The Nature of Science

- Astronomy is a science.
- Science is based on **rational thought**
- There is such a thing as **objective reality**.
- We do not make reality, but we can acquire knowledge of reality. Once knowledge is acquired, we can hang on to it, and we can pass it on.
- We need rules and principles, not feelings or desires, to understand reality.
- Every useful rule that we are looking for is reliable and can be counted on every time — even though we can conceive what would happen if it were not true.
- That is, every scientific principle worth testing has to be **falsifiable**: if it is really the wrong rule, it has to fail. Only if it has been tested and tested, repeatedly, and never failed — only then is it worth considering.
- Scientists make **observations** and **measurements**, and then develop **theories** to explain this data.
- Gathering good data might involve sophisticated **techniques** and sensitive **instruments**, but the data must be **objective**.
- This means that their data is **not privileged** in any special way, and that is why scientists are so determined to repeat their work and to share their data.
- **Occam's Razor** is a basic scientific principle. To quote the main character in the movie *Contact*: "it says, all things being equal, the simplest explanation tends to be the right one."
- Scientists are encouraged to be **skeptical**: they question everything.
- Authority, by itself, is almost worthless in science. Each scientist is capable of evaluating the data and the analysis by themselves, and they do not need to trust in the authority of anyone else.
- Scientific theories are almost always based on **mathematics**, and they must be very specific, never vague.
- The best scientific theories not only explain what has already been observed, they **predict** what can be observed next.
- Making a prediction means that the theory can be **tested**: if new observations agree with the prediction, the theory is **supported**, but if the prediction was unsuccessful, then the theory is **disproven** and must be abandoned in favour of a new and better theory.
- This cycle of
    1. observation
    2. analysis
    3. prediction
    4. new observation

    is called the **scientific method**.

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