Contrary to Belief

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Key Words

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Put it before them briefly so they will read it, clearly so they will appreciate it, picturesquely so they will remember it and, above all, accurately so they will be guided by its light. Joseph Pulitzer

One of the primary goals of communicating science to the public is to capture the excitement of scientific discoveries while trying to follow the advice of Joseph Pulitzer. Writers and speakers often fall short of this goal and say too much, use too much jargon, or use picturesque language carelessly, as in saying that a neutron star is "incredibly dense", when the data have shown that the density is credible.

More problematic is the use of the word "believe", as in: "Astronomers believe that most galaxies harbour massive black holes at their centres", or: "Scientists believe that elements such as oxygen, silicon and sulphur are dispersed into the galaxy primarily by the explosion of massive stars."

In most cases, to paraphrase Helen Quinn (Quinn, 2007), these statements mean something like: "Based on the evidence at hand, this is what most scientists think is going on, and there is no good evidence to indicate otherwise." It is much briefer to say: "Scientists believe…", but not nearly as accurate.

For many readers, the word "believe" could indicate a statement of faith, as in: "He believes in God." Or it could be a statement that involves an educated guess, as in: "I believe the Red Sox will win the World Series again this year."

The latter is closer to what is meant when we say scientists believe, but does not reflect the state of scientific knowledge, which is well beyond an educated guess. In the example above, the evidence is strong that supernovae play a critical role in the dispersal of heavy elements and that supermassive black holes exist at the centres of most galaxies. It is healthy to maintain a little scepticism, but not to the point of describing the state of understanding inaccurately.

To say that: "The evidence indicates that most galaxies harbour massive black holes…" would seem to be a good compromise that satisfies both the brevity and accuracy criteria.

The search for knowledge using the scientific method proceeds in a random walk, with steps that can be forward, backward or sideways. It moves along a broad path, beginning with having an idea, to thinking something might be true, to being so sure as to say that we know it is true. For example, we know that gravity acts throughout the Universe, and that we can use our knowledge of the law of gravity to launch satellites and send them to planets in the outer reaches of the Solar System.

Progress along the path from ideas to knowledge is driven by applying the steps of the scientific method — observation, hypothesis and testing with more observations or experiments. Several hypotheses are almost always proposed to explain initial observations and further observations are undertaken to distinguish between the hypotheses.

For scientists who formulate hypotheses, the sobering fact is that most of their hypotheses will turn out to be wrong. But that's not necessarily a bad thing. As Nobel laureate Frank Wilczek said, "If you don't make mistakes, you are not working on hard enough problems."

The process of developing an idea into a working hypothesis and building models to test the hypothesis can take years or even decades before it finally becomes an accepted theory. In the meantime, the evidence indicates that we should be more careful and use phrases like "The evidence indicates…" instead of "Scientists believe…" when describing the state of scientific understanding.

References

Quinn, H. 2007, Physics Today, January 2007, 8

Biography

Wallace Tucker, an astrophysicist, is science spokesman for the Chandra X-ray Center at the Harvard-Smithsonian Center for Astrophysics. He has authored or co-authored several non-technical books on astronomy, the latest of which is *Revealing the Universe*, written with Karen Tucker.