

NASA History – October 29 1965

Maynard cautioned systems managers to "assume that ASPO is morally obligated to prevent any possible contamination of the earth," and not to reply with "the standard answer that no changes can be made within present weight, cost, and schedule limitations. Admittedly," he said, "our first look may prove to be insurmountable." Nonetheless, review must be performed so that recommendations can be made concerning all such systems.

Memorandum, Maynard, MSC, to PHS Branches, "Earth contamination from lunar surface organisms," October 29, 1965.

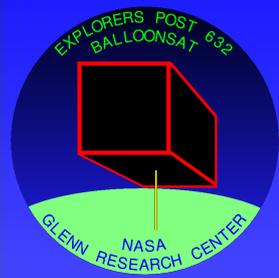
Note: Novel "Andromeda Strain" by Michael Crichton Published May 12 1969, before Apollo 11 launched July 16, 1969



Apollo 11 astronauts, still in their quarantine van, are greeted by their wives upon arrival at Ellington Air Force Base. July 27, 1969

Apollo 15 was first landing mission to not use a quarantine van.





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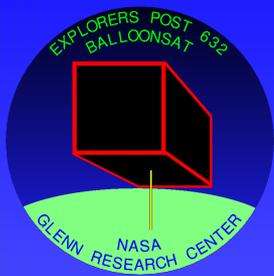
October 29

Owen E. Maynard, Systems Engineering Division chief, advised his branch managers of the U.S. Public Health Service's (PHS) growing concern that Apollo spacecraft and crews might bring organisms back from the moon. (See September 27.) PHS feared that such organisms would be "capable of multiplying in the earth environment and [that] precautionary measures must be undertaken to prevent global exposure." Therefore, Maynard told his group, PHS believed that the CM, its environment, and its crew must not be allowed to contact the earth's environment. Maynard further advised that efforts were already underway to define the design of an isolation facility, and isolation facilities for the recovery ships were being contemplated.

As a result of this strong stand by PHS, Maynard said, "It appears that ASPO will soon be requested to show what spacecraft measures are being taken to assure that the CM environment will not be exposed to the earth atmosphere. The spacecraft," Maynard told his group - who already knew as much - "has not been designed to preclude CM environment exposure." Actually, much the opposite had long been assumed to be part of normal operating procedures. Maynard therefore ordered subsystem managers to review their individual systems to determine:

- * If their system was potentially a carrier of moon germs
- * What could be done to confine such organisms
- * If a "strict no contamination edict" would affect the life and operation of systems
- * How postlanding procedures could be changed to prevent release of organisms from the spacecraft



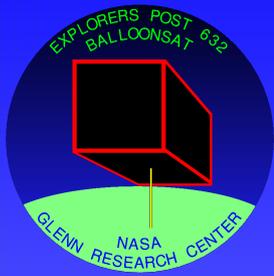


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Experiment Design

Explorers Post 632
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39 October 2008





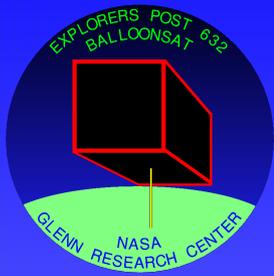
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Project

Types of Projects

- Experiment / Test
- Observation
- Model/Investigation
- Demonstration
- Invention





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Science vs Scientific

sci·ence

–noun

- 1. a branch of knowledge or study dealing with a body of facts or truths systematically arranged and showing the operation of general laws: the mathematical sciences.
- 2. systematic knowledge of the physical or material world gained through observation and experimentation.

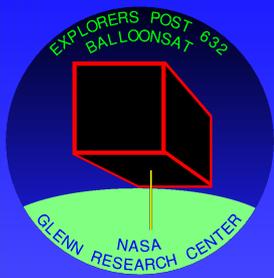
scientific method

–noun

- a method of research in which a problem is identified, relevant data are gathered, a hypothesis is formulated from these data, and the hypothesis is empirically tested.

