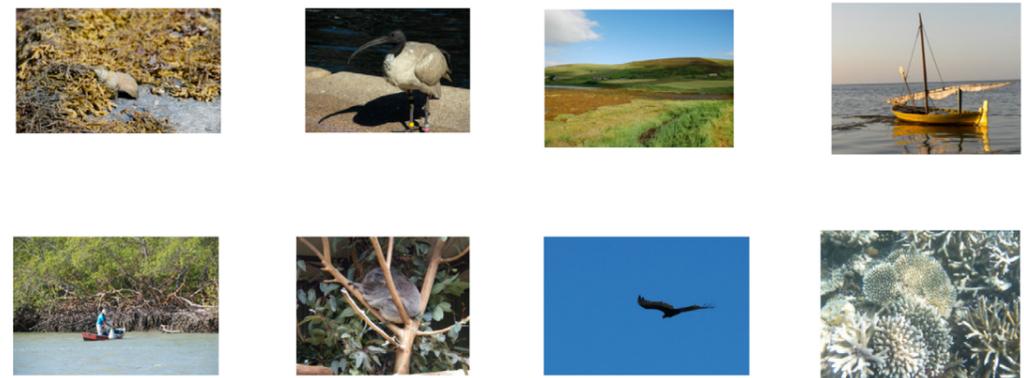
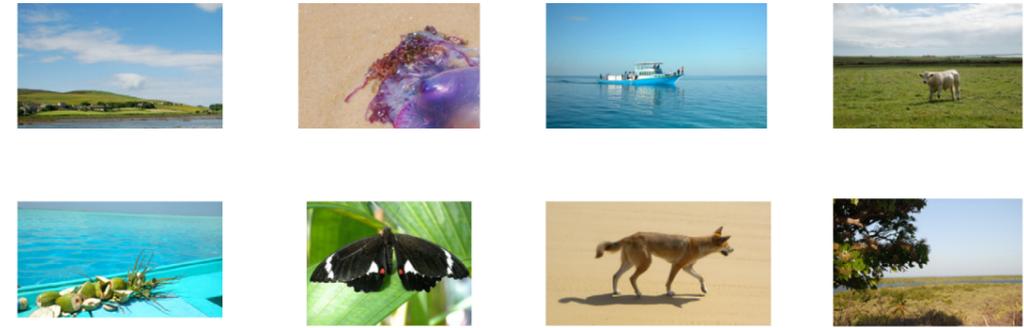


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THE RESEARCH GAME

THE SCIENTIFIC METHOD



motivating secondary school students to learn research methodology in science



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THE SCIENTIFIC METHOD

The **scientific method** consists of collecting data through observation and experiments in order to formulate hypotheses and theories. The scientific method is the way in which science investigates reality and is the method stated in the definition of knowledge. The modern conception of the scientific method is due to Galileo Galilei.

The main steps of the scientific method are the following:

- **analysis of the problem** - the researcher begins to gather information about the problem itself in order to understand its nature
- **formulation of a hypothesis** - the researcher formulates a possible solution to the problem
- **definition of the work/sampling** - the researcher defines the sampling method that will follow for the research activities
- **data collection** - the researcher collects data and information
- **processing of the collected data** - the researcher processes the data collected to produce one or more final results
- **test of the hypothesis** - the researcher verifies the correspondence between the results obtained from the research and its initial assumptions
- **communication of the results** - the final stage of the research process is the communication of the results.

THE DEDUCTIVE METHOD

It is a cognitive process, going from the general to the particular. In the deductive model the scientist starts from the general principles of the enunciation to get to the formulations of rules and laws, able to explain particular phenomena. The deductive process that leads from the general to the particular is based on reasoning and logic. The deductive method is in opposition to the inductive method, both have been known since the early Greek philosophers' period.

The Greek philosopher Aristotle uses the deductive method to construct the concept of Aristotelian syllogism by which from two general statements we can come to a particular conclusion, following a logical reasoning.

In the deductive method two general statements are required in order to deduce a third statement. Example:

- *All men are animals*
- *All animals are mortal*
- *(so) All men are mortal*

THE INDUCTIVE METHOD

It is a cognitive process from the particular to the general. In the inductive model, the scientist begins with the observation of particular and concrete phenomena to reach the enunciation of general and universal laws to explain other similar phenomena. The inductive method is opposite to the deductive method and is known since the beginnings of the Greek philosophy.

In the inductive method, the researcher tries to reach a general statement from the observation of some details of reality. Example:

- *Charles saw a black panther*
- *John saw another black panther*
- *(so) Probably all panthers are black*

In the inductive method the first two statements are based on the observation of the reality surrounding the observer. It concerns particular aspects and not statements which can be considered generally true. For this reason, the inductive method is the basis of the experimental method; only the collection of data and the repetition of experiments allow extending in a general sense the result obtained with the inductive method.

THE EXPERIMENTAL METHOD

It is mainly based on the observation of physical phenomena using mathematics and reproducible experiment. Through the observation of phenomena and repeated experimentation the researcher can interpret mathematical relationships that underlie and determine the natural phenomena.

The researcher formulates scientific hypotheses and submits to the control of the experimental method. Once the hypothesis is confirmed by repeated experiments, it becomes a scientific law. The same method (experimental) can be used to refute existing laws. During the eighteenth century, the experimental method was rapidly spreading