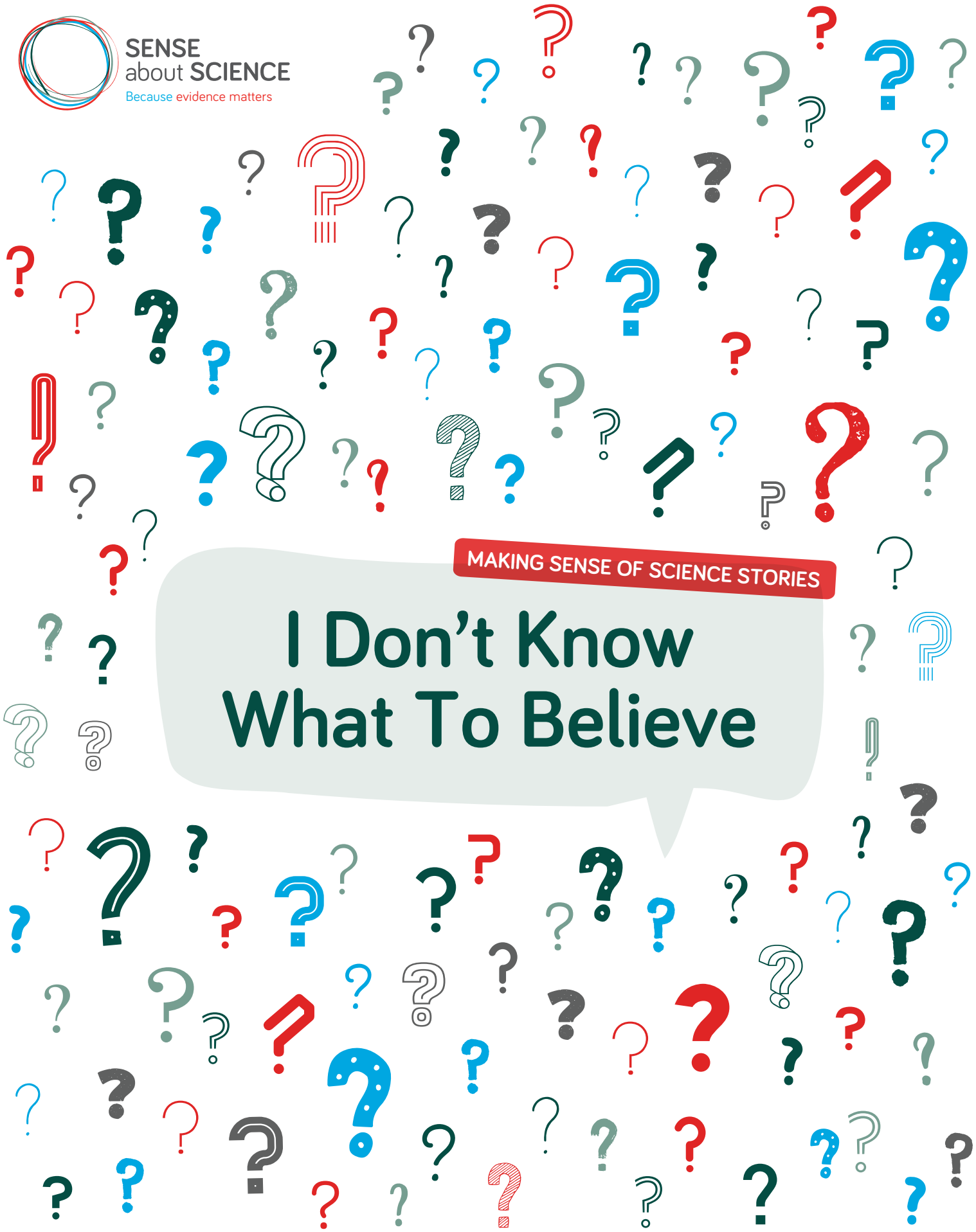
SENSE about SCIENCE
Because evidence matters

MAKING SENSE OF SCIENCE STORIES

I Don't Know What To Believe



This leaflet is for people who follow debates about science and medicine in the news. It explains how scientists present and judge research and how you can ask questions of the scientific information presented to you.

Summary

- Science has a system for assessing the quality of research before it is published. This system is called **peer review**.

- Peer review means that other scientific experts in the field check research papers for **validity**, **significance** and **originality** — and for **clarity.**

- Editors of scientific journals draw on a large pool of suitable experts to **scrutinise papers** before deciding whether to publish them.

