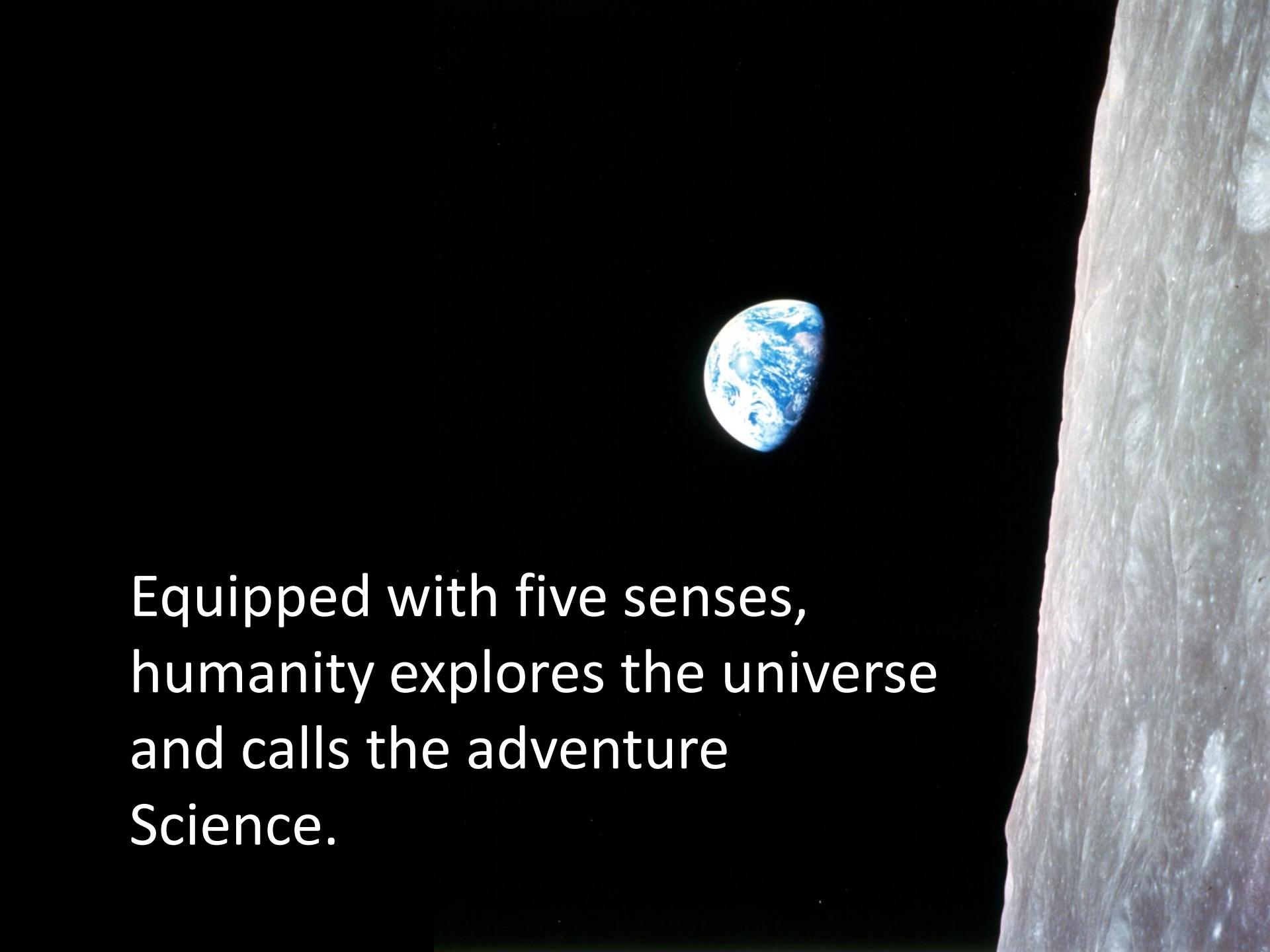


# The Nature of Science

2012 Virginia Science Standards  
Institute

Denny Casey, Ph.D.

The background of the image is a dark space scene. On the right side, a large portion of the Moon's gray, cratered surface is visible. In the upper center, the Earth is seen as a bright blue and white sphere against the black void of space.

