

# The Groundwater Project

## Progress & 2023-2028 Vision and Plans

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### The need

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Groundwater makes up 99 % of all liquid freshwater and is essential for sustaining biodiversity, food production, and climate adaptation. Although the future of humanity is closely tied to groundwater, there is a fundamental deficiency in the capacity to recognize, assess and solve groundwater problems. Groundwater science is a distinct discipline, requiring specialized knowledge and solutions that are at the core of freshwater. Decision makers and the public have been given insufficient exposure to this knowledge, which is needed to make informed decisions about the water resources. Furthermore, enhanced public knowledge will empower citizens and water stakeholders to take informed, local action on water issues. There are many factors that contribute to this situation of lack of groundwater knowledge and awareness, but the most important one is the widespread lack of opportunities to learn about groundwater, its problems, and solutions and how groundwater relates to food, energy, biodiversity, climate resilience and poverty. The Groundwater Project was initiated in 2017 to bridge the groundwater knowledge gap and provide free opportunities to learn about groundwater.

### Our Approach

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The Groundwater Project (GW-Project) *promotes groundwater learning: making the invisible understandable*. The GW-Project is driven by the philanthropic work of more than a thousand volunteers with new volunteers added regularly, with exceptional groundwater expertise from scientists and practitioners from more than 44 countries. Books published by the GW-Project present high quality synthesized scientific knowledge that should be taught and learned at the university level with knowledge that groundwater professionals need to understand. To achieve global reach, books are: (1) translated in many other languages; and (2) provided freely for downloading or online reading ([www.gw-project.org](http://www.gw-project.org)). Books are published in four categories: (i) *children's book*; (ii) *introductory books for the wider audience*; (iii) *overview books*; and (iv) *specialized books*.

Books are written according to the *GW-Project's 8 tenets for book writing and illustrations* which have a strong emphasis on creating engaging books with an emphasis on visualizations. Because groundwater problems are three dimensional puzzles that occur within a geologic host in space and vary in time, spatial learning is emphasized through visual content of exceptional quality.

### Our Progress

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Many advancements were made in the first 5 years of the Project (2017-2022) with the publication of 28 books, beginning with the first book in August 2020. Starting in 2023, there are 30 more books nearing completion and 200 in preparation. The time it takes for a book to move from conception to completion ranges from 1 to 4 years. In addition, the GW-Project has republished 10 books and one Children's book.

## Metrics of our Success

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There have been more than 125,000 book downloads (PDF) across 174 countries. Currently, GW-Project books are being translated into 44 languages with 118 book translations underway; 33 book translations have been published to date, including translations of republished books.

Furthermore, the *key accomplishments* off this first phase have been the strong endorsement of the volunteerism vision by the global academic and professional groundwater community along with the groundwater industry that provides the expertise and funding that have been essential for the proof-of-concept phase, and current operations.

## Our 2023-2028 Vision

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The vision for the next 5 years is much expanded for which additional and continuous funding is needed:

1. The books portfolio is being expanded to *cover all the essential subject matter* needed to understand and address groundwater problems in professional practice (e.g., solving groundwater problems in an interdisciplinary context and water management); this includes specialized books on a wide range of groundwater topics and interfaces with other disciplines.
2. In concert with Item 1, developing and publishing a series of practical *how-to-do-books* and books at the interfaces of groundwater science with important societal issues such as those at the water/food/energy nexus including hydraulic fracturing (oil and gas industry), CO<sub>2</sub> capture/storage, radioactive waste disposal and various types of groundwater pollution, and with other expertise domains including, among others, geotechnical engineering, mining, ecology, law, economics, water management, and human health. An example is the GW-Project book published on land subsidence and its mitigation in 2021.
3. *Road maps* will be prepared to navigate course instructors through the content of the GW-Project books to identify the elements most suitable for each of several types of courses with allowance for a variety of course objectives and student backgrounds.
4. Expanding the portfolio of books on *hydrogeology of each of the globally important types of geologic terrain* including sandstone/shale, basalt, crystalline rock, carbonate rock (non-karst), glaciated terrain and clayey aquitards, and with other groundwater books focused on *deserts, tropics, islands and mountains*. This is important because the nature of groundwater systems in any particular area or region is tied closely to which of these categories is dominant. Karst is soon to be intensely covered with two books already published, four more books coming soon, and more on karst planned.
5. A series of books will be prepared aimed at those with a *high-school level education, for high school teaching and for a broad readership*. The focus of these books is on explaining concepts without use of complex theory on physics, chemistry, and mathematics. These books will also be very suitable in university courses where visual and conceptual thinking is the focus with only rudimentary calculations.

6. Books and video lectures aimed at *assessing and explaining the state of the planet and humanity from a groundwater perspective*, as for example the lecture by John Cherry, *The Global Food Water and Poverty Paradox: Pumping Too Much and Pumping Too Little*. This endeavor includes topics such as groundwater within sustainable agriculture, the groundwater component of food /virtual water, determining global groundwater depletion, the groundwater contribution to the atmospheric CO<sub>2</sub> budget, the tipping point concept in a groundwater context and a pillars framework for assessing the state of the planet.
7. *Expanding on short books tailored towards young children and elementary school levels*. For example, the GW-Project has in its portfolio *Wally & Deanna's Groundwater Adventure to the Saturated Zone*, a very successful Children's book which has been translated by the GW-Project into more than 20 languages with more to come.
8. *Engagement and collaboration with indigenous communities* on translations of GW-Project books and incorporation of topics addressing groundwater issues pertinent to indigenous communities. For example, in Canada, First Nations communities have recurring challenges around safety and reliability of their water supplies. In some communities, groundwater and domestic wells may be a more appropriate water supply.
9. Increasing the number of previously published hard copy *books of enduring excellence*, which will be made available in pdf format on the GW-Project website. For example, the Freeze-Cherry 1979 book is already available at our website. The aim of making these books available is for students to study explanations from the intellectual leaders of previous generations.
10. The compilation of *knowledge and preparation of learning materials* aimed specifically at developing countries. There is a large deficiency in accessible groundwater knowledge for solving the most pressing groundwater problems in developing countries, which generally are much different from those in the developed countries. For example, there is little capability concerning groundwater in the various organizations responsible for water supply, water management and health in the developing countries. Groundwater is often the only source of water in developing countries and so appropriate information needs to be provided to stakeholders with an emphasis on hydrogeology and well drilling methods combined with terrain analysis for enhancing drilling success, rainwater harvesting and family scale food production in rural areas to alleviate poverty. Inclusion of manual drilling and lowest cost engine-driven machines and engagement of local communities are essential.
11. Developing *interactive learning modules* in conjunction with its original online books to facilitate conversion of knowledge to understanding and thus to improve the learning outcomes. These tools are multimedia-based which, compared to conventional textbook-based learning, better resonates with the new generation of learners, is more flexible than books, and allows for a global reach because the tools and modules are available online. The learning modules are not exclusively for self-learners, but also for integration with classroom lectures. The self-learning modules will be available online at no cost for everyone, everywhere with access to internet and a computer and/or mobile device.