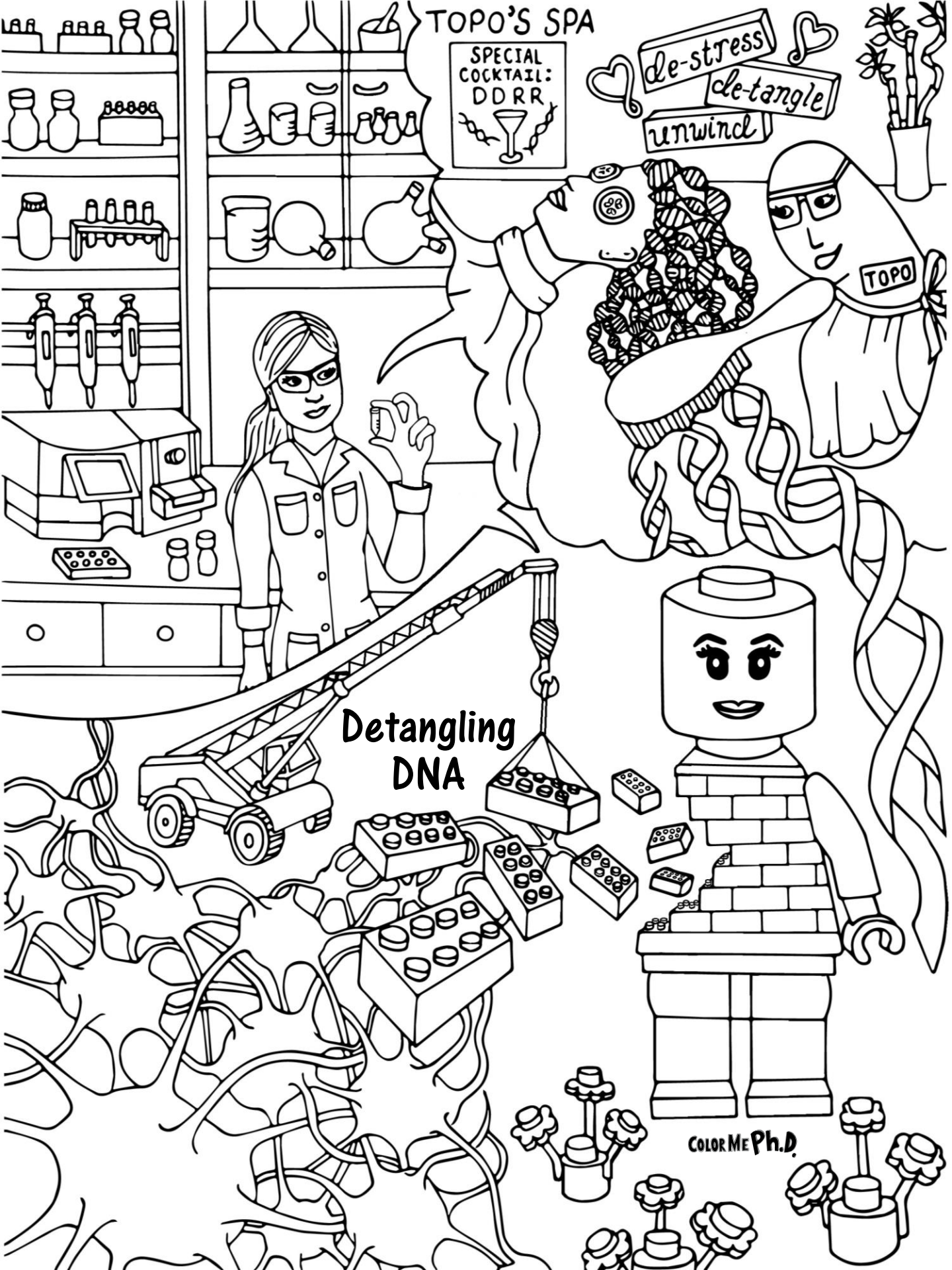
TOPO'S SPA
SPECIAL COCKTAIL: DDRR
de-stress
de-tangle
unwind
TOPO
Detangling DNA
COLOR ME Ph.D.

Detangling DNA

1. **Cells = Body Legos:** Cells are the building blocks of our bodies. When they get damaged or diseased, the body normally repairs them, but some damage and disease can be too severe.

2. **Engineered Cells:** One way of replacing a large loss of cells is by engineering new ones. Cells can also be engineered to fight diseases like cancer.

3. **Reprogramming Cells:** It's hard to predict which cells will respond to reprogramming. It's a mystery why some cells reprogram and others do not, and this is a major limitation.

4. **Single cell:** Looking at individual cells allowed us to identify the rare cells that can reprogram. Curiously, it was cells that both multiplied quickly and made RNA faster that could successfully reprogram.

5. **Privileged Cells:** When we looked at the way the molecules inside the cells multiply, we found that the fast production of both cells and RNA puts stress on the cell's DNA. Without a way to relieve this stress, cells would die or stop reprogramming.

6. **Detangling the DNA:** Special proteins called topoisomerases (derived from the word topology, which means shape) reduce the stress caused by high rates of multiplication as well as production of RNA. We can picture the topoisomerase like a hair dresser, detangling the DNA to relieve stress. With large amounts of these detanglers, cells can quickly and completely reprogram to new cell types.

7. **What it Means:** Now that we understand why some cells reprogram better than others, we can more easily make engineered cells. It may also be possible to design the genome (the whole set of DNA polymers) to fight changes that let cells reprogram to become cancer cells.

Dr. Katie Galloway studied Chemical Engineering at UC Berkeley and obtained her PhD from Caltech. Through her work, she has engineered systems for dynamic behaviors across multiple scales, from the molecular design of noncoding RNA devices to optimization of large transcriptional networks. In the fall of 2019, Katie started her lab at MIT as an assistant professor in the department of Chemical Engineering. Outside of lab she enjoys chasing around her four kids and exploring the outdoors with her husband (and sometimes cooperative kids).

Reference: Babos, K. N., Galloway, K. E. et al, "Mitigating Antagonism between Transcription and Proliferation Allows Near-Deterministic Cellular Reprogramming," Cell Stem Cell 25 (2019), 486-500.