

The Elements of Science

i>Clickers



- Available at the Price Center bookstore
- You will need to bring the clickers to every lecture
- For more info: <http://clickers.ucsd.edu/>

Basic Operation of i>Clicker



- Turn on the clicker by pressing the bottom "On/Off" button.
 - Text will appear in the window at the top of the remote.
- Set frequency to
 - While clicker is off, hold power button until flashing text appears
 - then press the two letter code
- When I ask a question in class (and start the timer), select A, B, C, D, or E as your answer.

How do you know your answer was received?



- In the window next to the answer you submitted a check mark will appear
- You can vote early and often, but only your last answer will be scored
 - As long as the timer is going, you can change your answer by simply voting again

Registering your i>clicker

- In order for me to give you points for your i>clicker responses, I must be able to link for clicker ID to your name and student ID. Send an email with this information to phil12@mechanism.ucsd.edu
 - your name
 - your student ID number
 - your clicker ID (located on the back of your clicker, below the scan code)



Other i>clicker information

- Before using a new clicker for the first time, pull the plastic tab out of the battery compartment.
- Check out www.iclicker.com for FAQs
- Email support@iclicker.com or phone 866-209-5698 for help

What Do Scientists Do?

- One proposal: Scientists observe patterns in what happens in the world
 - Mendel observed a pattern in the inheritance of traits in peas
 - Halley observed a pattern in the occurrence of a comet
- But they do much more: they attempt to **explain why** things happen
 - Mendel proposed factors which accounted for traits
 - Halley proposed an orbit for a comet

Hypotheses and Theories

- A hypothesis is a conjecture about the way some phenomenon in the world is brought about
 - Malaria is transmitted by mosquitoes
 - Mental imagery uses the same brain processes as perception
- A theory is a systematic set of hypotheses
 - Newton's theory of motion
 - Freud's psychodynamic theory
 - Darwin's theory of evolution

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It is just a theory!?

- Hypotheses and theories range from just conjectures or guesses to well-substantiated proposals
 - When first proposed, most hypotheses are just conjectures or proposals—guesses as to how things might be
 - What matters is whether *appropriate* evidence can be marshaled for them
- Hypotheses and theories that were once well-substantiated may turn out to be false!
 - The theory that the sun circled the earth was once very well supported
- Because hypotheses and theories go beyond the evidence, they always risk being falsified by future evidence

Clicker Question

How does a theory differ from a hypothesis?

A theory is true whereas a hypothesis is just a guess.

A hypothesis is a structured set of theories.

A theory is a systematic set of hypotheses.

A hypothesis is true whereas a theory is just a guess.

Predictions and Explanations

- We value hypotheses and theories because they give us power and satisfy our curiosity
- **Predictions**—specific detectable phenomena which we can infer from a hypothesis and to which the hypothesis is committed (false predictions count against the truth of a hypothesis)
 - From the hypothesis that mosquitoes transmit malaria, we predict that if we eliminate mosquitoes we will stop (or at least reduce) the spread of malaria
- **Explanations**—enable us to understand why something happens and often to alter it
 - From the hypothesis that a disease is produced by a vitamin deficiency, we can figure out how to treat that disease

Statements: Atoms of representation

- A statement is a sentence that has a **truth value**—it is either true or false (even if we do not know which)
 - Today is Saturday
 - A woman will be President of the US in 2020
 - DNA is found in the nucleus of cells
- A statement has an internal structure (subject, predicate, etc.), but for our purposes we will not go inside of a statement.
 - We will treat statements as atoms (indivisible)
 - They are the basic units with a truth value

Combining Statements

- While we won't divide them, we can combine them using connectives such that the truth value of the compound is determined solely by the truth value of the components
 - AND: true when both components are true
 - OR: true when at least one of the components are true
 - IF, THEN: true unless the first component is true and the second false
 - NOT: true if the component is false

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Clicker Question

What is the distinctive feature of a statement?

It reports the facts.

It has one subject and one predicate.

It has a truth value.

It is written on paper.

Types of statements

Contingent statements: whether they are true or false depends on how the world is

Contradictions: false no matter what the truth value of the component statements are

Tautologies: true no matter what the truth value of the component statements are

Definitions: stipulate that the two components have the same truth value

Clicker Question

The sentence

My name is Bill but Bill is not my name

is an example of

- A contingent statement
- A contradiction
- A command
- A tautology

Definitions: Important But Vastly Overrated!



- Definitions attempt to provide the necessary and sufficient conditions for being an instance of a word
 - Example: an odd number is a positive integer that is not divisible by two without remainder
- A necessary condition is a condition which must be met for something to be an instance of the term
 - Being an positive integer is necessary for being an odd number
- A sufficient condition is one which suffices for being an instance.
 - Being both a positive integer and not being divisible by two is sufficient for being an odd number
- Sufficient conditions are especially interesting when there are different ways of satisfying a term
 - What are the different ways that suffice to be a U.S. citizen?

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Trying to define ordinary terms

- Necessary and sufficient conditions can generally only be provided for technical terms (e.g., in mathematics or in legal contracts)
- Most ordinary terms defy such definition: For any attempted definition, a counter-example can be found
- A counter example is either
 - An example that fits the definition but we would not count as an instance of a term
- Or
 - An example that does not fit the definition but we would count as an instance of a term

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Define *bird*

Flying: Not all birds fly (and most insects do)

Feathers: is everything with feathers a bird?

Caudipteryx, Microraptor seem to have had feathers but are not birds



Doing without definitions

Using examples and similarity: start with typical cases



Robin

Chickadee

Blue jay

Finch

Extend to unusual cases



Defining Argument

- While this picture may represent what we typically call an argument



- For our purposes we will offer a specific definition
 - This is common in academic fields
 - Define terms for their own purposes, leaving behind the ordinary meaning

Arguments and justification

- An argument is a set of **statements**, some of which are offered as support for other statements in the set
 - Arguments serve to provide justification: they provide reasons to believe something
 - If someone asserts something which you do not believe, you frequently ask them to justify what they say
- As we define argument, it need not involve another person—you can construct an argument to demonstrate that something is true without showing it to anyone

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Premises and Conclusions

- The statements offered in support are called premises
 - Often indicated by words such as *Because, Since, Given that, On account of*, etc.
- The statements that are supported are called conclusions
 - Often indicated by words such as *Thus, Therefore, This establishes that*, etc.
- Example: Today is Friday, thus, the sun will set.
- Example: Because there is water on Mars there will be life.

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Clicker Question

In the argument

We can infer from the fact that the dog has lost its hair that there will soon be a lunar eclipse

The statement “the dog has lost its hair” is

- A premise
- A conclusion
- Neither a premise nor a conclusion
- Unable to determine from the information given
