■ Science in the Movies: The Martian (2015) — Teacher Answer Key (Unicode Fixed)

■ A. Science Connections — Suggested Answers

1. Organic Waste: Watney mixes his waste with Martian soil to add nutrients (mainly nitrogen and carbon) to create fertile soil for the potato plants.
2. Water Creation: He burns hydrogen and oxygen to make water. The chemical equation is $2H_2 + O_2 \rightarrow 2H_2O$.
3. Risks: Producing water this way is dangerous because hydrogen and oxygen are highly flammable and can explode if not controlled properly.
4. Engineering Design: His plan aligns with the steps of 'Ask, Imagine, Plan, Create, Improve.' He identified the problem (no food), imagined solutions, tested his ideas, and refined them based on the results.

■ B. Data & Analysis — Suggested Answers

1. Total soil area = $400 \times 0.5 = 200$ m^2.
2. His habitat has only 20 m^2, so he could grow 40 potatoes ($20 \div 0.5 = 40$) at a time.
3. Other limiting factors include light availability, temperature control, carbon dioxide levels, and water supply.

■ C. Real-World Connection — Suggested Answers

1. NASA Veggie Experiment (ISS): Astronauts grew lettuce and zinnias on the International Space Station using LED lights and nutrient pillows.
2. Findings: Plants can grow in microgravity, but they need careful water distribution and airflow management to prevent mold and uneven growth.
3. Mini Martian Garden Idea: Students can grow beans or radishes using sand mixed with compost under LED lights to simulate limited soil nutrients.

□ Challenge Answer: Low gravity would cause water and nutrients to distribute unevenly, possibly pooling around roots or floating away, which affects plant stability and growth.

■ D. Reflection — Example Responses

- The Martian demonstrates perseverance, creativity, and the application of scientific reasoning to survive.
- Watney’s positive attitude and problem-solving mindset reflect real scientific resilience.
- Example response: “Science helped Mark Watney survive because it allowed him to solve one problem at a time and create systems for food, water, and shelter.”

■ Extension (Optional) — Teacher Notes

Encourage students to include:
- A creative title (e.g., 'Survival on the Red Planet')
- Three science strategies: water creation, plant growth, resource recycling
- Real-world fact: NASA has tested growing crops on the ISS and in simulated Martian soil
- Colorful visuals or diagrams showing their survival setup.