From Dictionary.com Unabridged (v 1.1)





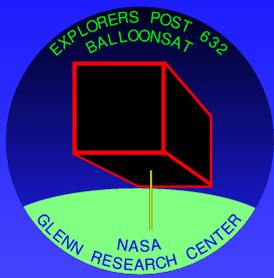
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Scientific Method

Scientific Method involves three Parts

- Hypothesis
- Evidence (Observation, Experiment)
 - Test of Hypothesis
- Conclusion
 - Supported Hypothesis
 - Refute Hypothesis
 - Modify Hypothesis



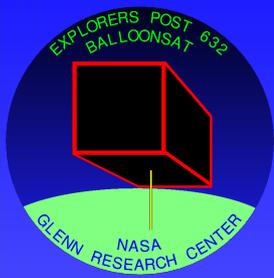


Hypothesis/Prediction

Hypothesis provides a framework for understanding, and examining Evidence

- Must be testable, make a prediction.
- May be simple.
 - A Parameter is important.
 - May be observational
 - **Does Something exists.**
- May be based on a Model.
 - Is the model sufficiently accurate?
- Caution: that Hypothesis does not bias conclusion.
 - Observers are biased.



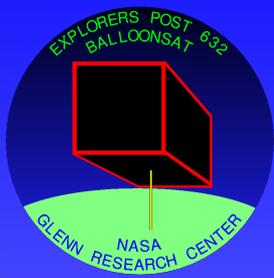


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Basis for Hypothesis

- There is usually some reasoning to develop and support a Hypothesis.
 - Accumulation of past observations
 - Theory or Model
- Hypothesis must be
 - Testable (True or False)
 - Measurable (usually quantitative)





Test Hypothesis / Evidence

'Evidence' is used to Test the hypothesis

- Reproducible
 - Must be described well enough that another investigator can replicate the Evidence.

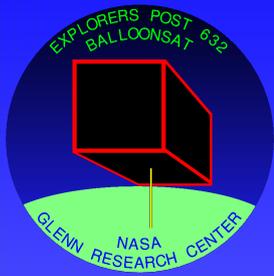
Observation:

Weak form of evidence
Often Subjective
 Biased By Observer
May be difficult to reproduce
 'Statistics' can help.
Useful when difficult to establish
 reproducible conditions.

Experiment:

Preferred test method
Controlled, Reproducible
Investigate one parameter or
 effect at a time.
 Keep other conditions the
 same, constant.





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Confirm/Reject/Refine

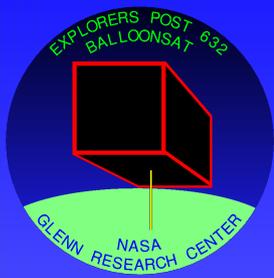
Based on results the hypothesis may be confirmed or rejected
(Mythbusters)

or:

Hypothesis may be refined, to be subjected to new tests

Inconclusive Experiments or Tests may be refined to improve accuracy.



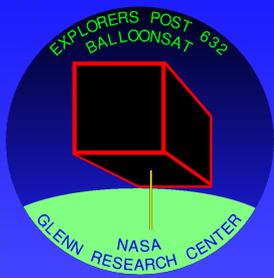


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Accuracy/Precision

- To Evaluate a Hypothesis and Experiment need to understand the Accuracy of the Prediction and Accuracy of the measurement.
 - Is there a range limit to the prediction? Is there an uncertainty (error/noise) to the predictions?
 - Is there a Limit to the Measurements?

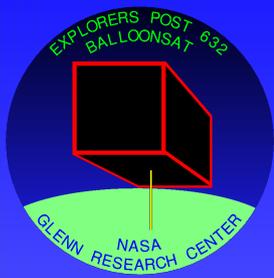




Statistics

- Multiple measurement may give an idea about reproducibility of measurement.
- Average or mean
 - $\langle x \rangle = \sum x_i / n$
- Standard Deviation:
 - $\sigma^2 = \sum (x_i - \langle x \rangle)^2 / (n-1)$
- Chi-squared can be used to test confidence
 - $\sum X_i = \sum ((x_i - x_j) / \sigma_i)^2$





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Experiment

- Hypothesis
 - Motion described by $x=x_0+v_0t-1/2gt^2$
 - Acceleration due to gravity 9.8m/s^2
- Experiment: Measure position of falling object with
 - Video
 - High speed Camera
- Is fit within Standard deviation?

