the box below. In a few sentences, explain how Newton's Third Law is used in your design. Make sure you explain what materials you would use in your design.

Your design

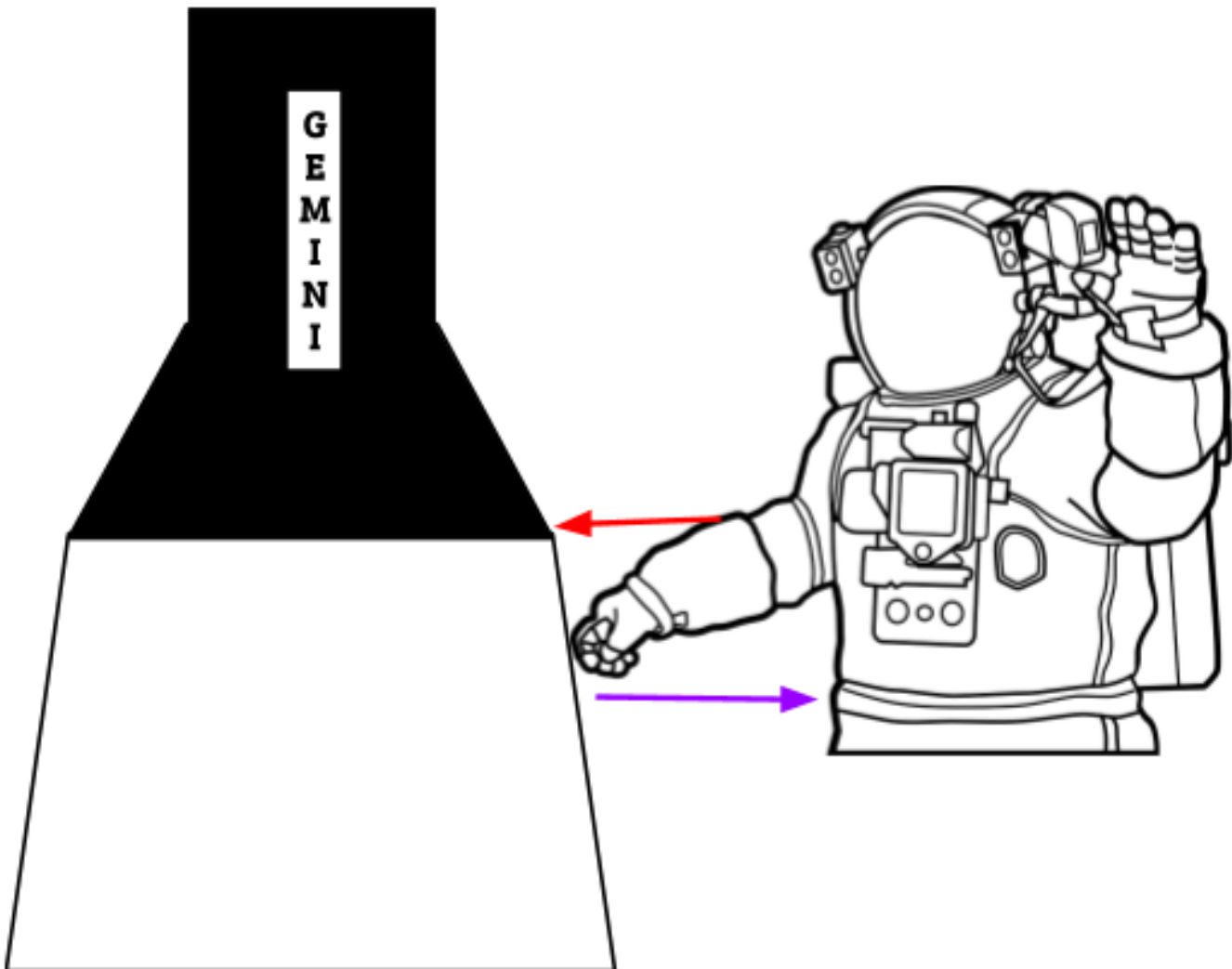
Assessment KEY 7.1.2

Standard 7.1.2: I can design a solution that reduces the impact of two colliding objects.

Task 1

At the beginning of this standard, you were shown a video about astronaut Gene Cernan. During his difficult spacewalk, Cernan would try to push or turn a valve and was repelled from the spacecraft. If Cernan tried to put a hand on the spacecraft to steady himself, he went flying away from spacecraft, the opposite of what he wanted. First, draw the forces in this system between the astronaut and the spacecraft. Second, write a description of the effects of Newton's Third Law in this system.

The spacecraft pushes back on Gene Cernan with a force that is equal in magnitude and opposite in direction to the force Cernan exerted on the spacecraft.



Task 2

Use Newton's Third Law to explain why Gene Cernan was repelled from his spacecraft after trying to push a button but we are not repelled from an elevator after we push an elevator button.

When he tried to push a button, the button pushed back on Cernan, causing him to be repelled from the spacecraft in zero gravity conditions. He was not anchored to anything more massive than himself to help him keep his position. On Earth, when we push an elevator button, we are anchored to the Earth, combining our mass to the mass of the Earth. The small reaction force the elevator button exerts on us is not enough to accelerate or move us (and the Earth). However, the same small reaction force is enough to accelerate the mass of an astronaut when they are not connected to the more massive Earth.

Task 3

You are on NASA's engineering team. After Gene Cernan's disastrous spacewalk, you have been given the task of designing a solution to keep the astronaut from flying away from the spacecraft every time they touch it or push or twist a valve. How would you keep the astronaut close to the spacecraft and make it easier for them to do work in space? First, design a solution and then sketch your solution in the box below. In a few sentences, explain how Newton's Third Law is used in your design. Make sure you explain what materials you would use in your design.

Your design

Answers here will vary. Any answer that prevents the astronaut from flying away from the spacecraft will be acceptable as long as the student can explain how they applied Newton's Third Law in their design. As an example, NASA added handholds and footholds on the outside of the spacecraft so that astronauts doing work outside would have something to help them become anchored to the spacecraft. Being anchored to the spacecraft makes the combined mass of the craft and the astronaut high enough that the reaction force cannot accelerate the astronaut.