

Educational Alignment for 3-2-1 Liftoff!

Based on the Next Generation Science Standards (NGSS)

3-2-1 Liftoff! is a fulldome film designed for children in upper elementary school (**Grades 3–5**), with enrichment value for middle school (**Grades 6–8**). Through the adventurous story of Alan the hamster and his attempt to return a stranded robot to its spaceship, the film introduces children to fundamental principles of physics, engineering, and space science. By dramatizing failed experiments and eventual success, the film fosters resilience, curiosity, and scientific thinking.



Core Disciplinary Areas

- **PS2.A** – Forces and Motion
 - **PS2.B** – Types of Interactions
 - **PS3.A** – Definitions of Energy
 - **PS3.B** – Conservation of Energy and Energy Transfer
 - **ESS1.A** – The Universe and Its Stars
 - **ESS1.B** – Earth and the Solar System
 - **ESS2.D** – Weather and Climate (Atmosphere)
 - **ETS1.A** – Defining and Delimiting Engineering Problems
 - **ETS1.B** – Developing Possible Solutions
 - **ETS1.C** – Optimizing the Design Solution
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- **MS-PS2-2**: Plan an investigation to provide evidence that the change in an object's motion depends on the sum of forces.
 - Explicitly illustrated when Alan explains action–reaction (Newton's Third Law) with the fire extinguisher and rocket.
 - **MS-PS3-2**: Develop a model to describe that when the arrangement of objects interacting at a distance changes, energy is transferred.
 - Illustrated through atmospheric thinning, engine failure at altitude, and why airplanes cannot function in space.

Target Grades

- Primary focus: **Grades 3–5**
- Enrichment level: **Grades 6–8**

NGSS Performance Expectations (PEs)

PHYSICAL SCIENCE

- **3-PS2-2**: Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
 - Seen in Alan's repeated trials with balloons, airplanes, and rockets.
- **4-PS3-4**: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
 - The film demonstrates this in experiments using helium balloons, airplanes, and a fire extinguisher rocket.

NGSS Performance Expectations (PEs)

EARTH & SPACE SCIENCE

- **3-ESS2-2:** Obtain and combine information to describe climates in different regions.
 - Enrichment: highlights the difference between Earth's dense atmosphere and thin upper layers.
- **5-ESS1-2:** Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and seasonal appearance of stars.
 - Enrichment: children see orbital movement and why spaceships move faster than expected.
- **MS-ESS1-2:** Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.
 - Implied in orbital mechanics (spaceship orbit vs. balloon flight vs. rocket launch).

ENGINEERING DESIGN (ETS)

- **3-5-ETS1-1:** Define a simple design problem reflecting a need or a want that includes criteria for success and constraints on time, materials, or cost.
 - Alan needs to get the robot back to its spaceship with limited junkyard materials.
- **3-5-ETS1-2:** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints.
 - The narrative explicitly compares balloons, airplanes, and rockets as problem-solving attempts.
- **MS-ETS1-4:** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process.
 - The repeated testing and refinement cycle is the central arc of the story.

Cross-Curricular Competencies

- Social-Emotional Learning (SEL):
 - Builds resilience by showing how failure leads to new learning.
 - Encourages teamwork (Alan and the robot, eventually the rats).
- STEM Identity Development:
 - Presents a relatable "outsider scientist" character who succeeds through persistence.
 - Highlights real-world space science and engineering concepts in story form.
- Science Communication:
 - Translates abstract physics concepts (atmosphere, gravity, Newton's laws) into tangible and humorous narrative experiments.

Summary

3-2-1 Liftoff! aligns strongly with NGSS standards for **Grades 3–5**, with enrichment links to middle school. It introduces foundational ideas about atmosphere, gravity, forces, motion, and engineering design through an engaging narrative of trial and error. Teachers can use the film as both a science enrichment tool and a platform for classroom experiments and discussions.

Suggested classroom extensions:

- Test balloons with air vs. helium and record differences.
- Build and launch paper rockets to model Newton's Third Law.
- Discuss: Why can't airplanes fly into space?
- – Writing/drawing prompt: If you were Alan, what invention would you try next?

