Evaluating Helium

Learning Outcomes in Focus

Contextual Strand: CW 10

Students should be able to evaluate how humans contribute to sustainability through the extraction, use, disposal, and recycling of materials.

EVALUATE (ethical judgement) - Collect and examine evidence to make judgments and appraisals; describe how evidence supports or does not support a judgement; identify the limitations of evidence in conclusions; make judgments about ideas, solutions or methods.

Nature of science: NoS 10

Students should be able to appreciate the role of science in society; and its personal, social and global importance; and how society influences scientific research.

Learning Intentions

Students will learn to:

1. Examine evidence regarding the extraction, use and recycling of Helium.
2. Explain the impact of the extraction and use of helium on society and the environment.
3. Make judgements and describe how the evidence does or does not support these judgements.

Prior Learning

Students have used the Periodic Table and are familiar with the element Helium (are aware that it is an inert gas). Students have possibly encountered Helium in the use of party balloons.

An tSraith Shóisearach do Mhúinteoirí
Junior CYCLE for teachers

Student Activity Sheet

Should Helium party balloons be banned?

What do you think? Using the articles supplied, **examine the evidence to make a judgment** and decide how the **evidence supports or does not support your judgement.**

- In a group of 4 each person chooses a different **article to examine**.
- Make 3 or 4 main summary points on the article on an A4 sheet and **make a judgement on the question posed**, based on YOUR article justifying whether **the evidence supports /does not support your decision.**
- As a **group discuss** the summary points of each article and each judgement made with regards to the question posed.
- Taking all information into consideration can the **group come to a justified consensus** on a judgement to the question posed?

Points for discussion

1. Why is it important to look at many sources before making a judgement?
2. Why is it important to discuss with others your opinions and judgements?
3. What should society and scientists do now to help the sustainability of helium?

www.wired.com/author/brendan-cole SCIENCE 06.29.16

THAT DIRE HELIUM SHORTAGE? VASTLY INFLATED

The large Hadron Collider, a welder's workshop, a nuclear reactor, an MRI, and a birthday party all share a common element. Literally: All of them need helium. Liquid or gaseous, room temperature or near absolute zero, the world uses up about 8 billion cubic feet of this noblest of gases every year. And you may have heard that we're running out.

Which is why the discovery of a huge pocket of helium in Tanzania, revealed yesterday at a conference in Japan, has received so much press. Researchers from the University of Oxford found helium released from rocks by underlying volcanic heat, and they found a lot of it. There's at least 54 billion cubic feet of the stuff (enough to make everyone on Earth sound squeaky for about 20 minutes) and likely much more. That's just under seven times the annual global demand. But it's a reach to say that these researchers have resolved the global helium shortage—because there isn't one.

Earth does have a finite supply of helium. Gravity can't hold onto the tiny element once it's moving quickly in the upper atmosphere, so it escapes into space. And because it's small enough to slip through holes in rocks, helium would escape from Earth whether or not humans were sucking it up. Which they are—though it's not as easy as sticking a straw in the ground. While some helium is made naturally through radioactive decay, it's not a huge amount and it's generally spread out over the crust. So scientists have to look for natural pockets that are a millions or billions of years old.

If quickly using up supplies of a resource millions of years in the making sounds like a job for the fossil fuel industry, you're not wrong. Most of the world's helium comes from natural gas, where it can exist in very small quantities. A good source will be about 3 percent helium, but more often helium hovers between 0.1 percent and 0.5 percent—nothing compared to the relatively astronomical 10 percent pocket found in Tanzania. But worldwide, helium is about a thousand times less lucrative than gas, so even though removing (inert) helium makes the gas burn better, companies don't usually bother to take it out. "Normally, it's an afterthought," says Samuel Burton, assistant field manager at the Federal Helium Program. "It's something that they don't even consider because the natural gas makes so much more money for them."

When helium's price goes up—like it has for most of the past few years—natural gas companies are incentivized to sell extracted helium on its own. Countries like Qatar mine so much natural gas that even though it has relatively little helium, they can crank out a decent percentage of the world's demand as an afterthought.

Most of the remainder currently comes from the Federal Helium Program's underground tanks in Amarillo, Texas—though that's changing. The US government started stockpiling

helium back in the 1920s (when blimps were a viable wartime strategy) but they really got serious about it in the 1960s. “From ’62 to about ’75, they purchased about 34 billion cubic feet of crude helium,” Burton says. They’ve sold most of that off over the last 20 years or so, with the aim of closing their doors in 2021. Inconsistent and last-minute legislation about the rate of the selloff has helped to drive helium prices up over that time.

Increased prices usually mean lower supply, but that’s not true for this gas. “There is actually so much helium that’s flooding the market that it’s not in short supply at all,” Burton says. And as for the future, “I’ve seen a lot of talk about this global shortage of helium—that’s actually not the case. In the United States, we’ve got at least 20 years of known supplies that are easily, readily available.” There’s far more worldwide—including now this new rich deposit found in Tanzania. In 2014, the US Department of Interior estimated that there are 1,169 billion cubic feet of helium reserves left on Earth. That's enough for about 117 more years.

