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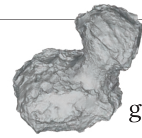

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Graduate axe

PhD students in the United States could soon face an alarming cut in their disposable income, thanks to a bill that would force them to declare waivers in tuition fees.

Doing a PhD is a classic exercise in delayed gratification. While classmates enter the workforce and start putting money into retirement plans, students who enrol in graduate school face many years of long hours, teaching requirements and weekends running experiments that can't wait. Someday, perhaps, an advanced degree will land them a more lucrative and rewarding job.

Meanwhile, none of that work is well compensated. In the United States, according to the US Department of Education's latest data, from 2011 to 2012, more than half of graduate students make less than US$20,000 a year. For reference, the federal poverty line for a single person without children is $12,060. Living in an expensive region such as Boston, Massachusetts, or the San Francisco Bay Area in California is especially tough. For example, graduate stipends at the US National Institutes of Health (NIH) are capped at $23,844 and are not adjusted for cost of living. To help out, universities often waive tuition fees, which can sometimes be more than a student's income.

The last thing that graduate students need is a tax hike. But that is what many would face under a clause in the federal-tax-reform bill passed by the US House of Representatives last week. It will now need to be reconciled with the Senate's tax-reform bill (which retains many existing student tax benefits), and signed by the president.

The 429-page tax plan — which President Trump reportedly tried to christen the "Cut, Cut, Cut Act" because it would ostensibly shrink taxes for many — would require students to report tuition-fee waivers as taxable income, moving the students into a higher tax bracket. Graduate students, who receive the lion's share of tuition waivers, would be most affected. And 60% of the 145,000 students who get tuition reductions each year are working in science, engineering, technology and mathematics fields, the US Department of Education estimates.

The amount of money that the government would reap from these taxes would be minuscule, given the $20.5-trillion national debt. But it could weigh heavily on young scientists. Take a hypothetical PhD student at the Massachusetts Institute of Technology (MIT) in Cambridge, in receipt of a $23,844 NIH stipend. Under the current system, she would pay very little in taxes. The new law would add her $49,000 MIT tuition bill to her taxable income as though she were paid a $73,000 salary — an amount she never actually sees. This would add thousands of dollars to her tax burden.

This example is extreme — most graduate schools' tuition fees are closer to $16,000 — but it is safe to say that many students could see their tax rate rise. Students who attend public universities outside their home states would be especially hard hit: out of state, tuition can cost double what it does in-state. The bill would also eliminate a tax benefit that allows people with low incomes to deduct student-loan interest from their taxable income.

Higher taxes could be one more disincentive to pursuing an advanced degree, given the already bleak prospects in an oversaturated academic job market and the flat budgets at science-funding agencies. The prospect of a steady income in a less-skilled job might seem that much more attractive to a new graduate than years of even greater penury. The loss of talented graduate students would be a blow to universities and industries that depend on scientists with higher degrees, and to science overall.

The Trump administration and other Republicans in Congress are probably not trying to discourage graduate study or undermine science. The goal of the bill's authors is to maintain revenue while lowering taxes on businesses; universities are just one of its targets. Students and other people who are above the poverty line, but on low-to-middle incomes, are likely to shoulder much of the burden.

> ***"The provision is indicative of the growing disregard for intellectualism and expertise."***

Still, the provision is indicative of the growing disregard for intellectualism and expertise that has become prominent among policymakers in recent years. Rhetoric about valuing US competitiveness and entrepreneurship is undermined by actions that do not account for the realities of how those dreams are achieved.

The current effort to overhaul the US tax system, if successful, would mark the first major tax reform since 1986. It is no doubt an excruciatingly complex task, and nothing that lawmakers produce will be perfect. But if the result penalizes bright, underpaid young people, what will be "cut, cut, cut" will include the positive economic and social impact of scientific research in the United States. ■

Picture perfect

A Nature journals guide to drawing structures should aid expert and casual chemists alike.

Think back to those organic-chemistry classes at school. Did you draw a benzene ring as a hexagon that contained a circle, to represent its delocalized clouds of electrons? If so, you are showing your age. Convention these days is a depiction containing three double bonds.

How molecules are represented is important. It is a worry when the literature contains ugly or inconsistent versions. So this week, the Nature journals launch two tools to help both expert and casual chemists (see go.nature.com/2zvoeza). An updated chemical structure guide details how authors should draw molecules. And an associated template enables them to do so in the program ChemDraw. (Both can be found in each journal's guide to authors.) Our goal is to make the creation of figures much simpler, especially for those working outside their core discipline.

Appearance and aesthetics play a significant part in chemistry. Organic chemists often describe their strategies to make natural products or pharmaceuticals as 'elegant' or 'attractive'. Robert Burns Woodward, winner of the Nobel Prize in Chemistry in 1965, noted that the creative challenge that synthesis offers would see it endure as long as people "write books, paint pictures, and fashion things which are beautiful, or practical, or both". And as French chemist Marcellin Berthelot put it in the nineteenth century, "chemistry creates its own object" — conjuring an image of a molecular artist.

