

**Our senses tell us that a table, for example, is a solid object; science tells us that the table is mostly empty space. Thus two sources of knowledge generate conflicting results. Can we resolve such conflicts?**

The problem with reconciling science with empiricism is that scientific research uses empirically intangible concepts to explain our sensory observations. In the question, the sensory claim (that the table is solid) is true, but is affected by the physical limits of perception. The scientific claim is also true, but we must justify science's claim independent of its power as a social authority.

The difference between science and sensory perception involves necessary and contingent truths: our senses might say that an object such as a gold ring is solid but it melts into a liquid when heated. Therefore, "Gold is solid" is not a necessary truth (always true) – it's temporary and contingent upon temperature. Science searches for a necessary truth to explain an object's properties. In this case, scientific theory claims that objects are made up of tiny particles held together by mutual attraction; the particles move away from each other when heated until they are no longer perceived as a solid mass. Science's atomic theory and subatomic particles give us a law to explain why gold can appear to our senses as solid or liquid.

Truth also has three main criteria: it must be pragmatic, coherent, and correspondent. The pragmatic truth for a construction worker is the empirical evidence of his own two eyes: the wood must be solid because it holds up the house that he builds. This is also coherent to the final product of construction, which is a house that doesn't collapse on the empty space inside the wood. For a construction worker, science's research doesn't

matter because it is simply an exploration of our faculty of reason – trying to explain what he already knows is true. The coherent and pragmatic truth for a chemical physicist is the concept of empty space between electrons and protons, reinforced by quantum theory and experiments where higher-velocity particles can pass through atoms with no resistance, showing that they have negligible density. 25

However, reducing our conception of the table to particles and spaces doesn't detract from the wood's own properties, which are the same as they always were. The interaction of particles and spaces is merely the scientific explanation for the table's properties. 30

The title question seems to present a table as particles in empty space, ready to fall apart, completely contradicting our senses. But that's not how it works: science is devoted to explaining empirical observations, not opposing them. Scientific theories also state that the particles, which have positive or negative charges, are being held so rigidly by electrical attraction and repulsion that they can't "fall apart" – the electrical forces act as a framework to hold the table together. Thus there is actually less conflict between the sources of knowledge than we might think. 35

There is also the issue of language: the term "solid" is a sensory concept, not a scientific one; it indicates that we observe the table as one unified object. When we describe wood or gold, we use the word "solid" in the empirical sense, but we don't mean that the object is made entirely of dense matter – only that it appears solid to our senses. We can still believe the scientific claim that an object's subatomic particles have spaces between them. 40

In dealing with our senses, however, we know that there are many instances in which 45  
empirical knowledge isn't very reliable, so we often yield to science. In fact, our culture  
influences us to hold science as an ultimate authority, superseding other claims. For  
example, I found an article in the Journal of Agricultural and Food Chemistry<sup>1</sup> claiming  
that blueberries and cranberries contain anti-oxidants, meaning we should eat more of  
them. I then tried eating more blueberries, believing that they were beneficial even 50  
though I didn't feel physically better while I was eating them. Obviously, I let scientific  
information overrule my senses. We tend to trust science over our senses because  
today's science involves concepts which are far removed from our unaided senses –  
examples include string theory, light waves, and theories of the creation of the universe.  
The information we receive about these concepts is often second-hand (through 55  
television, Internet, or books) or largely conceptual. In fact, we quickly begin to accept  
second-hand scientific knowledge without questioning it; the justification for science's  
claims is often beyond our level of understanding in any case. In the end, our cultural  
reverence for science leaves it open to exploitation; reason and logical justification seem  
to become superfluous when we precede a claim with "Scientific research shows..." In 60  
the blueberry example, I didn't question the research because science is such a powerful  
cultural authority. In fact, the source of knowledge seems more important than the  
justification for the claim. Science is said to have certainty because it is open to  
verification and to peer review, but science's newest advances, like electron orbits and  
nuclear fission, cannot be known and understood by the ordinary person except through 65