Helium isn’t infinite, of course, and it remains worth conserving. Many research labs, for instance, have developed ways of catching and recycling helium instead of letting it escape through cracks in (or just the outlet of) their experiments. But next time you see someone with helium balloons, don’t berate them. Enjoy the party instead.

Massive 'Life-Saving' Helium Field Just Turned Out to Be Far Bigger Than We'd Hoped

No more helium shortage!

MICHELLE STARR 10 OCT 2017

A big helium deposit was found in Tanzania last year. Scientists today say that there may be even more gas than they thought.

At the time they estimated that they had found at least 54 billion cubic feet (1.5 billion cubic metres) of Helium. How much is that? Well the US has total known helium reserves of 153 billion cubic feet.

Now, according to new measurements taken of the helium, there could be a lot more. Around 98.6 billion cubic feet, according to Thomas Abraham-James, CEO of helium company Helium One.

"It's pretty much doubled in size," he told Live Science.

There is a global helium shortage. This affects a lot more than party balloons.

Helium is used to cool the magnetic resonance magnets in MRI machines. Helium is used also as a coolant at the Large Hadron Collider. NASA uses helium in rocket fuel. Helium used as a carrier gas in gas chromatography and spectroscopy.

The new estimates were based on new measurements. These were taken by University of Oxford geologists Peter Barry and Chris Ballentine in 2016. The first methods used in 2015 for the initial estimate allowed air into the sample. This made the density of helium read incorrectly.

"Detailed macro seep gas compositions shows the deep gas to contain between 8-10 percent helium. This significantly increases the resource estimates which were based on uncorrected values," wrote Barry and Ballentine. This was in an abstract of a paper they presented in August at the 2017 Goldschmidt Conference.

The initial samples contained an average of 2.6 percent helium. To calculate these the samples were collected in the field. They were then taken back to laboratory for analysis. For last year's survey, Barry and Ballentine used a portable mass spectrometer.

"We made about 50 measurements out there in the field. We saw up to four times as much helium in these samples," Barry said. "This was really exciting for us. We were able to show that there is a lot more helium than we thought."

The deposit found last year could turn things around. It is very big. They used new ways to uncover it.

The research team found that volcanic activity releases helium from pockets close to the surface of the Earth. Once they had this information, they went looking for a helium deposit. They found it.

At the time the discovery was announced, Ballentine said that 54 billion cubic feet was enough to fill 1.2 million MRI machines. The new estimate of 98.6 billion cubic feet could fill 2.2 million.

And, according to Abraham-James, that estimate is conservative.

We are still underestimating how much is present That gives us room to update and improve as we progress," he said.

Why We Are Running Out of Helium And What We Can Do About It

Are we really running out of helium? originally appeared on *Quora* - the knowledge sharing network where compelling questions are answered by people with unique insights

Answer by Inna Vishik, physicist, on Quora.

Yes, we are running out. Everyone uses products of the many industries that require helium, and there is no way to cheaply make more.

Many people do not realize that helium is a non-renewable resource. It is made on earth via nuclear decay of uranium, and it is recovered from mines. Once it is released into the atmosphere it becomes uneconomical to recapture it, and eventually atmospheric helium will *escape earth altogether because it is so light.* This is an issue that many people outside the industries that use helium are unaware of, but one that will eventually affect them nonetheless.

In response to the element's scarcity, the United States has been stockpiling helium since the 1960s in a National Helium Reserve called the Bush Dome, a deep underground reservoir outside of Amarillo, Texas. By the mid-1970s 1.2 billion cubic meters of the gas was stored there. The current reserve is approximately 0.6 billion cubic meters, or roughly 4 times the current world market.

But, Chan notes, in 1996 the Helium Privatization Act mandated that the Department of the Interior sell off all the stockpiled helium by 2015. "As a consequence," he says, "the United States government is selling the equivalent of 40 percent of the world market of helium at a below-market price."

"This action discourages the active exploration of helium," Chan explains

Source: Probing Question: Are we running out of helium?. A few months after this article appeared, congress passed a bill to maintain the reserves.