This attitude goes hand in hand with a science that is primarily drawn, not written. Take benzene. In 1858, chemists August Kekulé and Archibald Scott Couper independently suggested the concept of a chemical structure that links carbon atoms. The invention thereafter of a symbolic language showing how the various atoms are connected gave chemists a way to show what was going on in their flasks. Famously, Kekulé had a vision in which he saw the ouroboros — a snake biting its own tail — giving him the idea for benzene's ring structure. Since then, there have been many modifications to how structures are represented, as our understanding of electrons, covalent bonding, quantum mechanics and molecular shape have evolved.

Equally important is presentation. And as the molecules that can be made become ever more complex, we need updated design principles. Fraser Stoddart at Northwestern University in Evanston, Illinois, who won a share of the Nobel Prize in Chemistry last year for his role in creating molecular-sized machines, is noted for his use of colour in his papers to represent different parts of a molecule. These illustrate the various atomic-scale pumps, switches and knots with cartoons that link to the chemistry involved. Some chemists are more creative artists than are others.

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So, more than simply standardizing how chemical structures look in Nature journals, we hope that our guide and template will help researchers to depict the complexity of life's molecules clearly. For those unfamiliar with the drawing software, this template will do the work, as well as avoiding chemical impossibilities such as 'Texas' carbons (named for their resemblance to the emblem of the Lone Star State). Everything is already in Nature style and to scale, so the tools mean less work for authors and editors alike. We offer them, not to dampen flair, but to make it easier for all to draw chemical structures with minimal fuss. Now go create! ■

Beamline boost

China should make the most of opportunities provided by its powerful neutron source.

In 2009, China opened what was at the time its costliest piece of scientific infrastructure — a 1.2-billion-yuan (US$176-million) synchrotron light source in Shanghai.

The facility put China in an elite club, and produced impressive results, such as revealing the structure of proteins that allow mammalian brain cells to get fuel from glucose, and the plumage structure of birds' dinosaurian ancestors. More than 20,000 scientists have been involved in projects there.

But it should be doing more. When it opened, its designers promised that 30 beamlines would be feeding experiments within 5 years. Now, 8 years later, there are only 13.

Building facilities of this size and complexity brings headaches for a variety of unpredictable reasons; and the frustrations don't end when the last door is on its hinges. For example, a deputy director at the Shanghai synchrotron told *Nature* that difficulties in arranging investment from various funding agencies had delayed the addition of new beamlines. (He says that this is now taken care of and that there will be 18 more beamlines over the next 5 years.)

Another scientific resource in the country, the China Advanced Research Reactor, reached criticality in 2010 and full power in 2012. But scientists have told *Nature* that the facility is not operating, and that specially built instruments sit unused. (The China Institute of Atomic Energy, which oversees the facility, did not respond to *Nature*'s request for an update.)

Now there is the new 2.2-billion-yuan China Spallation Neutron Source (CSNS). The facility, which started producing neutron beamlines in August and is readying instruments to start experiments by early next year, merits an enthusiastic welcome. It will be one of just a handful of neutron spallation sources around the world — facilities that deliver dense beams of neutrons, which can be used, like X-rays from synchrotrons, to examine the inner workings of various materials but with certain advantages (see page 284). It promises a bonanza of both fundamental and commercially oriented achievements, in fields ranging from materials science and Earth science to palaeontology.

It is also part of a bid to develop southern China as an alternative science base to Beijing and Shanghai. The CSNS is in Dongguan, sandwiched between the business hubs of Guangzhou and Shenzhen, an area known more for manual labour than for cutting-edge physics.

Building science capacity in southern China is a noble idea. It is also where the problems start. The complexity of making and operating the CSNS beamlines and instruments requires expertise applied day-to-day. Most of China's neutron-source experts are still in Shanghai or Beijing and only dart in and out of Dongguan, sometimes leaving postdoctoral researchers to keep the development of their instruments moving forward.

The facility would do well to hire more-senior people from China or other countries to stay permanently. But Dongguang lacks the cosmopolitan attraction of Beijing or Shanghai, so the facility's managers need to contemplate offering comparatively high salaries or other enticements. Younger researchers could also be cultivated to fill the gap, possibly by first sending them abroad to long-established neutron facilities, something for which funding agencies might be able to set aside money.

The many new universities in the region could also hire more researchers in related fields, to pull in the much-needed human resources — this world-class facility could put them on the map. Several are already doing this, but there is room for more such activity. The CSNS, for its part, should create a strong outreach programme to inform potential users in China and globally of the facility's capabilities.

China also needs to be more flexible in its equipment purchasing rules. Procurement guidelines at the CSNS favour domestic companies. However, requiring instruments to be built with Chinese parts, when tried and tested versions are available overseas, can slow construction and compromise quality.

Some scientists have already registered their frustration that only three instruments are being readied for the facility's experimental debut when there are some 20 beamline slots available. More instruments are coming, and China's science ministry, the Chinese Academy of Sciences and the National Natural Science Foundation of China should support the building of human resources to make the most of the facility.

The CSNS is important for other countries, too. There are scientists around the world who want access to its projects. As science funders everywhere scrutinize the costs and benefits of new science facilities, China's neutron users should encourage colleagues abroad to help demonstrate that such investments are worthwhile. ■