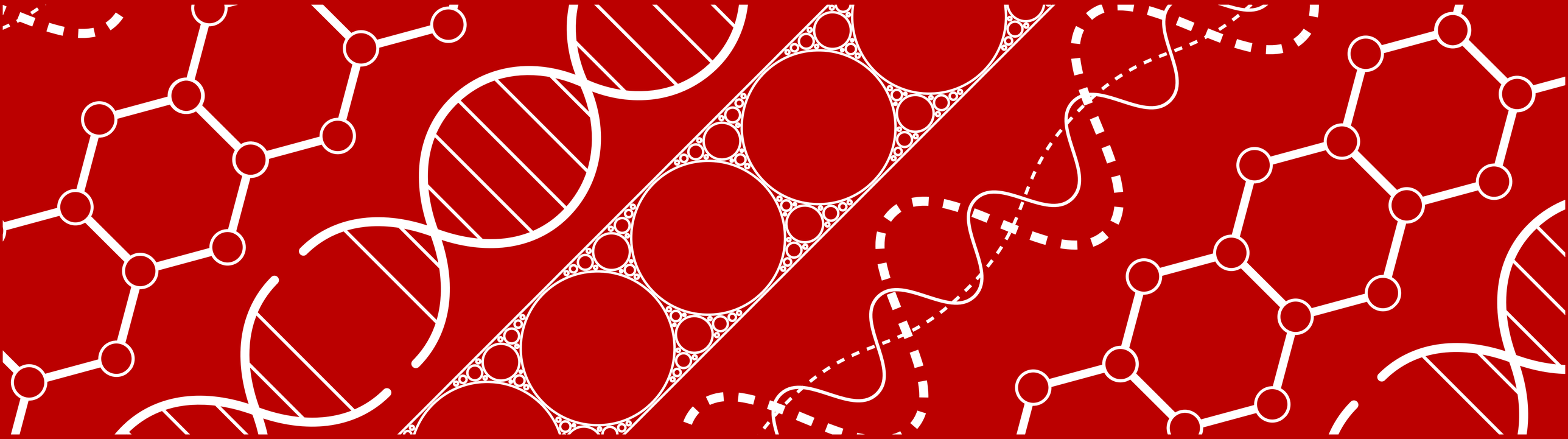
Telling Science Stories



SCIENCE COMMUNICATION

Carnegie Mellon University

Ardon Shorr, Ph.D.

How would you explain this to someone who didn't know soccer?

> Argentina played another great game last night against Brazil — the last game in Group C. In the first half, Brazil maintained the majority of the possession, but got few clear looks on the goal.
>
> With under 5 minutes to half-time, a long ball was sent towards the Brazilian center back, who misplayed the ball. As the ball skipped behind him, the Argentinian center forward was able to gather it for a 1v1 with the keeper. The result was a 1-0 lead for the Argentina.
>
> In the second half, Brazil struggled to keep possession of the ball. The Argentinian midfielders were able to stop any clear looks, preserving the shutout and advancing their team to the knockout stages.

Stories have common elements

Clear stakes

Hard obstacles

Exciting solution

Resolution

This was the final game to decide who is eliminated, a tense encounter between Argentina and Brazil. For the first half, Brazil seemed to be running the show. But halfway through, an Argentinian player took a bold risk that paid off, and his team pulled into the lead. The Argentinians then kept up their own defenses, and ultimately won the game!

Story elements prompt us to include critical information

- Clear stakes
- Hard obstacles
- Exciting solution
- Resolution

} Elements of a compelling story

Research can fit into a storytelling template

Goal	Big problem you're trying to solve
Obstacle	Why it's difficult
Approach	Your methods that solved an obstacle
Result	Results (so far)
Benefit	How those results impact the original goal