There is focus on the negative impact that bad policy has on *scientific* users of helium, but I want to emphasize that *there are many other uses of helium in industry and medicine*, and a few are listed below*:*

- Helium is used as a cryogen to cool down superconducting magnets for **MRI machines**. This is the largest use of cryogenic helium. *This is one application where another cryogen can eventually be substituted because there are several new superconductors that can produce the required magnetic field when they are cooled with higher-temperature cryogens like liquid hydrogen, oxygen, or neon. However, I doubt that hospitals and MRI machine manufacturers will make this move anytime soon.*
- Helium is used as an inert gas for **welding**. In these applications, I think *they could substitute another noble gas if we were to run out of helium.*
- Helium is used in the semiconductor industry as an inert gas for growing semiconductor crystals, to quickly cool components, and to control heat transfer.
- Helium is used for leak detection to test containers which will be subjected to high pressure or low vacuum for cracks. *This is an application which another gas cannot be substituted, at least for extremely high and extremely low pressure, because helium can flow through the smallest cracks.*

The scientific community is perhaps most vocal about this shortage because:

1. Many scientific experiments require liquid helium because it allows scientists to reach the lowest temperatures of any cryogen. Low temperature is often required to observe quantum mechanical phenomena cleanly. *There is no substitute for this application.*
2. Research institutions are often lower priority when there are shortages. I have had many experiments delayed because we could not get liquid helium for weeks, and this is a fairly normal experience.

What we can do:

- Implement sensible helium exploration/storage policy such that mining companies are compelled to extract this resource and users are not subjected to erratic cost/supply. In 2013, the US congress approved a bill to maintain the reserves and not sell helium at below market rate. This makes for a steadier supply, but does not change the fact that this resource is *not* renewable.
- Limit wasteful use of helium, and **recycle** that which we do use. For cryogenic applications, this means installing a closed re-circulation system to re-compress helium which comes out of the exhaust of a cryogenic system. For large-scale users such as the LHC, this has always been the operating procedure. However, with the recent cost hikes and supply disruptions, individual research labs are beginning to implement such systems as well (including the lab where I work). The startup costs are huge (over $100K), but the cost savings emerge in just a few years, and the convenience becomes apparent immediately. In the future, I think (and hope) that such systems will *not be optional* for research and medical users of liquid helium.

What we can't do:

We cannot produce more helium once it is all extracted from the earth. All methods to *produce* more helium are so ridiculously costly that they are not worth discussing: 1) hydrogen fusion 2) bombarding other atoms (such as lithium or boron) with energetic protons in a particle accelerator 3) mining it on the moon is a ridiculous proposition in terms of the volumes that are needed to be transported back to earth (mining Helium-3 on the moon is probably economically viable however). In that sense, the problem of running out of helium is different from the problem of running out of petroleum. For the latter, people can and do synthesize alternatives such as ethanol fuel, not to mention the myriad non-carbon-emitting energy options out there.

However, for many applications where helium is used, *there is no alternative to helium*.

Edit: In 2008, 78% of the world's helium was extracted in the US and the US has historically supplied most of the world's helium, which is why I presented such a US-centric answer to a question about a global problem. A substantial fraction (25%) of the remaining un-mined helium is in the Persian Gulf.

theguardian

Should we ban helium balloons?

No Christmas party is complete without them. But helium has vital medical uses – and there's only a limited amount left.

Homa Khaleeli

Tuesday 11 December 2012 17.23

Helium balloons ... soon to be a thing of the past? Photograph: Philippe Lopez/AFP/Getty Images

If Christmas feels a bit flat this year, perhaps we should be blaming Peter Wothers. The Cambridge University chemist is calling for a ban on helium balloons, claiming we should not be wasting such a precious gas on the party decorations.

Not even the joy to be had in inhaling the gas to make our voices sound squeaky is enough to deflate the scientist's objections – he insists our limited resources should be used for other admittedly more pressing functions of cooling magnets in MRI scanners, or helping new-born babies to breathe.

Wothers will be calling for an end to helium balloons when he gives the Royal Institution's Christmas lecture this year, calling the scarcity "a really serious issue". "I can imagine that in 50 years' time our children will be saying: 'I can't believe they used such a precious material to fill balloons,'" he says.

And he's not alone – other scientists have warned that helium is becoming so scarce that research that makes use of its cooling power may have to be limited or stopped. Although it is the second most abundant element in the universe, helium cannot be manufactured, and once released into the atmosphere is lost for ever. Most of our supplies are extracted from the earth's crust in the US. In the 1920s the country started stockpiling helium, before eventually selling this off in the 1990s, causing prices to plummet.

Now prices are on the rise again – but Professor Robert Richardson, of Cornell University, New York, who won the Nobel physics prize in 1996 for his research on helium, argues that a helium party balloon should cost £75, to more accurately reflect the true scarcity value of the gas.

The Balloon Association, however, is still fighting for the right to supply party balloons. They argue the impure helium gas used for balloons is not the same as the liquid helium used for the MRI market, and is a by-product of supplying liquid helium. As demand for the gas increases, it will become more worthwhile for companies to start extracting it, they say. What's more, they argue, balloons don't take up that much of the available supply. "A reasonable estimate is that latex 'party' balloons and their foil equivalent account for between 5% and 7% of the total helium usage."

Wothers, however, hopes his young audience will appreciate the importance of preserving stocks of the gas. "But," he says, "with helium easily available on huge retail websites, there is still a long way to go."