- Many of the research claims you read in newspapers and magazines, find on the internet, or hear on television and the radio are **not published in a peer-reviewed journal.**

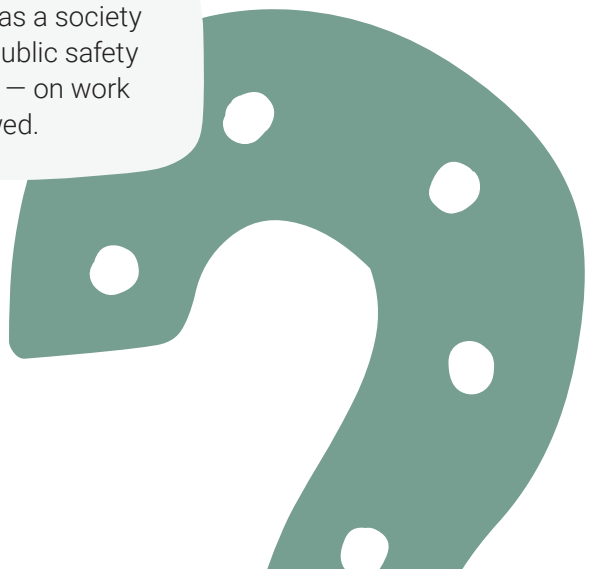
Some of this research may turn out to be good but much of it is **flawed** or **incomplete**. Many reported findings, such as claims about "wonder cures" and "new dangers", **never come to anything.**

- **Unpublished research is no help to anyone.** Scientists can't repeat or use it and as a society we can't base decisions about our public safety — or our family's health for example — on work that has a high chance of being flawed.

SO, NO MATTER HOW EXCITING OR COMPELLING NEW SCIENTIFIC OR MEDICAL RESEARCH IS, YOU MUST ALWAYS ASK...

Is it peer reviewed? If not, why not?

If it is peer reviewed, you can look for more information on what other scientists say about it, the size and approach of the study and whether it is part of a body of evidence pointing towards the same conclusions.



How should you make sense of science stories?

Every day we are bombarded with information about science from newspapers, radio and television programmes and the internet. Making sense of it all can be very difficult. What should be taken seriously? Which are 'scares'? Sometimes scientists are reported as saying conflicting things. **How do we know what to believe?**

There is a system used by scientists to decide which research results should be published in a scientific journal. This system, called **peer review**, subjects scientific research papers to independent scrutiny by other qualified scientific experts (peers) before they are made public.

Peer review can help you make sense of science stories as it tells you that the research has passed the scrutiny of other scientists and is considered **valid**, **significant** and **original**.

Peer review means that statements made by scientists in scientific journals are **critically different from other kinds of statements or claims**, such as those made by politicians, newspaper columnists or campaign groups. Science is therefore more than just another opinion.

A short explanation of peer review

When a researcher, or team of researchers, finishes a stage of work, they usually write a paper presenting their methods, findings and conclusions. They then send the paper to a scientific journal to be considered for publication.

If the journal's editor thinks it is suitable for their journal they send the paper to other scientists who research and publish in the same field.

What do scientists do when they assess a paper for peer review?

- Comment on its **validity** — are the research results credible; are the design and methodology appropriate?
- Judge the **significance** — is it an important finding?
- Determine its **originality** — are the results new? Does the paper refer properly to work done by others?
- Give an opinion as to whether the paper should be **published, improved or rejected** (usually to be submitted elsewhere).

This process is called **peer review**. The scientists (peers) assessing the papers are called **referees** or **reviewers**.

SCIENTISTS NEVER DRAW FIRM CONCLUSIONS FROM JUST ONE PAPER OR SET OF RESULTS

They consider the contribution it makes in the context of other work and their own experience. It usually takes **more than one research paper** for results to be seen as good evidence or accepted as a public truth.

The science publishing scene

For scientific knowledge to progress scientists need to share their research findings with other scientists. The main way they do this is by **publishing their research in scientific journals** — periodical publications intended to further the development of science by reporting new research.

Journal editors receive many more papers than they can publish, so they use a **two-step selection process**. First, they consider whether the paper is a 'fit' for their journals. For example, some journals only publish research papers that are groundbreaking; others only publish research in a specific area, such as microbiology.

If a journal editor decides that a paper is right for their journal, they send it for peer review to check whether the research findings are valid, significant and original.

Did you know?

There are around **28,000** scholarly and scientific journals that use the peer-review system. A high proportion of these are scientific, technical or medical journals, publishing over **1 million research papers each year.**

A NOTE ON JOURNAL FUNDING AND AVAILABILITY

Most journals receive their income from subscriptions and some from organisational subsidies, conference organising and advertising.

Most journals are behind paywalls, though many show abstracts of papers for free, or make the content free after a certain period. Other journal funding models are growing, including open access publishing, where scientists pay the costs of reviewing and publishing their articles so that they can be made freely available.