Radiolab uses many tools to motivate content

Specific examples

Nitrogen can be found in poop

Nations literally went to war

It's like oil is today

Flag new terms

Pause before, slow down, emphasize, repeat

Strong action verbs

Nitrogen atoms *cling* and *fiercely* hold together

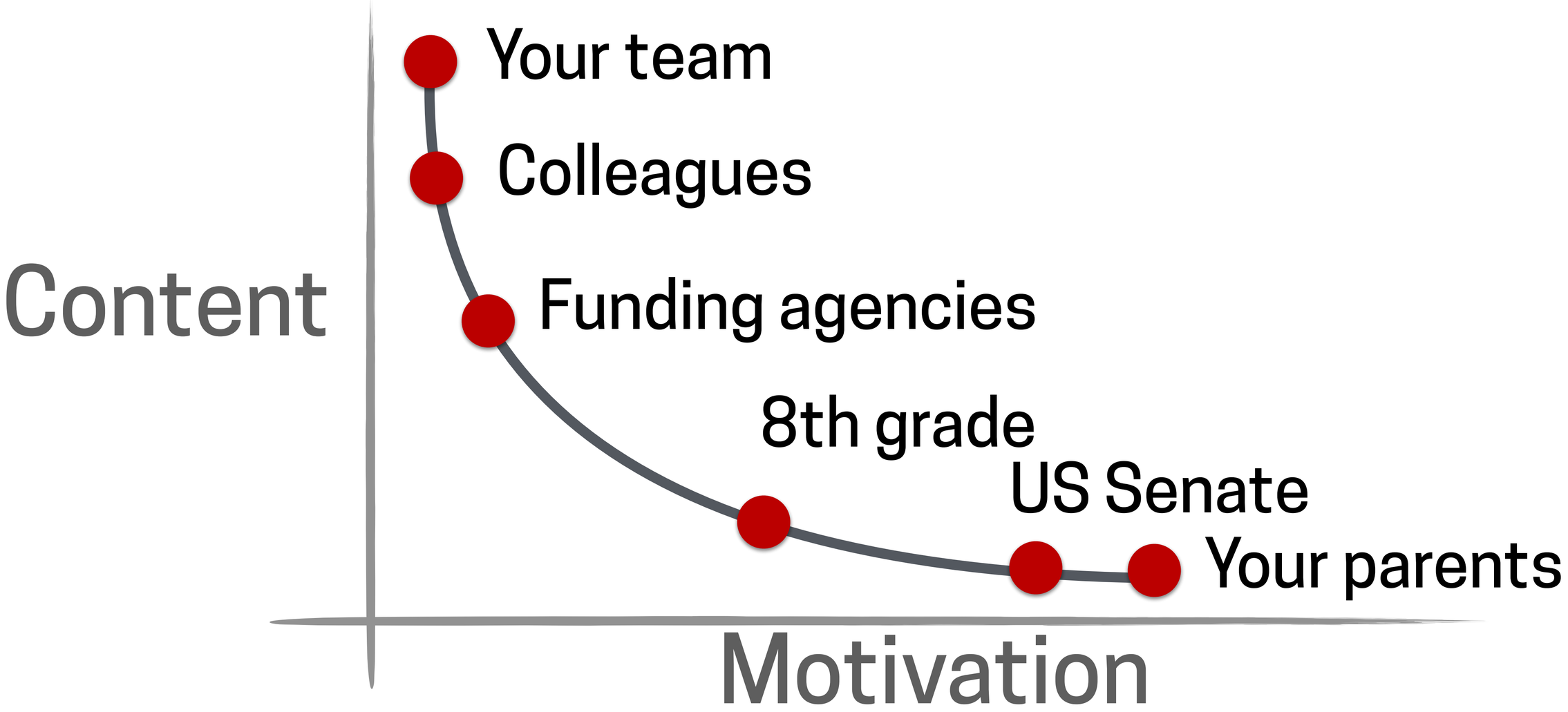
A *drip drip drip* of ammonia

Noun Replacement Therapy

β-amyloid plaques → cobwebs in your brain

Microglia → the janitors of the brain

The balance between motivation and content depends on your audience



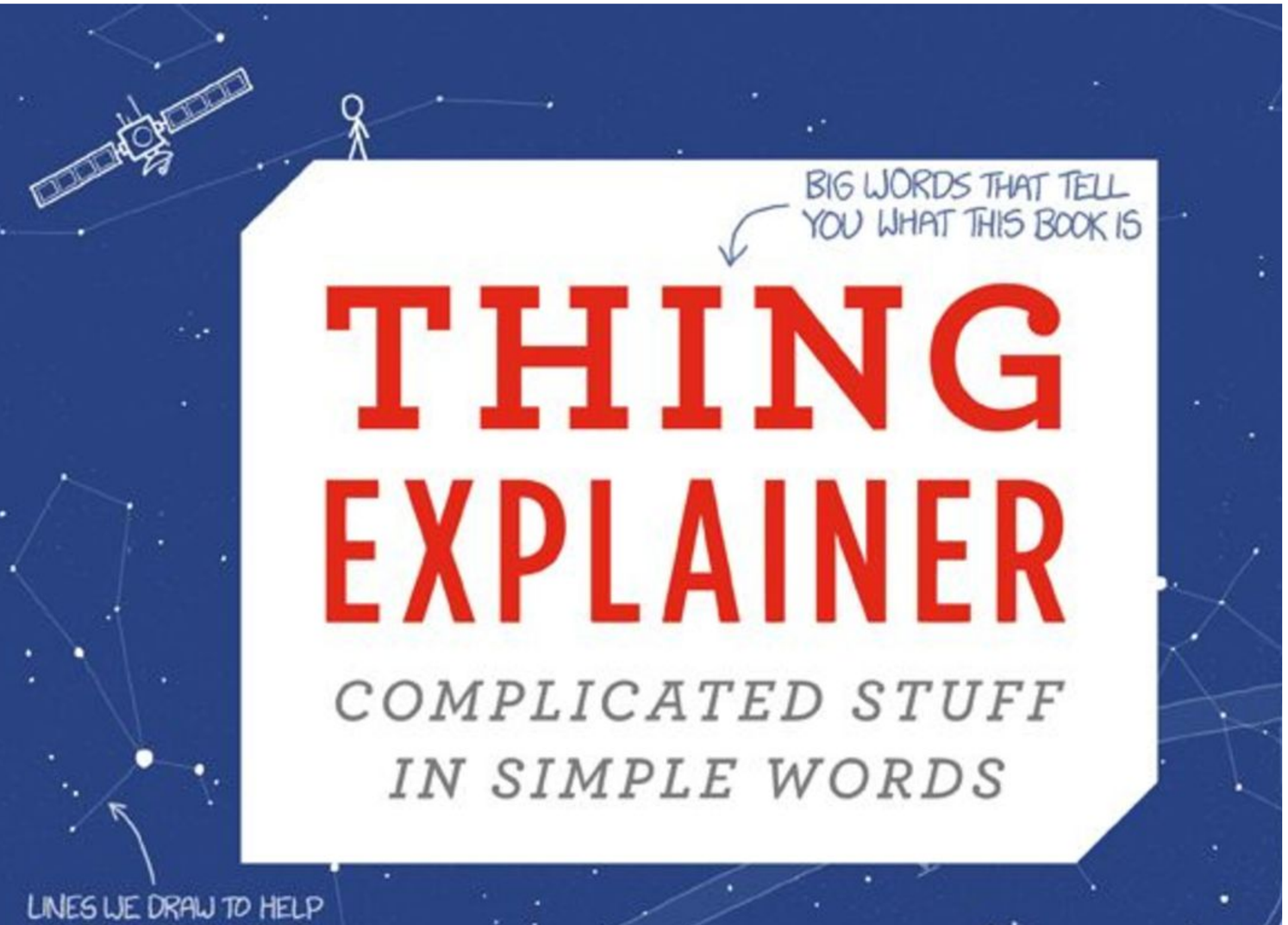
Focus on the meaning behind the details

“Argentina played the last game in Group C.”	▶	This was the decisive game
“Brazil maintained the majority of the possession…”	▶	Brazil seemed to be in control
“the Argentinian center forward was able to gather it for a 1v1 with the keeper.”	▶	Argentina took a risk that paid off

Focus on the meaning behind the details

“Excitation was restricted to a femtoliter volume”	▶	We eliminated a major source of noise
“Trivalent nitrogen bonds contain 945 kJ/mol”	▶	Nitrogen clings so tightly to itself, nobody knew if it could be pried apart
“I’m building an annotated corpus”	▶	I’m teaching a computer what to look for

Focus on the meaning behind the details



Tiny bags of water you're made of

Boxes that make clothes smell better

Shape checker

2% paint
98% propellant

Structure Analysis

Research can fit into a storytelling template

Goal	Big problem you're trying to solve
Obstacle	Why it's difficult
Approach	Your methods that solved an obstacle
Result	Results (so far)
Benefit	How those results impact the original goal

Goal, but **Obstacle**

is a series of parallel statements to connect your work into a big picture problem

We want [**Goal**], but [**obstacle**].

Solving the obstacle becomes the new goal

We want to [**solve obstacle**], but [**more detailed obstacle**].

Storymap Analysis

Radiolab establishes motivation with a series of increasingly specific obstacles

Goal	People didn't know how to feed a growing population.
Obstacle	We couldn't grow enough food because plants need nitrogen.
Obstacle	There's plenty of nitrogen in the air, but not in a usable form.
Obstacle	It's not usable because nitrogen clings tightly to itself
Approach	But Haber found a way using temperature and pressure…
Result	…to capture nitrogen gas into liquid ammonia.
Benefit	That discovery allowed the world to feed 7 billion people.

This same rhetorical technique is used in Porter 2011, NEJM

Goal	Killing cancer cells usually hurts the surrounding tissue.
Obstacle	Specifically targeting cancer cells is hard because cancer disguises immune signals.
Obstacle	We've tried to inject T-cells that recognize cancer, but these T-cells don't last very long in the body.
Approach	We found a new method
Result	to add persistent T-cells.
Benefit	This resulted in specifically killing leukemia tumors.