Equipped with five senses,  
humanity explores the universe  
and calls the adventure  
Science.

# So, what is **science**?

On an index card, take a moment and  
write down your definition of  
science.

## *science* noun (Google)

- The **intellectual and practical activity** encompassing the **systematic study** of the structure and behavior of the **physical** and **natural world** through **observation and experiment**
- A particular area of this - veterinary *science*
- A **systematically organized body of knowledge** on a particular subject - the *science* of criminology
- **Knowledge** of any kind

*sci·ence noun (dictionary.com)*

- a branch of knowledge or study dealing with a body of facts or truths systematically arranged and showing the operation of general laws
- systematic knowledge of the physical or material world gained through observation and experimentation
- any of the branches of natural or physical science
- systematized knowledge in general
- knowledge, as of facts or principles; knowledge gained by systematic study

# Science in 3 domains

## 1. A body of knowledge

- facts
- definitions
- concepts
- theories
- laws
- etc.

# Science in 3 domains

## 2. A set of methods and processes

- observing
- measuring
- estimating
- inferring
- predicting
- classifying
- hypothesizing
- experimenting
- concluding
- etc.

# Science in 3 domains

## 3. A way of knowing about nature

- Scientific knowledge is based on evidence.
- Scientific knowledge can last over time.
- Creativity plays an important role in science.
- Background knowledge influences how scientists view data.
- etc.

# So, what is the **nature of science**?

NOS seeks to describe the nature of the scientific enterprise and the characteristics of the knowledge it generates.

# Why teach the **nature of science**?

Research shows:

- it helps us better define the boundaries of science and non-science
- increased student interest
- developing awareness of the impacts of science in society

# Why teach the **nature of science**?

To help students develop a better understanding of:

- what science is
- the types of questions science can answer
- how science differs from other disciplines
- the strengths and limitations of scientific knowledge (Bell, 2008)

