Where is the proof in pseudoscience?

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Science or pseudoscience? Credit: Flickr/Aff

The word "pseudoscience" is used to describe something that is portrayed as scientific but fails to meet scientific criteria.

This misrepresentation occurs because actual science has creditability (which is to say it works), and pseudoscience attempts to ride on the back of this credibility without subjecting itself to the hard intellectual scrutiny that real science demands.

A good example of pseudoscience is homoeopathy, which presents the façade of a science-based medical practice but fails to adhere to scientific methodology.

Other things typically branded pseudoscience include astrology, young-Earth creationism, iridology, neuro-linguistic programming and water divining, to name but a few.

What's the difference?

Key distinctions between science and pseudoscience are often lost in discussion, and sometimes this makes the public acceptance of scientific findings harder than it should be.

For example, those who think the plural of anecdote is data may not appreciate why this is not scientific (indeed, it can have a proper role to play as a signpost for research).

Other misconceptions about science include what the definition of a theory is, what it means to prove something, how statistics should be used and the nature of evidence and falsification.

Because of these misconceptions, and the confusion they cause, it is sometimes useful to discuss science and pseudoscience in a way that focuses less on operational details and more on the broader functions of science.

What is knowledge?

The first and highest level at which science can be distinguished from pseudoscience involves how an area of study grows in knowledge and utility.

The philosopher John Dewey in his Theory of Inquiry said that we understand knowledge as that which is "so settled that it is available as a resource in further inquiry".

This is an excellent description of how we come to "know" something in science. It shows how existing knowledge can be used to form new hypotheses, develop new theories and hence create new knowledge.

Testing the knowledge. Credit: Flickr/biologycorner

It is characteristic of science that our knowledge, so expressed, has grown enormously over the last few centuries, guided by the reality check of experimentation.

In short, the new knowledge works and is useful in finding more knowledge that also works.

No progress made

Contrast this with homeopathy, a field that has generated no discernible growth in knowledge or practice. While the use of modern scientific language may make it sound more impressive, there is no corresponding increase in knowledge linked to effectiveness. The field has flat-lined.

At this level of understanding, science produces growth, pseudoscience does not.

To understand this lack of growth we move to a lower, more detailed level, in which we are concerned with one of the primary goals of science: to provide causal explanations of phenomena.

Causal explanations

Causal explanations are those in which we understand the connection between two or more events, where we can outline a theoretical pathway whereby one could influence the others.

This theoretical pathway can then be tested via the predictions it makes about the world, and stands or falls on the results. Classic examples of successful causal explanations in science include our explanation of the seasons, and of the genetic basis of some diseases.

While it's true that homoeopathy supporters try very hard to provide causal explanations, such explanations are not linked to more effective practice, do not provide new knowledge or utility, and so do not lead to growth.

In the same way, supporters of neuro-linguistic programing claim a causal connection between certain neurological processes and learned behaviour, but fail to deliver, and astrologists offer no coherent attempt to provide an explanation for their purported predictive powers.

The lack of testable causal explanations (or models, if you will) that characterises pseudoscience gives us a second level of discrimination: science provides casual explanations that lead to growth but pseudoscience does not.

Operational aspects of science

The third level of discrimination is where most of the action between science and pseudoscience actually takes place, over what I earlier called the operational details of science. Getting these details right helps deliver useful causal explanations.

This is where battles are fought over what constitutes evidence, how to properly use statistics, instances of cognitive biases, the use of proper methodologies and so on.

It is where homeopathy relies on confirmation bias, where the anti-vaccine lobby is energised by anecdotes, and where deniers of climate science selectively highlight agreeable data.

This level is also where the waters are muddiest in terms of understanding science for much of the population, as seen in comments on social media posts, letters to the editor, talkback, television, media articles and political posturing.

The knowledge is out there

It is important to address these basic operational understandings, but we must also highlight, in both science education and science communication, the causal explanations science provides about the world and the link between these explanations and growth in knowledge and utility.

This understanding gives us better tools to recognise pseudoscience in general, and also helps combat anti-science movements (such as young-earth creationism) that often masquerade as science in their attempt to play in the same rational arena.

A vigorous, articulate and targeted offence against pseudoscience is essential to the project of human progress through science, which, as Einstein reminds us, is "the most precious thing we have".

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