Where you start depends on which goal motivates your audience

Goal Killing cancer cells usually hurts the surrounding tissue.

Obstacle Specifically targeting cancer cells is hard because cancer disguises immune signals.

Obstacle We've tried to inject T-cells that recognize cancer, but these T-cells don't last very long in the body.

Approach We found a new method

Result to add persistent T-cells.

Benefit This resulted in specifically killing leukemia tumors.

In Search of the Dream Team: Temporally Constrained Multi-Armed Bandits for Identifying Effective Team Structures

Sharon Zhou, Melissa Valentine, Michael S. Bernstein
Stanford University
sharonz@cs.stanford.edu, mav@stanford.edu, msb@cs.stanford.edu

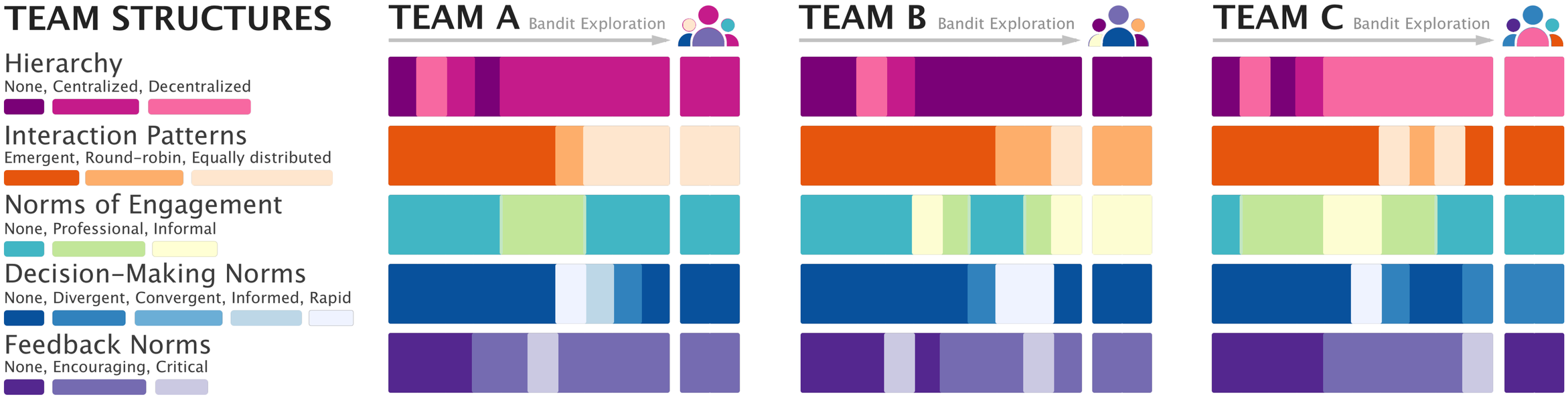


Figure 1. Each team succeeds under different roles, norms, and interaction patterns: there are no universally ideal team structures. The DreamTeam system exposes teams to a series of different team structures over time to identify effective structures for each team, based on feedback. We introduce multi-armed bandits with temporal constraints to guide this exploration without overwhelming teams in a deluge of simultaneous changes.

Goal	Good team work requires good team rules. We want to nudge people to use the best team rules.
Obstacle	But maybe there is no universally ideal team rules
Goal	So we want to explore a large space of team rules
Obstacle	But that involves overwhelming change
Goal	To make changes that aren’t overwhelming,
Approach	We’re using an algorithm to limit the amount of changes
Result	This outperforms other forms of management
Benefit	Computation can help us do our best team work

Goal

Obstacle

Approach

Result

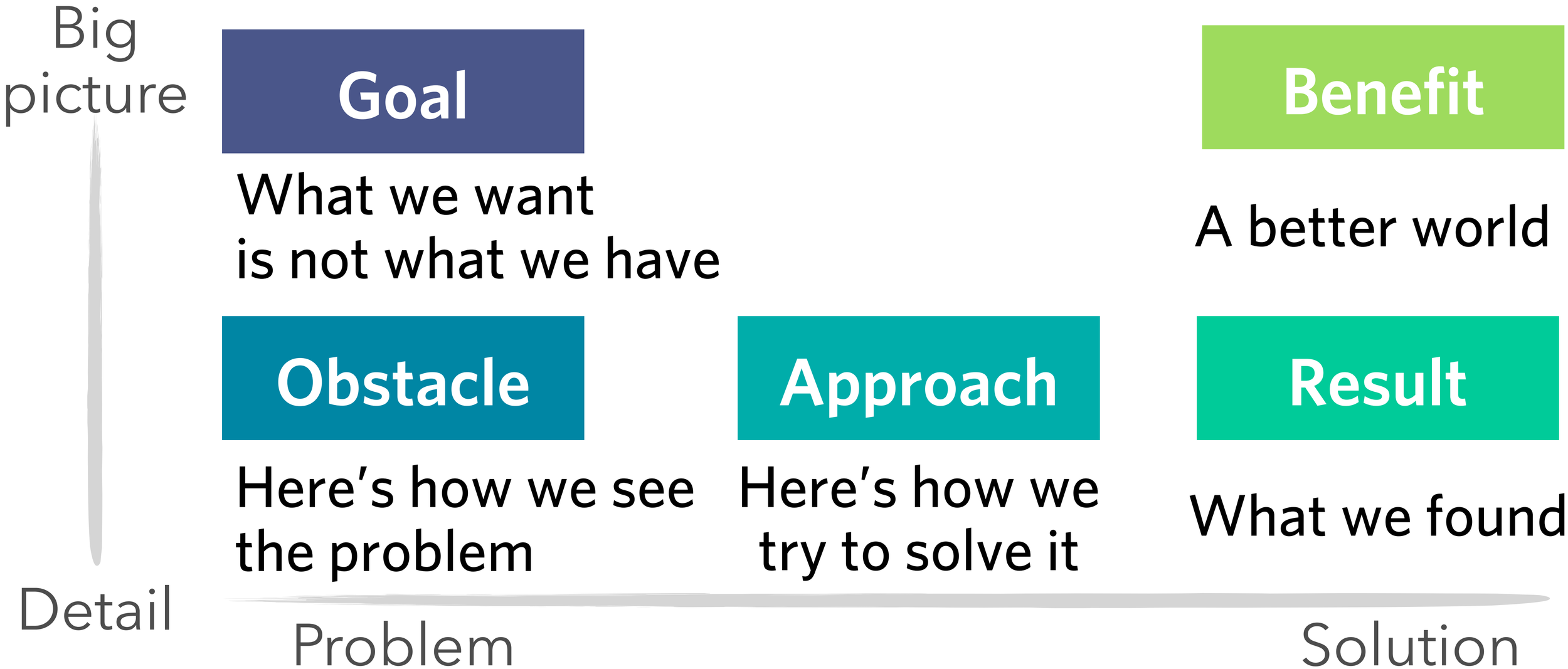
Benefit

Team structures—roles, norms, and interaction patterns— define how teams work. HCI researchers have theorized ideal team structures and built systems nudging teams towards them, such as those increasing turn-taking, deliberation, and knowledge distribution. However, organizational behavior research argues against the existence of universally ideal structures. Teams are diverse and excel under different structures: while one team might flourish under hierarchical leadership and a critical culture, another will flounder.

