

Science and Fluoridation

Understanding truths about the world is what science attempts to do. Whether the question is 'Do the sun and stars revolve around the earth?'; 'Do UFOs exist?'; 'Is more sunlight the cause of bigger tomatoes?', or, 'Is fluoride in drinking water safe and efficacious?', science is the best method we have for getting to the truth.

Science does this by continually moving closer to the 'truth' by repeatedly testing ideas and adjusting hypotheses (another name for a proposed truth).

The process is simply:

HYPOTHESIS (a best guess at the truth)	>>>>>>	PREDICTION of CONSEQUENCES (if the hypothesis is true, then ...)	>>>>>>	EXPERIMENTALLY TEST by comparing prediction to observation/data
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e.g. the amount of sunlight determines the size of tomatoes	more sunlight>bigger less sunlight> smaller
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Rarely, if ever, does a single set of experiments (usually resulting in a 'paper' in a scientific journal) change scientific thought. At best, it will prompt further work, with each addition either confirming the hypothesis; amending it or demonstrating it to be false. It is only the last outcome that is definitive; the others can only be said to be moving us closer to the truth since science (unlike mathematics) cannot 'prove' a truth.

In the trivial tomato example, the additional experiments might find, for example, that too much light was bad for the plants, perhaps causing the loss of too much water, leading to the conclusion that tomato size is dependent on more than simply sunlight; the hypothesis would need to be amended.

However, one of the papers in our example might have also found that sunlight was not important to tomato size. This would be considered an extraordinary claim, greatly at odds with the accumulated data and everyone else's experience. Consequently, for this new claim to be accepted, extraordinary scientific data would be necessary:

The scientific maxim is:

EXTRASORDINARY CLAIMS REQUIRE EXTRAORDINARY DATA

At the very least the **claim or hypothesis** must be measurable and testable, with clear and predictable outcomes. **Experiments** should:

- Involve large numbers of identical (or near identical) tests or test subjects
- Be blinded to the investigator
- Have appropriate controls or references
- Be repeatable by different workers

In any case, science only gets us closer to the truth by demonstrating which ideas (hypotheses) are false and accepting the simplest idea supported by the data and evidence. This is especially true in cases where experiments are difficult to do or simply have not been done.

A famous example comes from the physicist Richard Feynman:

The existence of UFOs is a good example that is complicated by the inability to do direct experiments. Science cannot prove that UFOs do not exist, but virtually all scientists make the claim that there is no evidence for UFOs. Why?

As Feynman put it: “Based on the totality of the data and my knowledge of the world- It is more likely (i.e. closer to the truth) that the reports of UFOs are the results of the known irrational characteristics of terrestrial intelligence rather than the unknown rational efforts of extraterrestrial intelligence. “

Re Fluoridation: Unfortunately the question of the safety and efficacy of fluoride use in general and fluoridation of drinking water in particular concerns more of a political agenda than a scientific issue. Indeed there are several organizations dedicated to building a case against fluoride. Unfortunately this has led to ‘science’ being reduced to searching the web for bias confirmation, the cherry picking of data, misleading or, at best, misunderstood, representations of fact and, when all else fails, leaping to the next issue.

Fluoride has been used for many hundreds of millions of people for decades to limit tooth decay. The overwhelming sense from individual dentists and dozens of organizations that care about child health is that fluoride makes a significant difference in decay levels.

The argument is made that stopping fluoride delivery via drinking water has made no difference in several studies; or that most of Europe does not fluoridate its drinking water. Invariably these claims fail to mention that:

- Fluoride is naturally occurring in many, if not most drinking water supplies
- Alternative delivery of fluoride is possible such as in salt or in milk or bottled water (the most common source of drinking water in Europe). In addition, some localities have paid for school programs that administer periodic fluoride mouth rinses to school children.

- Direct, well-controlled studies of neighboring localities with and without fluoride treatments do show significant effects.

The argument is then made that fluoridation is unsafe, citing studies that claim to show fluoride as responsible for everything from osteosarcomas to a loss of IQ through neurotoxicity. Given the decades of exposure by hundreds of millions of individuals, these claims are in the category of extraordinary claims. They require extraordinary data for acceptance and that has not been forthcoming.

Dangers have also been claimed for the fluoridating agents themselves, especially fluorosilicic acid. In its pure form it is corrosive and can present handling issues for its addition to water supplies (and consequently is not used in Gloucester). However, once added to water it is safe, with the only products being fluoride ions and silica molecules.

It has also been asserted that the fluoridating agents are contaminated with toxins, especially heavy metals. Two sets of testing (covering hundreds of samples from 2007-11 and 2000-06) by NSF- formerly the National Sanitary Foundation- found that fluoridation products “do not contribute measurable amounts of arsenic, lead, other heavy metals or radionuclides to the drinking water”. In addition, it should be noted that all fluoridation products are required to have certificates of analysis before they are used.

The only accepted adverse effect of fluoridation appears to be dental fluorosis and, as reported by the CDC, is rarely significant.

Lastly it has been asserted that for formula fed infants, the CDC ‘recommends alternating fluoridated water with un-fluoridated water to reconstitute powdered formula to prevent dental fluorosis’. At best this is misleading, the actual language is “*You can use fluoridated water for preparing infant formula. However, if your child is exclusively consuming infant formula reconstituted with fluoridated water, there may be an increased chance for mild dental fluorosis. To lessen this chance, parents can use low-fluoride bottled water some of the time to mix infant formula; these bottled waters are labeled as de-ionized, purified, demineralized, or distilled.*”