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<sup>1</sup> Wei Zheng and Shiow Y. Wang, "Oxygen Radical Absorbing Capacity of Phenolics in Blueberries, Cranberries, Chokeberries, and Lingonberries," Journal of Agricultural and Food Chemistry, Vol. 51 2, 27 Nov. 2002, 9 Nov. 2007  
<[http://152.1.118.33/Files/Journal%20of%20Agricultural%20and%20Food%20Chemistry%202003%2051%20\(2\)%20502-509.pdf](http://152.1.118.33/Files/Journal%20of%20Agricultural%20and%20Food%20Chemistry%202003%2051%20(2)%20502-509.pdf)>.

an authority. Science's position as a social authority means that we must always look for justification for its claims. I can personally sense the solidity of an object like a table, but scientific claims require more specific justification, such as the existence of science's coherent atomic theory, evidence of past research as proof, and the possibility of verification in the future. That said, the atomic theory is well-established and well-70 documented; it, like many other claims, is usually acknowledged to be true in the interests of progress and expediency.

Finally, science is based on sensory evidence: while it is true that our senses can give us information – for example, the table is opaque and feels solid – they can also misguide us. Perception is notoriously unreliable: for example, we can be tricked into seeing a picture that isn't really there in an optical illusion. Descartes discounted empirical perception altogether, maintaining that thinking is the only certain thing. However, since 75 we draw so heavily from our observations of the world both for science and for everyday conclusions, we cannot afford Descartes' total skepticism.

One reason for uncertainty about science's evidence is the use of an electron 80 microscope – a scientific object invented by humans – to produce a large part of the empirical evidence supporting the theory of atoms and hence the empty spaces inside them. When we look through the microscope, do we still see true empirical evidence?

It is entirely possible that the microscope was designed incorrectly and so what scientists believe they see in an electron microscope is in fact nothing but fabrication. 85

There is also the possibility that the electron microscope is merely fraud; since we can't see atoms with our own eyes, they may not exist at all. The microscope might

simply be a fake – a manufactured image intended to give weight to scientific declarations.

However, I have myopia and my unaided eyes also tell me that a tree, seen from a distance, is one solid, opaque lump. I need to use corrective lenses to be able to see individual leaves on a tree. It's hardly practical to say that my observations aren't valid because of this – I need to accept technology as a visual aid. An electron microscope is another type of corrective lens, allowing us to see billions of atoms instead of one solid, opaque lump of wood.

It is possible that, like my eyes, the average human eye is short-sighted and can't see individual protons or the spaces between them. In that case, the only way we can hope to learn about the nature of atoms is to continue with our current theories and tools, despite the possibility of falsification. The use of scientific equipment leaves science open to skepticism and makes scientific proof less accessible to everyone. However, if used correctly it can augment our senses and extend the limits of empiricism.

Our senses tell us that a table is solid; science merely makes more detailed observations in order to develop a reliable law and explanation for the substance's behaviour. Thus the scientific information and the sensory information are both rooted in empiricism. We already know, however, that our senses have limits; at best, empiricism tells us how something appears, but not what it is. To truly understand an object's essence – what Plato would call its Form – we must apply reason to what we observe. Reason is what allows us to reconcile two conflicting sensory impressions to form an overall impression of an object.

Can we reconcile empirical evidence with what science and reason tell us? The scientific concepts of atoms, protons, and gaps between particles are linguistic and intellectual concepts, but my knowledge of the table as a solid object is tangible empirical evidence. Both are flawed and arguably could be false: Are “atoms” an invented concept or is “solid” an invented concept? Is either one more false than the other? Both could be true, but a thorough understanding of science can help explain sensory impressions, rather than exclude them.

Because of this, we accept science’s claims intellectually, but we usually rely on our senses to give us simpler information about the world. In the same way, I know intellectually when I look at a tree that there exist individual leaves, but my senses are too limited to see them except as a single clump. Unless there is a specific pragmatic need for the scientific claim to be true and verifiable, we often rely on the simplest empirical observation without requiring an explanation. In the end, the necessity for scientific explanations is determined by our curiosity, not by any specific standard.

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**Works Cited**

Zheng, Wei and Shiow Y. Wang. "Oxygen Radical Absorbing Capacity of Phenolics in Blueberries, Cranberries, Chokeberries, and Lingonberries." *Journal of Agricultural and Food Chemistry*, Vol. 51.2. 27 Nov. 2002. 9 Nov. 2007  
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