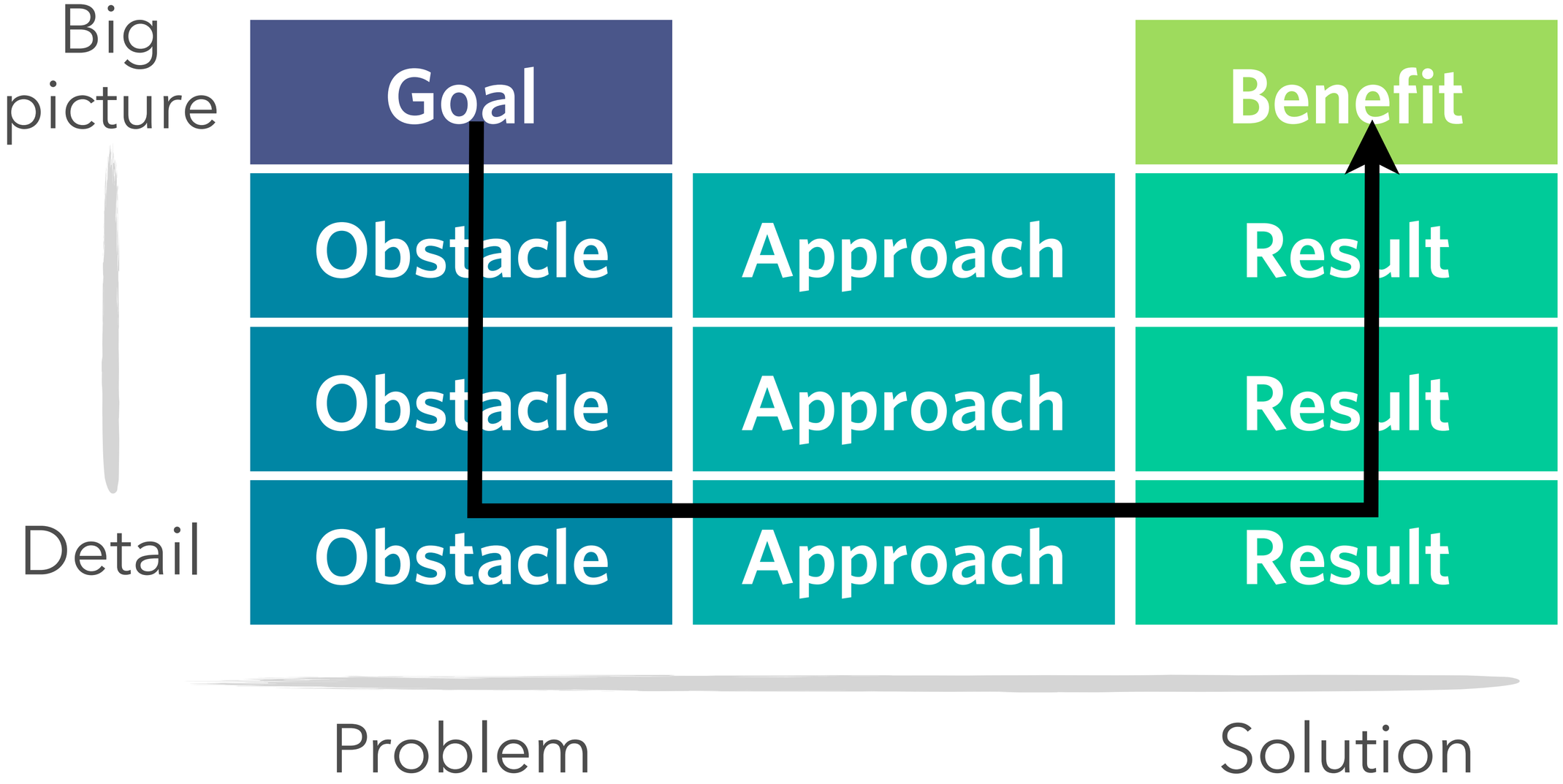
In this paper, we present DreamTeam: a system that explores a large space of possible team structures to identify effective structures for each team based on observable feedback. To avoid overwhelming teams with too many changes, DreamTeam introduces multi-armed bandits with temporal constraints: an algorithm that manages the timing of exploration–exploitation trade-offs across multiple bandits simultaneously.

DreamTeam teams outperformed self-managing teams by 38%, manager-led teams by 46%, and teams with unconstrained bandits by 41%. This research advances computation as a powerful partner in establishing effective teamwork.

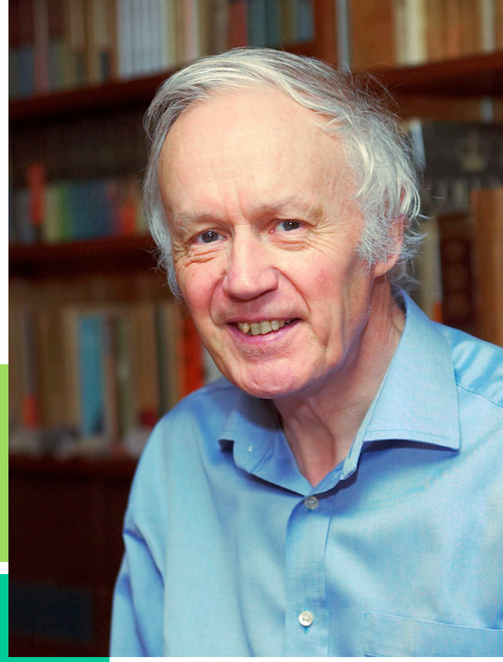
Stories move vertically in **detail**
And horizontally in **solving problems**



Different explanations are different paths through the same idea-space



Leggett's path was disconnected from motivation and payoff



Big picture

Detail

Goal		Benefit
Obstacle	Approach	Result
Obstacle	Approach	Result
Obstacle	Approach	Result

Problem

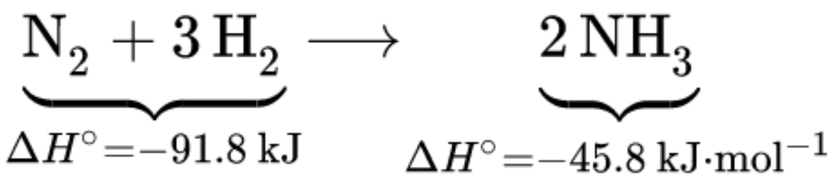
Solution

Essentially, we solve problems at many levels

Goal	Approach	Result
More food		7 billion people
More nitrogen		Fertilizer!
Deployable nitrogen		It’s a liquid!
Break triple bond	High Temp + Pressure	Ammonia!

