some detail, along with other important factors, such as private patronage from wealthy figures who were unhealthily obsessed with the hypothetical phenomenon of antigravity.

The renaissance of general relativity provides a rich case study for thinking about fundamental problems of scientific change. How are theories used and not used? What is the difference between healthy and withering research programs? Can the resurgence of a theory be explained by new observational discoveries? Technological advances? Individual personalities? Social and political developments? The book is a great cross section of those different approaches, which will make it valuable to scholars in history and sociology of physics—although it might set a fairly high methodological barrier to entry for nonspecialist readers. Nevertheless, *The Renaissance of General Relativity in Context* will quickly become a classic in the history of the field, and it will perhaps spur new research programs of its own.

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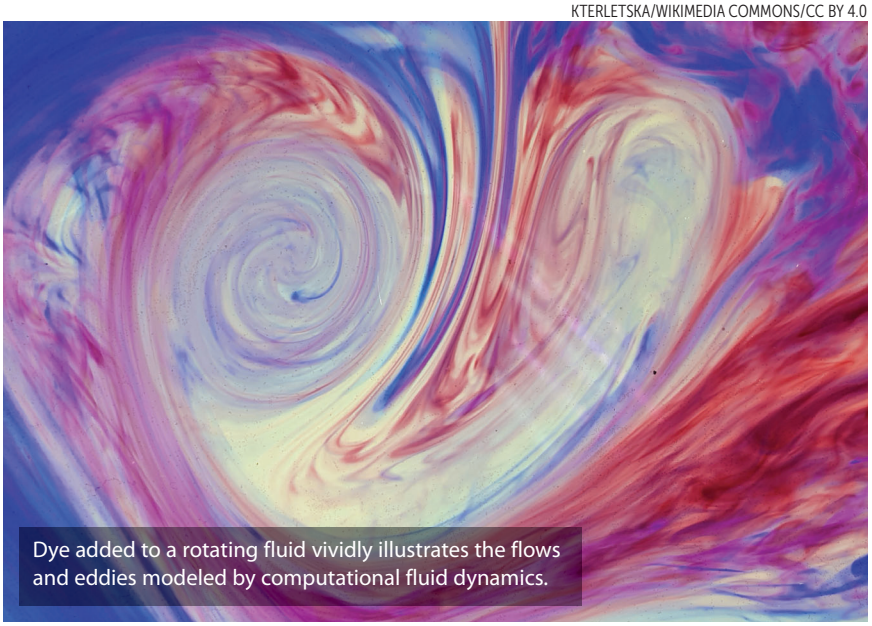
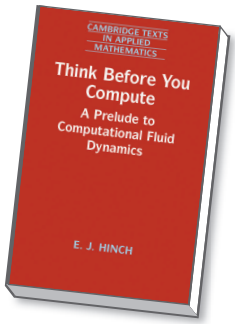


Dye added to a rotating fluid vividly illustrates the flows and eddies modeled by computational fluid dynamics.

# Numerical methods: A user's guide

## Think Before You Compute
### A Prelude to Computational Fluid Dynamics

**E. J. Hinch**
Cambridge U. Press, 2020. $79.99




The equations governing the flows of fluids are inherently nonlinear, so exact solutions are rare and gemlike. Approximate solutions of the equations are thus critical to understanding most of the interesting behaviors seen in fluids. Although analytic approximations have been used to glean insight into fluid phenomena since the field's beginning in the 19th century, numerical approximations provide a complementary way to learn about the behaviors of the solutions. In his new book, *Think Before You Compute: A Prelude to Computational Fluid Dynamics*, renowned fluid dynamicist Edward John Hinch provides an introduction to those techniques.

The titular exhortation outlines the book's objective: To help readers develop intuition about the physics and the mathematics necessary to formulate a problem, learn the techniques and algorithms used to solve the equations approximately, and understand the meaning of the results. The product of decades spent teaching the subject, *Think Before You Compute* is a superb introduction to the basic methods underlying the theory and practice of computational fluid dynamics (CFD).

The book is split into three parts. The first part starts with an invitation to jump directly into the deep end of the pool and solve the two-dimensional Navier–Stokes equations for flow in a cavity with a driven lid, which is a classic problem that encompasses and highlights all the major issues of CFD. The section discusses different formulations of the problem; issues associated with the pressure singularity at the corners; questions of stability, consistency, and accuracy in the finite difference discretization; and various iterative and projection-based methods. Helpful ready-to-run MATLAB codes are available on the author's website. (A better solution might be to host the code on GitHub and permanently link to the repository from the publisher's site.)

Hinch makes the case for part 1 to be covered in about three lectures and a few exercises. I tried that recently, and it works. The approach of using a single example to illustrate the main difficulties of the field is a refreshing change from other books in the genre that often take too long to spin up.

