Rotating fluid dynamics experiments are fun!

But we need to think about when and how to use them, and make sure students have a sound understanding of the corresponding non-rotating cases first, otherwise they become a spectacle rather than a tool that supports transfer between theory and practice.

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Rotating fluid dynamics tank experiments are fun!

Rotating tank experiments look impressive and are a great way to develop intuition for large-scale ocean and atmosphere phenomena that are hard to directly observe and therefore typically taught theoretically. A great and affordable setup builds on LEGO: Hill et al. (2018)

But students need scaffolding to make sense out of them.

When we show rotating tank experiments too early and mostly "for fun" (for example for incoming students or on science days), students typically see that something “looks pretty and moves”, but they have no foundation of physics to understand what makes this specific experiment special in the eyes of an expert, e.g., what is different in the rotating experiment from if there was no rotation at all (Crouch et al., 2004; Glessmer & deWet, 2018; Roth et al., 1997). We need to build intuition (or remind students of earlier observations) of non-rotating cases first, so they have the chance to learn from the rotating cases!

Example: combining thermal and rotational forcing

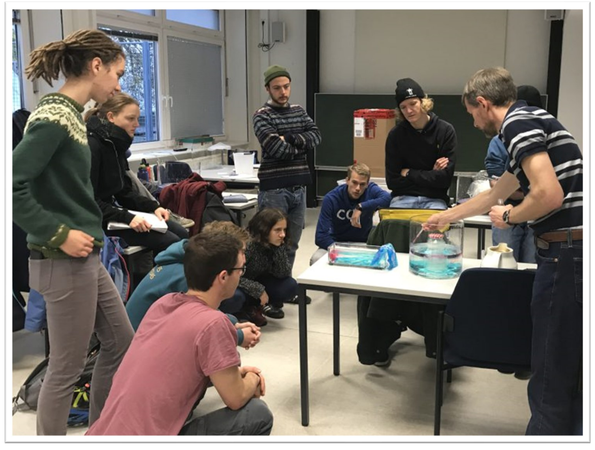
This experiment can be used to show a ”thermal wind”/“Hadley cell”-type circulation or baroclinic instabilities

What happens without rotation?

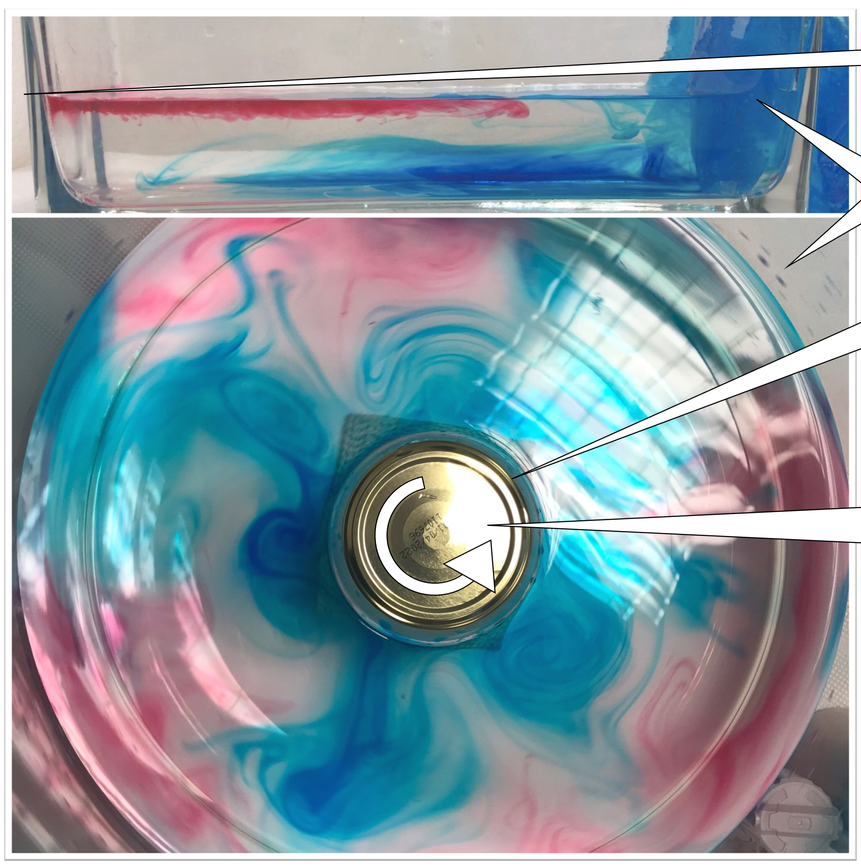
If we only use thermal forcing, an overturning circulation develops

What does the rotation do?

The ”thermal wind”/“Hadley cell” circulation at slow rotation breaks up into a depth-independent circulation at fast rotation



← In class, students do both experiments



Example: Turbulence

This experiment shows how even random movement becomes less random under rotation

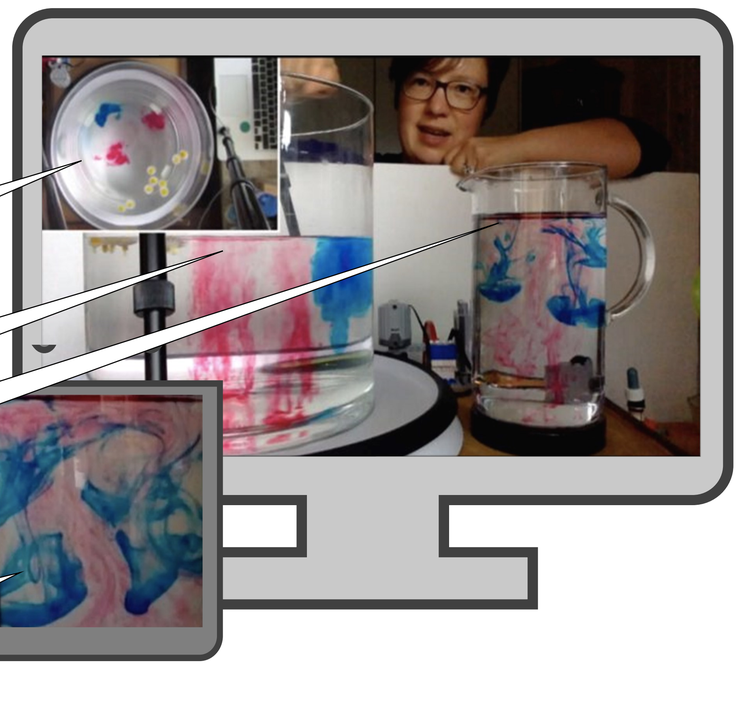
What happens without rotation?

Dripping dye into water at rest shows the development of turbulent, upside-down mushroom structures

What does the rotation do?

When the same is done to rotating water, the structures are only 2D

At home, students can easily do the non-rotating experiment and thus gain practical experience →



Further reading & videos of experiments

https://www.oceanblogs.org/teachingoceanscience/
https://mirjamglessmer.com/remotely-controlled-diynamics-kitchen-oceanography-experiments/

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- Glessmer, M. S., & de Wet, P. D. (2018). Supporting Conceptual Understanding of the Coriolis Force Through Laboratory Experiments. NATIONAL MARINE EDUCATORS ASSOCIATION, 25.
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