Essentially, we solve problems at many levels

Goal	Approach	Result
More food		7 billion people
More nitrogen	“He figured out a way”	Fertilizer!
Deployable nitrogen		It’s a liquid!
Break triple bond	High Temp + Pressure	Ammonia!



Le Châtelier

$K_p(T)$ for $N_2 + 3\ H_2 \rightleftharpoons 2\ NH_3$[12]

Temperature (°C)	K_p
300	4.34×10^{-3}

Essentially, we solve problems at many levels

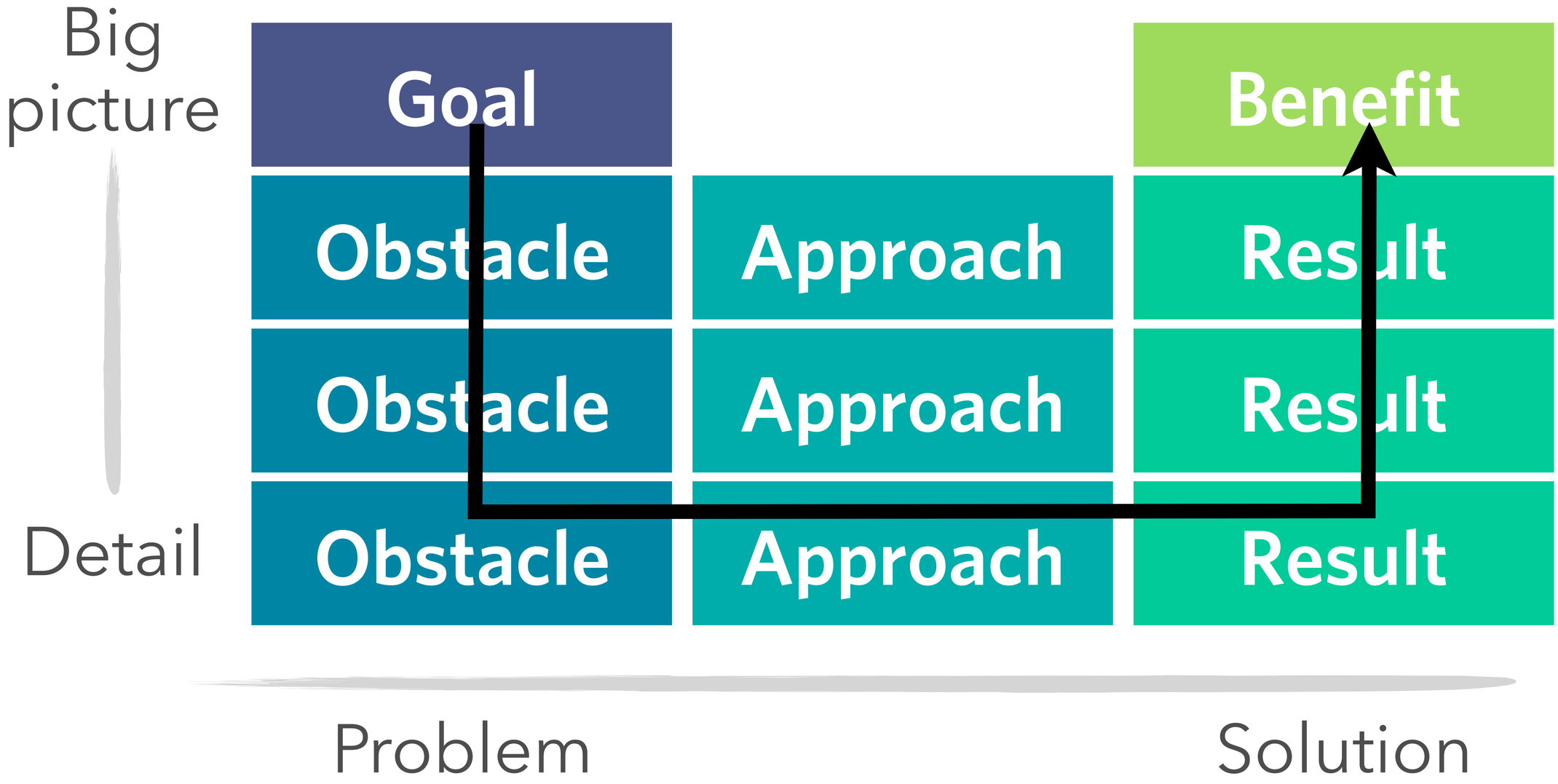
Goal	Approach	Result
Working in teams can be productive or awful		
There isn’t an ideal set of rules for every team	We come up with custom rules	Our teams solve puzzles 46% better