# Key NOS tenets

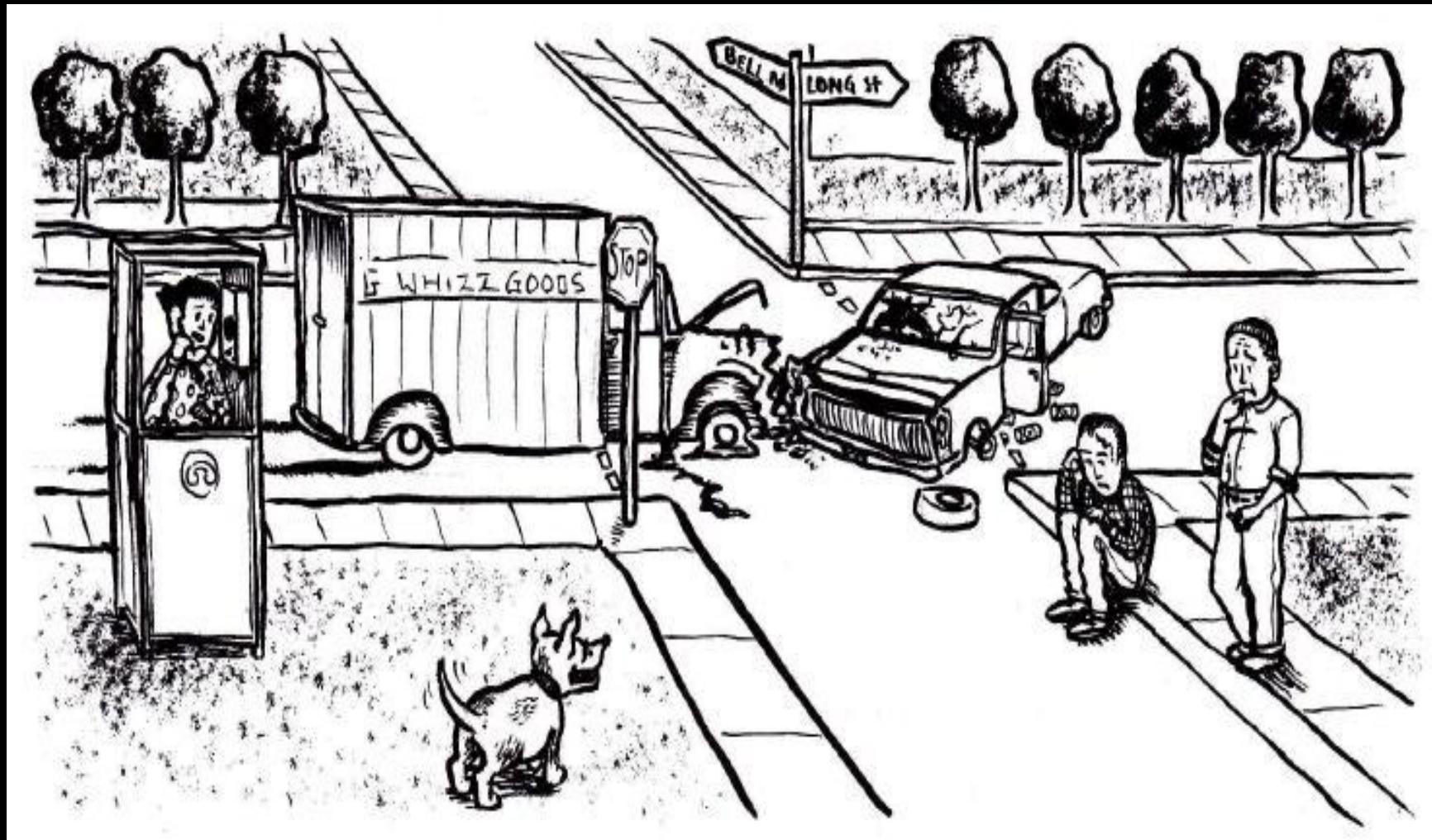
## Tentativeness

All scientific knowledge is subject to change in light of new evidence and new ways of thinking. That does not mean that we shouldn't have confidence in scientific knowledge, rather that it may change in the future.

# Key NOS tenets

## Observation and inference

Observation involves gathering information using the five senses while **inferences** are explanations based on observation and prior knowledge.



# Key NOS tenets

## Empirical evidence

Scientific knowledge is derived from data and evidence gathered by observation or experimentation.

# Key NOS tenets

## Scientific laws and theories

A **law** is a succinct description of relationships or patterns in nature based on observation and is often expressed mathematically. Scientific **theories** are broadly based concepts that make sense of a large body of observations and experimentation.

# Examples of scientific laws

- Hubble's Law of Cosmic Expansion
- Universal Law of Gravity
- Newton's Laws of Motion
- Law of Superposition
- The Ideal Gas Law
- Archimedes Law of Buoyancy
- Bernoulli's Law

# Examples of scientific theories

- Big Bang Theory
- Theory of Evolution
- Heliocentric Theory
- Cell Theory
- Atomic Theory
- Theory of Plate Tectonics
- Germ Theory

# Key NOS concepts

## Objectivity and subjectivity

Scientists strive to be objective and employ self-correcting mechanisms such as peer review. But intuition, personal beliefs, and social values all play a role in the scientific enterprise.

# Key NOS tenets

## Scientific methods

scientists employ a wide variety of approaches to generate scientific knowledge. There is no single universal method.

<http://undsci.berkeley.edu/>

# Key NOS tenets

## Creativity

is a source of innovation and inspiration in science. Scientists use creativity and imagination throughout their investigations.

# Effective NOS instruction in the classroom

Kindergarten, first, and second grade students can begin to understand what science is, who does science, and how scientists work through classroom activities, stories about scientists, and class discussions.

Third grade students' knowledge base and observational abilities are increasing; asking scientific questions and constructing reasonable explanations based on evidence; and, communicating their own ideas and investigations.













Virginia Museum of  
**NATURAL HISTORY**

Dr. Richard Hoffman  
1928-2012



# References

- American Association for the Advancement of Science. (1993). *Benchmarks for science literacy*. New York, NY: Oxford University Press.
- Bell, R. (2008). *Teaching the nature of science through process skills*. Upper Saddle River. New Jersey: Pearson Education.
- Peterson, Linda NOS presentation available at  
<http://mason.gmu.edu/~lpetersn/nos>
- National Research Council. (1996). *National science education standards*. Washington, D.C.
- National Science Teachers Association. (2000, July). *The nature of science*. NSTA. Retrieved July 15, 2012, from <http://www.nsta.org>.
- Understanding Science: How It Really Works.  
<http://undsci.berkeley.edu/>