Part 2 presents a broad but succinct introduction to different CFD approaches, including methods based on compact finite differencing, finite elements, spectral techniques, and the many ways of time stepping. It concludes with a chapter on numerical linear algebra that starts with a very apt caution to readers: "HEALTH WARNING. Do not do it." Each topic is presented concisely, and the exposition is uniformly lucid.

The final third of the book is a discursive amble through such topics as hyperbolic problems and shock capturing, boundary integral methods, interface tracking, lattice- and particle-based methods, numerical continuation, and wavelets. Throughout, Hinch shows readers how to think via examples embedded in the text. Those include the use of scaling estimates for real and spurious instabilities and singular behaviors, how to separate the behavior of the algorithm from that of the continuum equations, and a discussion of convergence and speed of computation. Part 3, however, is probably too brief to be useful for a beginner except as an appetizer.

Overall, the relatively short book strikes a good balance by being neither too technical nor too recipe driven, and it imparts key concepts and practical details without a fuss. Adding an online supplement with examples of when the maxim in the title was not followed would illuminate the teachable moments at the origin of the amusing and occasionally inscrutable pronouncements sprinkled throughout the book.

In our digital age, the firepower afforded by cheap and fast computing is immense, and it is easy to generate Colored Fanciful Displays; this minimalist book has none and is none the worse for it. CFD has succeeded—and will continue to do so—because it augments physical experimentation and analytic approximation. Hinch's direct and informal writing style and his emphasis on understanding fluid dynamics via a recursive loop—think, compute, and think again—make *Think Before You Compute* an attractive textbook for a standalone course on CFD or an excellent supplement for a graduate course that includes conceptual, analytic, and numerical approaches.

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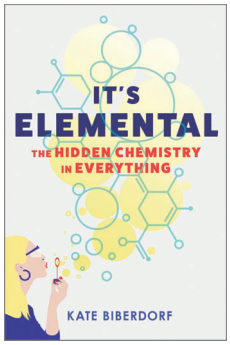
# NEW BOOKS & MEDIA

## Voyagers

**Neil Burger**
AGC Studios/Fibonacci Films/Ingenious Media/Thunder Road Films, 2021


How do you train a crew to travel to another solar system if most of them won't be alive at the end of the 86-year-long trip? In *Voyagers*, the solution is to keep them isolated from Earth, so they never know any environment other than their spacecraft. And to keep them incurious, the fix is to ban art, theater, and music that portray humanity's quest to understand the deep questions of existence. But the spacefarers are a bunch of highly intelligent young people. They soon realize that their emotions are being managed and attempt to break their conditioning. As some of the systems fail on the spacecraft, the crew's reaction to the changing environment brings the mission to the brink of failure and radically changes their societal dynamics. Colin Farrell, Tye Sheridan, and Lily-Rose Depp do an excellent job capturing the awareness of what it means to be human in this unusual take on an interstellar journey. —PKG




## It's Elemental

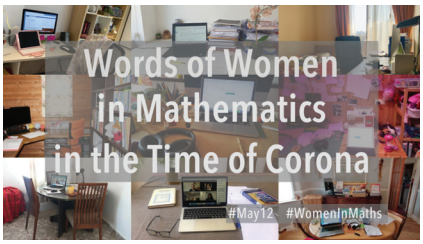
### The Hidden Chemistry in Everything

**Kate Biberdorf**
Park Row Books, 2021. $27.99

From brewing our morning coffee to working out at the gym and cooking dinner, chemistry is everywhere in our daily lives. Yet the atomic and molecular processes and phenomena underlying those and other activities remain a mystery to many people. Chemistry professor Kate Biberdorf of the University of Texas at Austin seeks to rectify that with her latest book. Part primer, part personal narrative, *It's Elemental* takes the reader through some of the typical activities most humans engage in and explains in detail diverse concepts, such as how pain medicines work inside our bodies and how shampoos clean our hair. Her nontechnical text and everyday analogies make the material easily accessible to a general audience, and she provides some useful tips along the way, including why you shouldn't mix household cleaning products. —CC

## Words of Women in Mathematics in the Time of Corona

**Irina Linke**
Vimeo, 2021




The pandemic has been an opportunity to learn new technologies. It's a time to rethink priorities. It makes concentration difficult. It's isolating. Remote interactions broaden communication. Forming new collaborations is nearly impossible. It's a time of anxiety and uncertainty. Those are among the sentiments conveyed in *Words of Women in Mathematics in the Time of Corona* by German documentary filmmaker Irina Linke. The film, available on Vimeo, features 86 women from 37 countries who speak 25 languages (most of which are accompanied by English subtitles). In vignettes that range from a few seconds to about a minute long, the women describe how the pandemic has affected them professionally and personally. The montage of comments, faces, and surroundings paints a moving and memorable picture. The film was released on 12 May, the birthday of mathematician Maryam Mirzakhani, who died in 2017 at age 40. —TF