Essentially, we solve problems at many levels

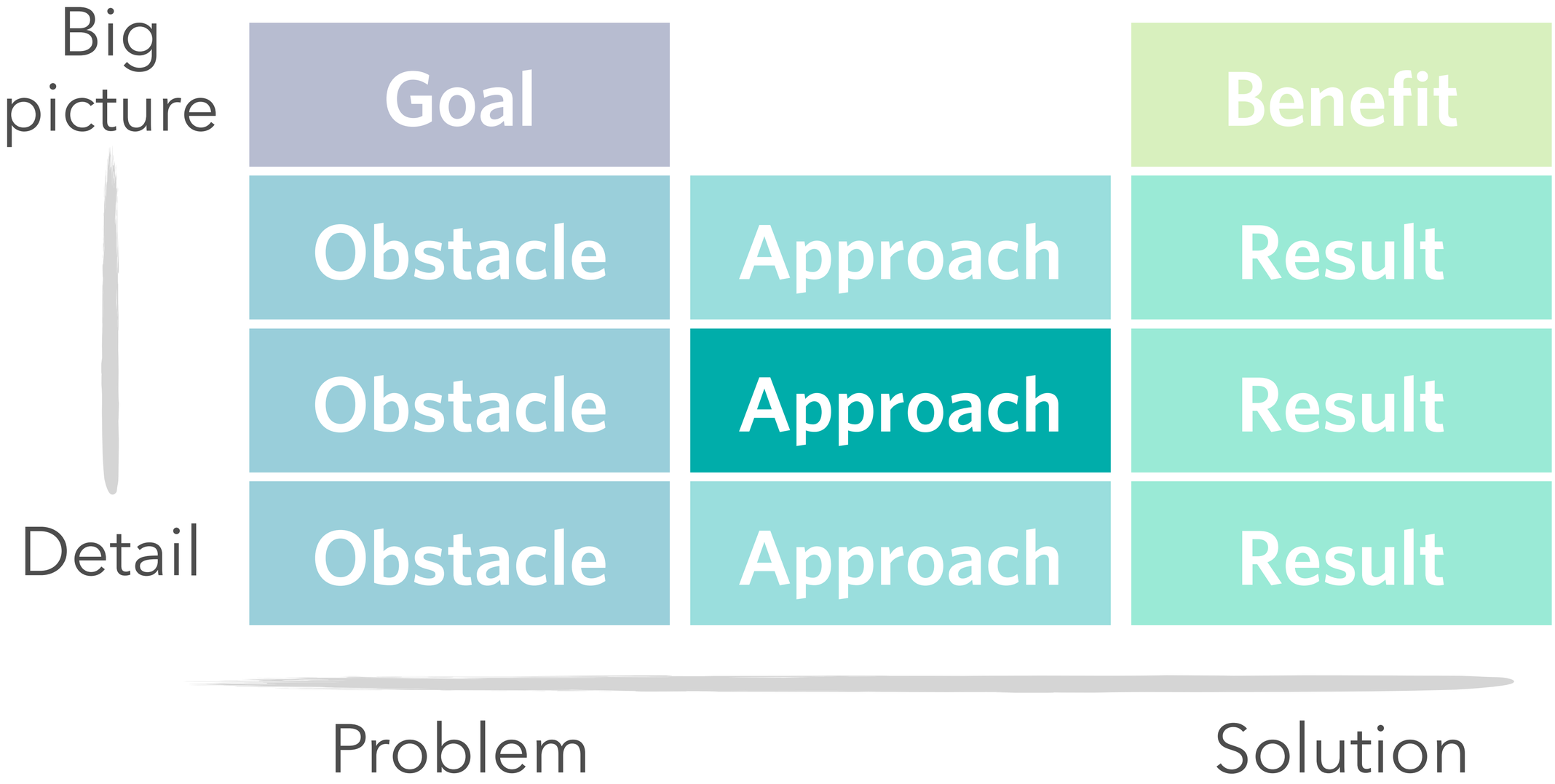
Goal	Approach	Result
Working in teams can be productive or awful	We figured out a way…	to help teams work better
There isn't an ideal set of rules for every team	We come up with custom rules	Our teams solve puzzles 46% better
We can't try all the combinations of rules	limit the number of changes you make	In 40 cycles we found good dynamics
…	…	…
The tolerance for change changes over time	$y \propto (t - T/2)^2$ increase likelihood of changes during the middle.	We limited the number of changes at each time

Crafting Storymaps

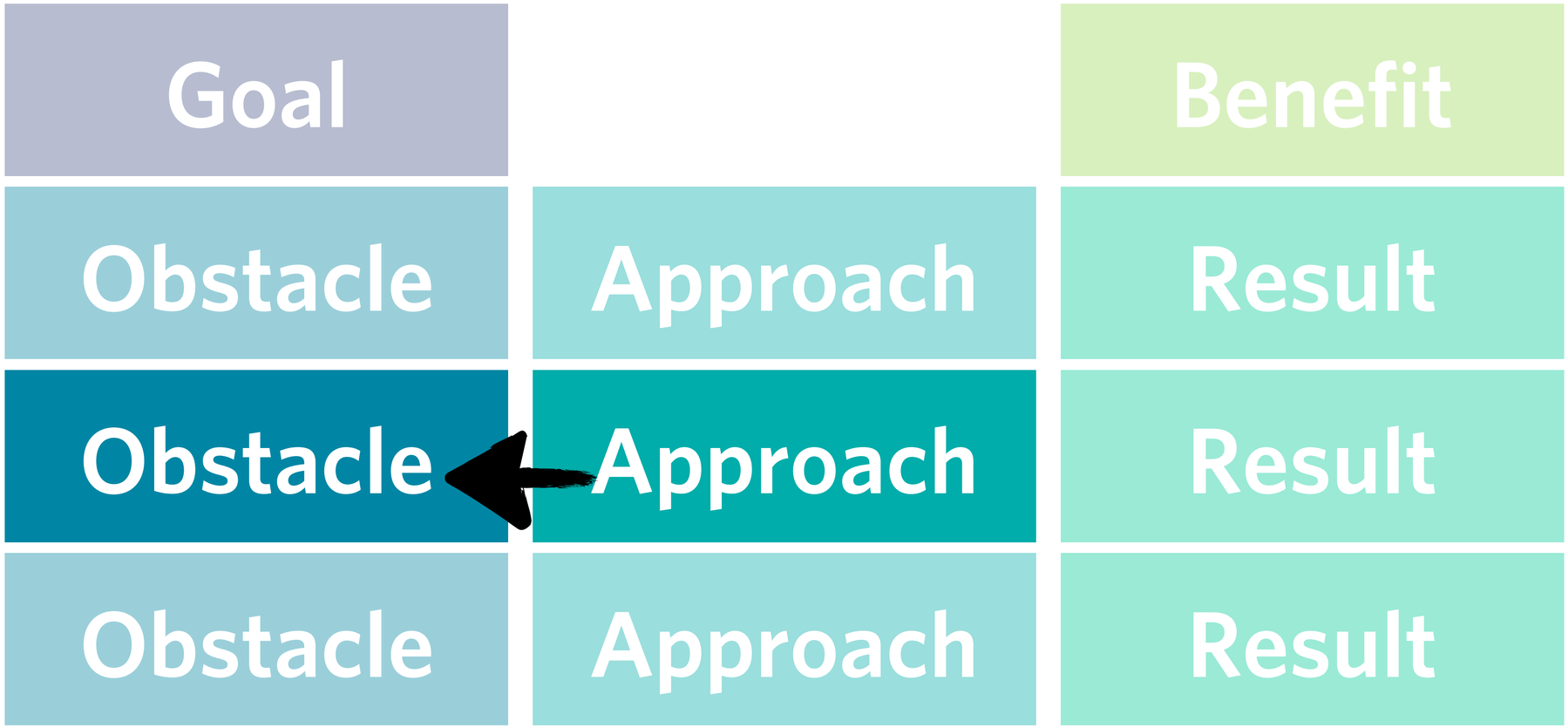
Tell the story with a U-shape, Build the story middle-out



