Pseudo-scientists want the mana of science but don't abide by the rules by which the scientific community earned its authority in the first place. Knowing those rules – the basis of the scientific method – gives you a powerful tool for assessing claims, whether they come from used-car salesmen or faithhealers.

What do you see?

It requires careful observation to sort out what we think we see or what we want to see from what we actually see. Is it really a Face on Mars or just a geological formation?

A pseudo-science often requires people to make their own interpretations to sort the desired phenomenon from the "noise". The "noise concept" doesn't apply just to things like satanic words buried backwards in rock music, but also to virtually any phenomenon that is at the very edge of the measurable.

Statistical support is often claimed for the merest hint of, say, psychokinesis in a series of dice rolls, or positive health results from homeopathic prescriptions. It doesn't necessarily imply fraud by the "researcher", being part of an uncertain world can often be enough, particularly for someone who is searching to prove their point.

Pseudo-sciences tend to remain barren -- they don't develop or change a great deal beyond their initial formation. Astrology has stayed pretty static over the past 3,000 years, homeopathy over the last 200 or so.

Repeat, repeat, repeat

Science understands the importance of repeatability of observations or experiments, and that this needs to be done by many people in different places to eliminate bias. Be skeptical about experiments that only work when the "right" people or "right" vibrations are present.

An unwillingness to provide evidence, to let others look at your work or to give them a chance to repeat it should raise warning signs, whether it's an alien autopsy film distributor not letting the film be analysed by independent photographic experts or a researcher withdrawing test samples from a study.

Failure can be Good

A so-called "failed" experiment can be as informative as one which succeeds; disproof can be as important as proof and good science will look for both.

The success of failure was demonstrated with the first-ever scientific tests of Rudolf Steiner's "peppering" approach to pest control which showed that there was no effect from the special potion of homeopathically diluted possum testicle ash. Yet this failure has been ignored and the biodynamic approach is still touted by those who believe in it.

The Bellman's Fallacy (taken from Lewis Carroll's *Hunting of the Snark*: "what I say three times is true") demonstrates how ideas which don't measure up nonetheless are believed through sheer dint of repetition. Such ideas can be very difficult to eradicate -- everyone has heard that ships disappear in the Bermuda Triangle, or that the US military has alien bodies in storage.

The mere fact that we hear something over and over again does not automatically make it true.

How did that happen?

Science makes us aware of the need for an understanding of how something could possibly work (a causative mechanism) – coincidence is not enough.

Iridology began when a young lad observed that an owl with a broken wing had a mark in its eye – that has been extended to the belief that all manner of illnesses produce effects in the eye. What sort of mechanism is there for a liver disease to produce a mark on the eye? There are no physical connections, and the anatomical explanations provided by iridologists are not borne out by fact. Combine this with the failure of iridology to pass basic tests of diagnostic ability, and you have good cause to class this as a pseudo-science.

We do need to evaluate ideas that don't have mechanisms, rather than dismiss them out of hand, as further gains in knowledge might provide support. Plate tectonic theory showed us that, where it took some time to establish it as a credible explanation for the movement of continents. We also need to be able to evaluate the likelihood of that mechanism appearing and the explanatory appeal of the idea involved to be sure that it is worth putting on the "maybe" shelf for further consideration.

Simple is best

The simplest explanations are often the best, most likely explanations.

Consider the extremely complex system built up by followers of the Earth-centered view of the solar system, and compare this to the simple Sun-based system which replaced it. If you have to keep adding ad hoc elements to

try and explain things that don't agree with your theory, then it is likely that the theory is wrong.

A friend of a friend said...

There is a significant difference between an anecdotal report – what a friend says or, worse still, a quote from some person touting the treatment or product – and a scientific double-blind trial when it comes to assessing the validity of a claim.

Many claims for the effectiveness of alternative medicines or therapies rely on reports from happy customers – you don't get to hear about any unhappy experiences. Poor record-keeping and people's reluctance to complain makes it very difficult to assess objectively the level of problems encountered.

Double-blind trials provide a form of "gold standard" for experimental work. These are trials where those involved (subjects and experimenters) do not know who is getting what until after the tests and results are recorded. A control group is used to provide an untreated sample whose results can be compared to the test group.

Sources and special pleading

Examine information sources. Avoid judging topics based solely on media portrayals, particularly when they are presented as a conflict or controversy. Be cautious of special pleading by single individuals, particularly when they start saying things like "they laughed at Einstein you know" claiming this as validation of their ideas. Pseudo-scientists often use criticism of their ideas by the scientific "establishment" as evidence that they are important because they are controversial.

Be cautious of people who are insistent on using an academic title, as many people with dubious qualifications or even self-awarded ones will often insist on using a title or a series of letters after their name.

Watch out for people using complicated language or terms they can't or won't explain. In trying to gain the mana of science, many pseudo-sciences adopt the language of science. So you find terms like "bio-energetic field", "quantum dynamics", "fluid plasma" etc bandied about. Ask for explanations of these terms.

Never be afraid to ask questions – they can be a powerful tool to protect you from harm. And don't be afraid to say you don't know.

I think it's much more interesting to live not knowing than to have answers which might be wrong.

Richard Feynman

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Critical Thinking

Just because Einstein was controversial does not mean that anyone who is controversial must be another Einstein.

Extraordinary claims require extraordinary proof.

Keep asking questions until you know, or you know that you don't know!