The main steps of the scientific method

1) **Observation** : this is the primary basis for any scientific method. If something cannot be observed, then it cannot be scientifically tested.

Important note: this point only applies to the natural sciences. For example, if we would like to analyze a battle that occurred during World War II we cannot examine the task this way because it has already happened.

2) **Defining the problem**: after the observation procedure, we have to define the problem in a way that it can give us a further guide and goal as well.

3) **Setting up the hypothesis or methods**: the solution for the given problem has to be done in a certain way defined by the scientist. It may be a hypothesis, or if the problem covers a larger area, it may be a whole method. When the data have to be analysed different hypotheses can be set up for the task. In this case, scientists usually use the so-called **Occam's razor**, which is the following:

If we have one or more hypotheses that cover the same area (at least partially), we have to analyze the one which consists of more straightforward facts or *fewer assumptions*. But be careful! This method has proven to be very useful, but it's only a philosophical recommendation. Its correctness can not be proven in every case.

(Astronomical example: Kepler's law of physics, physical example: Hooke's law - "an elastic deformation of the body is proportional to the force causing the deformation")

4) **Predictions** based on the hypothesis or method (deduction). Every scientific method will necessarily involve certain forecasts. The ones which prove to be useful for further scientific progress have to be tested. The hypotheses made during the scientific progress have to be examined. One of the criteria during these tests is called falsifiability. This criterion comes from *Karl Popper* (a scientific philosopher).

Falsifiability in this case has to be seen in the following way: if there is any kind of way (even just logical) which can contradict our hypothesis, then it is falsifiable. (For example: all swans are white. Of course there are black swans so the statement is not true, therefore falsifiable).

Criticism of the *Popper's method*: If the observation is inconsistent with the theory, then it is equally possible that the theory is correct or wrong or the required information is insufficient or false. (Astronomical example: our observations about Uranus let us predict that its movement behavior contradicts Newtonian laws. Levellier and Adams tried to explain this by saying that this movement is caused by an unknown planet's interference. Galle was the one who managed to find Neptune, which was unknown up to that time.

5) **Experiments and empirical verification**: This scientific method strictly involves repeat-ability and reproducibility as well. Experimental reproducibility means that the same results can be reproduced by setting the same given conditions (within a given interval of tolerance).

6) Wording/**setting up the hypothesis** or principal.

flowchart TD A[Observation] --> B[Define Problem] --> C[Set Hypothesis/Methods] --> D[Make Predictions] --> E[Experiment & Verify] --> F[Formulate Principle] E --> C