Tell the story with a U-shape, Build the story middle-out

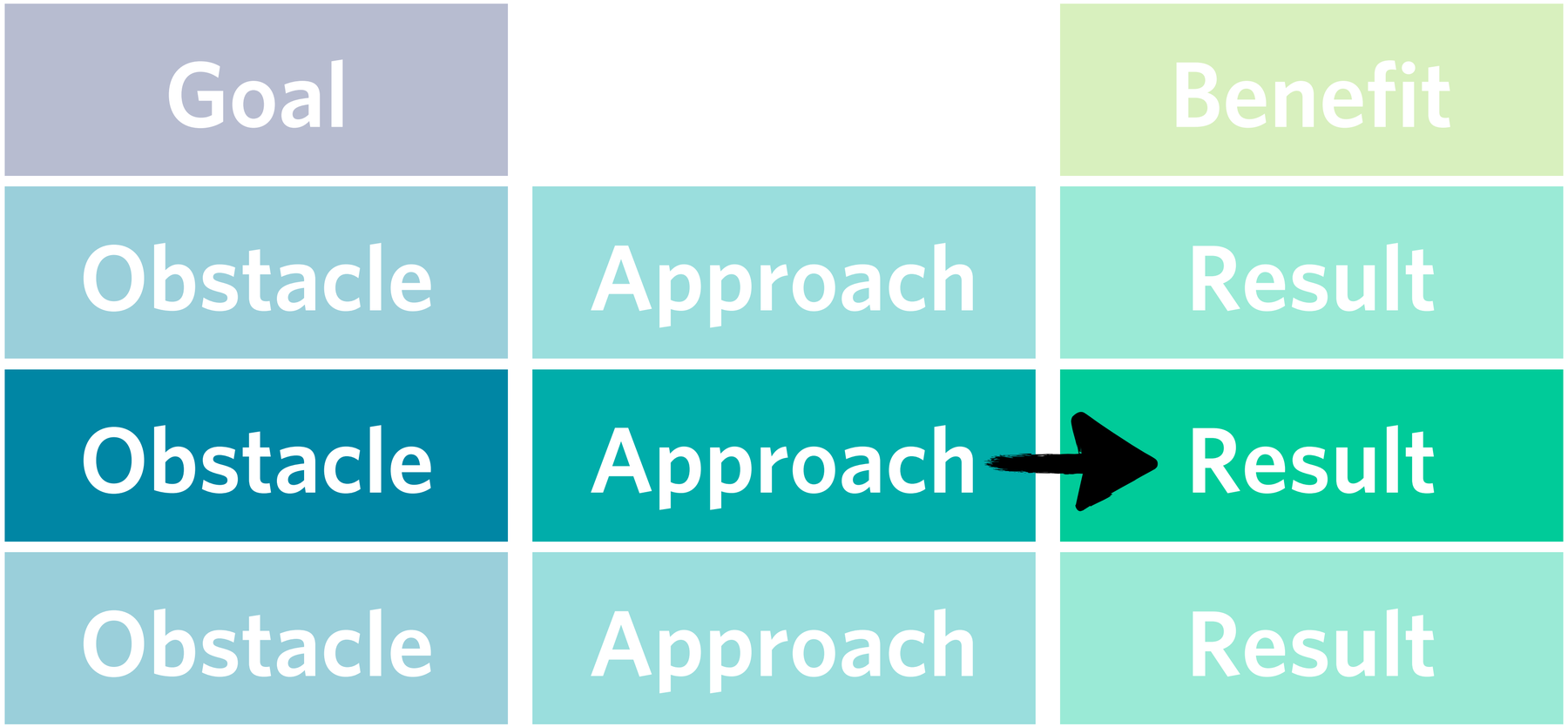


To fill in the gaps, ask yourself these questions:



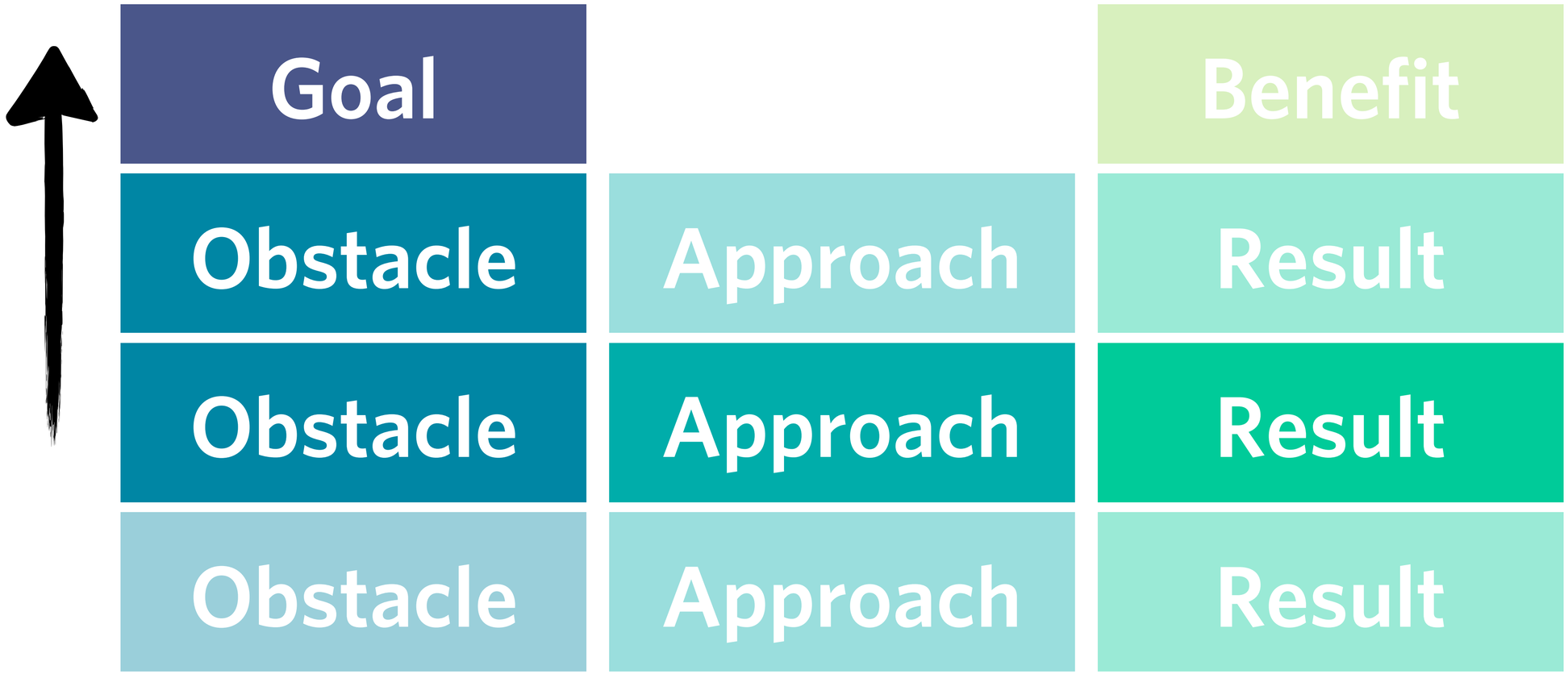
"What problem does that solve?"

