

Engineering Failure Investigation

Difficulty Intermediate	Time 1-2 class periods	Type Aerospace Mission
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Background

Engineering failures are rarely caused by a single bad decision. They often involve technical limits, communication problems, testing gaps, and pressure from schedules or cost.

Engineering Problem

Investigate a major engineering failure and identify how design-process improvements could have reduced the risk.

Learning Objectives

- Distinguish immediate causes from root causes
- Connect evidence to design-process decisions
- Identify ethical and communication factors
- Develop prevention recommendations

Materials

- Internet research access
- Engineering notebook
- Presentation or document software
- At least two credible sources

Procedure

1. Choose an approved case such as Challenger, Columbia, Mars Climate Orbiter, Tacoma Narrows Bridge, Hyatt Regency walkway, or another instructor-approved failure.
2. Create a short timeline of at least five events before the failure.
3. Identify the system or component that failed first.
4. Use a five-whys analysis to identify at least one technical root cause and one organizational root cause.
5. Find evidence of a warning, test result, or concern that was missed or misunderstood.
6. Map the failure to stages of the engineering design process.
7. Develop three specific prevention actions involving design, testing, communication, or decision-making.
8. Present the investigation in a one-page visual brief or three-minute presentation.

Engineering Requirements

- Use at least two credible sources
- Separate facts from your own conclusions
- Include both technical and human/organizational factors
- Provide three actionable prevention recommendations
- Cite sources in a consistent format

Constraints & Safety

- Do not use graphic images

- Do not copy a prewritten case summary
- Keep the final product to one page or three minutes
- Use respectful language when discussing injuries or loss of life

Deliverables

- Timeline
- Five-whys root cause analysis
- Engineering design process map
- Three prevention actions
- Source list
- One-page brief or short presentation

Reflection Questions

1. Which warning sign was most important?
2. Where could better testing have changed the outcome?
3. How did communication influence the failure?
4. What responsibility does an engineer have when a safety concern is ignored?

Engineering Tip

Ask “What allowed this condition to exist?” instead of stopping at “Which part broke?”

Common Mistake

A root cause is not simply the last event before failure. Look for deeper design, process, and communication conditions.

Stretch Goal

Compare two failures and identify one recurring pattern in engineering decision-making.

Career Connection

Safety, reliability, systems, and quality engineers study failures to prevent recurrence and improve standards.