and institutions, but it is far from a comprehensive list of implicit expectations. Specific aspects of the hidden curriculum may be more or less relevant for different disciplines or regions of the world. We therefore urge faculty and staff to examine the hidden curriculum of their own graduate school experiences and to recognize how they may have benefited from knowledge of, or cultural familiarity with, this curriculum.

Once the hidden curriculum is brought to light, it needs critical examination: are the cultural norms arbitrary, unnecessary barriers to participation that can be removed, or are they a crucial aspect of professional development that should be explicitly taught? As the hidden curriculum has a disproportionate effect on marginalized students, failure to address this aspect of graduate education means we will continue to disadvantage and isolate promising and important students. All faculty and staff must leverage their institutional power to confront traditions that reinforce exclusion in academia[6]. We advocate for robust professional development curricula that educate beyond the tangible and practical to provide an even playing field for all. ❐

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Competing interests

The authors declare no competing interests.

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First-year graduate courses foster inclusion

To the Editor — Recent studies have highlighted the lack of racial and ethnic diversity in geoscience[1] and the failure to increase diversity of students earning geoscience PhDs in the United States for more than 40 years[2]. In response to this crisis, programmes are working to expand diversity through graduate recruitment efforts[3]. However, our discipline will not become more diverse without making our graduate programmes more inclusive and sustainable for those who enter them. As part of our inclusive practices, we, as US professors and mentors of graduate students, have built courses for first-year graduate students that seek to make transparent the tacit knowledge needed to succeed in our discipline[4], sometimes called the hidden curriculum of graduate school.

Thriving in graduate school and preparing for the next career stage requires skills and strategies that many students have not learned through previous experiences. If underprepared, a bumpy transition to graduate school can derail students and erode their sense of belonging, leading to student attrition (Fig. 1).

The responsibility to guide new students through the adjustment to graduate school defaults to their advisors. In reality, advisor guidance varies widely and advisors are vulnerable to survivorship bias[5]; the assumption that everyone will learn, grow and succeed in the same way they did may limit advisors' ability to provide needed support for students unlike themselves. Leaving students to work things out on their own promotes further inequity. Many advisors might not have open discussions with their advisees on topics such as the impact of imposter syndrome, authorship expectations, time management, funding plans, conflict management, the norms of the department or institution, mentoring needs and implicit bias. These are among the many topics that we discuss within our first-year graduate courses in order to better equip students to successfully navigate graduate school. By providing the same information to all students, these courses promote equity and inclusion.

Although semester-long orientation programmes are recognized as the most effective approach for introducing students to graduate school and improving retention[6], fewer than 20% of surveyed US graduate schools offer an orientation programme longer than one day, with over 50% providing just a half-day orientation[7]. We recommend that geoscience programmes include professional development content in their graduate curricula that is specifically tailored to the geosciences and the department culture; an approach that has worked well for our US-based graduate programmes, which often already have some course requirements.

Geoscience-specific training allows discussion of issues that would not be approached within a general graduate-school orientation. For example, it should include discipline-specific barriers to diversity and inclusion[1], field safety[8], research ethics pertaining to sample/data collection and storage[9], and collaboration with local communities in the regions we study[10]. Another important benefit of departmental courses is that new students explore these issues together and develop a supportive cohort that they can turn to throughout the rest of their time in graduate school. If effective, the cohort-building facilitated by a first-year graduate course encourages students to forge connections across research groups and has the potential to increase retention of historically marginalized people. Students from marginalized groups including, but not limited to, first-generation college students, Black, Indigenous and people of colour, women, disabled people, international students and the LGBTQIA+ community of lesbian, gay, bisexual, transgender, queer, intersex and asexual people are especially vulnerable to attrition due to advisor conflict, misunderstandings about expectations, and/or feelings and experiences of exclusion[11]. Courses for