Publishing in a journal is an integral part of being a scientist it:

- **Connects like-minded individuals** and tells them about **new research**. A published paper is read by scientists all around the world.
- Is a **permanent record** of what has been discovered, when and by which scientists — like a court register for science.
- Helps scientists to **promote their work** and **gain recognition** from funders and other institutions.
- Shows the **quality** of the scientist's work: other experts have rated it as valid, significant and original.

BY THE WAY...

PEER REVIEW OF RESEARCH PROPOSALS

Peer review is also used to assess scientists' applications for **research funds**. Funding bodies, such as medical research charities, seek expert advice on a scientist's proposal before agreeing to pay for it. Peer review in this instance is used to **judge which applications are the best science** and have the potential to help the organisation achieve its objectives.

How can you tell whether reported results have been peer reviewed?

It can be difficult!

The full reference to peer-reviewed papers is likely to look like this:

Fellers J H and Fellers G M (1976) Tool use in a social insect and its implications for competitive interactions. Science, 192, 70-72.

or this:

Hedenfalk I, Duggan D, Chen Y, et al. Gene-expression profiles in hereditary breast cancer. N Engl J Med, 2001; 344: 539-48.

A few unscrupulous people use this style on websites and in articles to cite work that is not peer reviewed. But fortunately this is **rare.**

You are most likely to hear about new research where there is not space or interest in full references, but journalists should indicate if research has been published, and mention the name of the journal.

Research papers presented at scientific conferences have often begun a process of peer review but are usually still unpublished and preliminary.

The more we ask, 'is it peer reviewed?' the more obliged reporters will be to include this information. There is no definitive list of peer-reviewed journals but you can look up the names of selected peer-reviewed journals online at the science news service EurekAlert!

So scientists use peer review, so what?

When research findings have been peer reviewed and published in a scientific journal, this indicates that they are sufficiently valid, significant and original to merit the attention of other scientists.

Peer review is an **essential dividing line** for judging what is scientific and what is speculation and opinion. Most scientists make a careful distinction between their peer-reviewed findings and their more general opinions.

Sounds good, but what happens next?

Publication of a peer-reviewed paper is just the first step: findings, and theories about them, must go on to be re-tested and judged against other work in the same area. Some papers' conclusions will be disputed or further research will show that they need to be revised as more data are gathered.

Challenges for peer review

Why can't there just be a checklist of scientific validity?

Assessing scientific papers cannot be done in the same way as giving a car an M.O.T. or marking a maths test. New research usually has its own **unique features**, which are difficult to predict with a check list and which require **expert judgement** about their validity, significance and originality.

Is maverick science rejected through peer review?

Sometimes people worry that new ideas won't be understood by other scientists (although this is also an excuse given when researchers don't want to submit to the scrutiny of their peers). It is true that referees can be cautious about unusual findings; and important insights can initially be overlooked. But if someone has been exceptionally clever, other scientists are most likely to **recognise it** and to **distinguish it** from flawed or inflated claims. Journal editors like novel ideas and scientific publishing has brought **thousands of important discoveries to light.**

Does peer review detect fraud and misconduct?

Peer review is not a fraud detection system. Referees are likely to detect some wrongdoing, such as copying someone else's research or misrepresenting data, because they care about their subject. They know what research has been conducted already and the kinds of results that are likely. However, if someone deliberately sets out to falsify data, there is sometimes no way of knowing this until the paper is published and others in the scientific community scrutinise and try to repeat the work.

Does the peer review process slow down advances in scientific and medical knoweldge?

In our world of instant communication and 24-hour news, a deliberative process like peer review can seem frustratingly slow. Electronic communication has improved it, but good assessment of research does take time. Sometimes people justify the promotion of unpublished findings by saying they are 'too important to wait'. But, although some papers take months to review and improve, if there is a **major breakthrough** the process can be completed in weeks. Furthermore, if the findings are very important — e.g. they concern public health — then it is **all the more necessary to check them through peer review.**

Sources for further information

- **Ask for Evidence**

Sense about Science runs the Ask for Evidence campaign to help people request for themselves the evidence behind news stories, marketing claims and policies. www.askforevidence.org

- **Association of Medical Research Charities**

The AMRC has a page on peer review for medical charities. www.amrc.org.uk/our-work/peer-review

- **Committee on Publication Ethics**

COPE provides a sounding board for journal editors struggling with how to deal with breaches in research and publication ethics. www.publicationethics.org

- **NHS Evidence**

This evidence search provides access to selected and authoritative evidence in health, social care and public health. www.evidence.nhs.uk

- **The Science Media Centre**

An independent press office helping to ensure that the public have access to the best scientific evidence and expertise through the news media when science hits the headlines. www.sciencemediacentre.org

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www.senseaboutscience.org

SENSE about SCIENCE
Because evidence matters

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