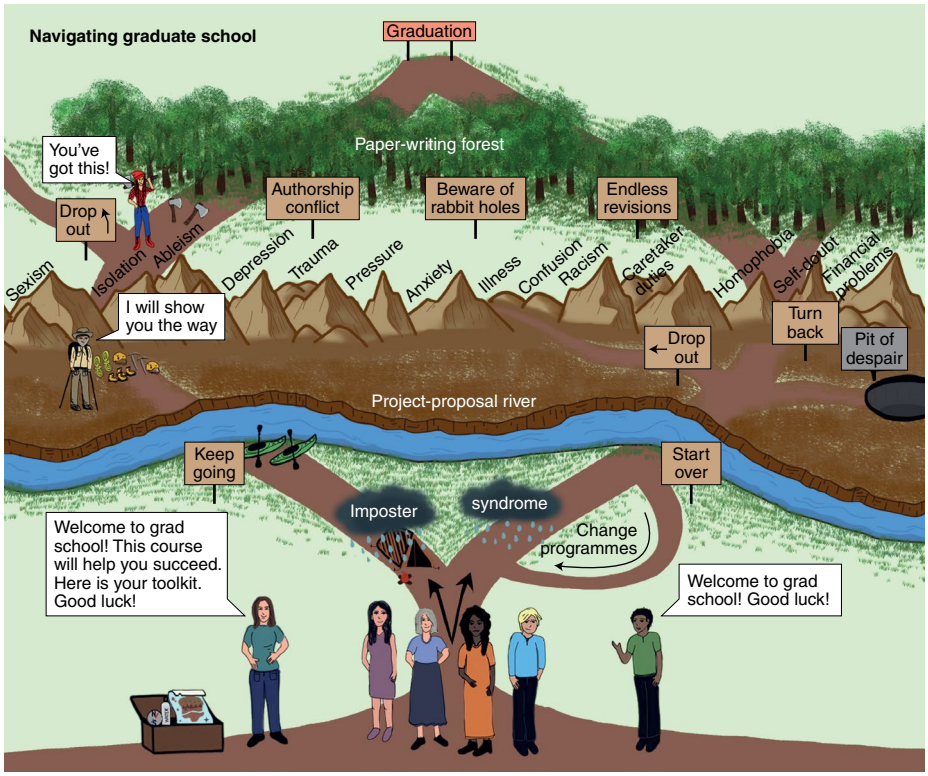

Fig. 1 | Navigating graduate school. The left-hand path is an example where graduate students are supported and guided through the challenges of graduate school. By contrast, without support, training, and appropriate skills and tools, the right-hand path appears impenetrable even to those with a map. Image: Makenzie Kerr.

first-year students that expose the challenges of graduate school and the implicit knowledge of our field can help students build strategies for success and facilitate cohort building that may improve our retention efforts.

First-year graduate course content should be flexible and tailored to the needs of each cohort and department. Because students have varying degrees of mentoring both before and during graduate school, any course will present ideas and strategies that are completely new to some students and well known to others. For example, international students may be new to the local education system. By presenting a variety of perspectives, course discussions may affirm their advisor's mentoring or provide alternative approaches that enrich student understanding. For similar reasons, first-year graduate courses benefit from having more than one instructor. Our courses create spaces where students and instructors together share knowledge and fill in mentoring gaps among students.

While geoscientists have many resources on training graduate students as teachers and communicators[12,13], we have found few discipline-specific resources for navigating graduate school. Furthermore, most resources on graduate-student professional development in geoscience focus on academic career preparation[14]. A course for entering graduate students that reveals common obstacles and provides dedicated time for cohort building promotes equity and inclusion by communicating the unstated norms of our programmes, providing resources and strategies to address potential challenges, and improving sense of belonging. As a result, geoscience programmes that offer first-year courses for graduate students may benefit from greater student success and retention. As we actively work to improve our own courses, we urge other faculty to develop similar courses as part of their inclusivity efforts. Readers interested in learning more can see the National Association of Geoscience Teachers Geoscience Graduate Curriculum resources[15]. ❐

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Competing interests

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