To fill in the gaps, ask yourself these questions:



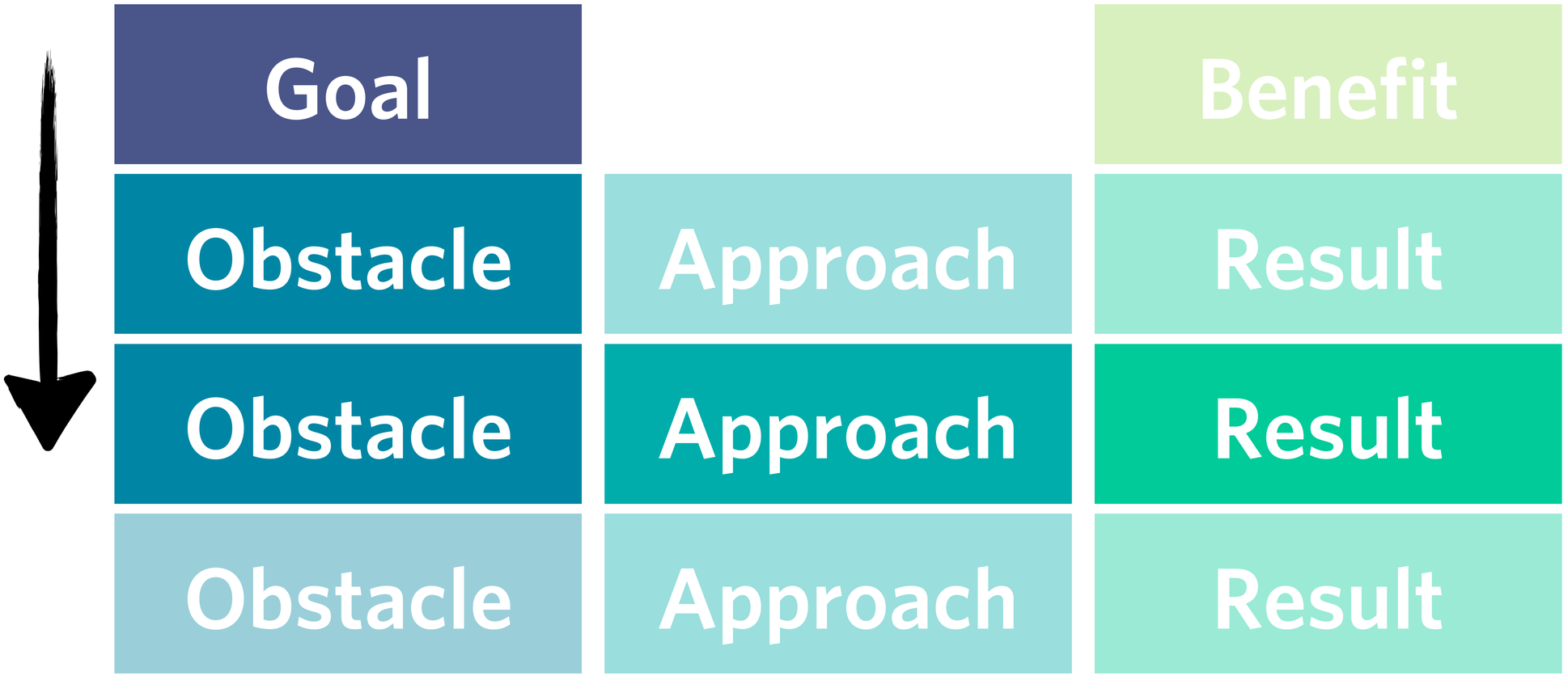
"What happens when we do that?"

To fill in the gaps, ask yourself these questions:



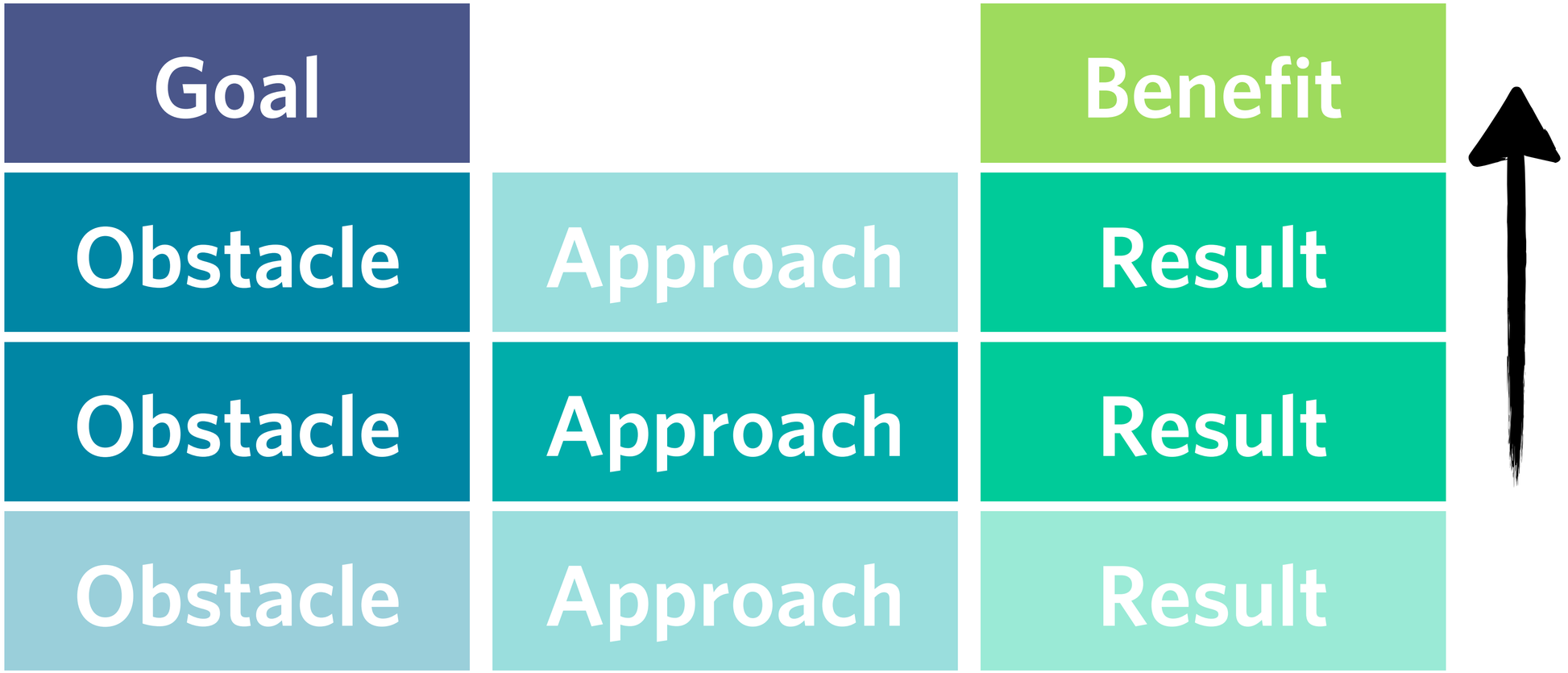
“Why do you want to solve that problem?”

To fill in the gaps, ask yourself these questions:



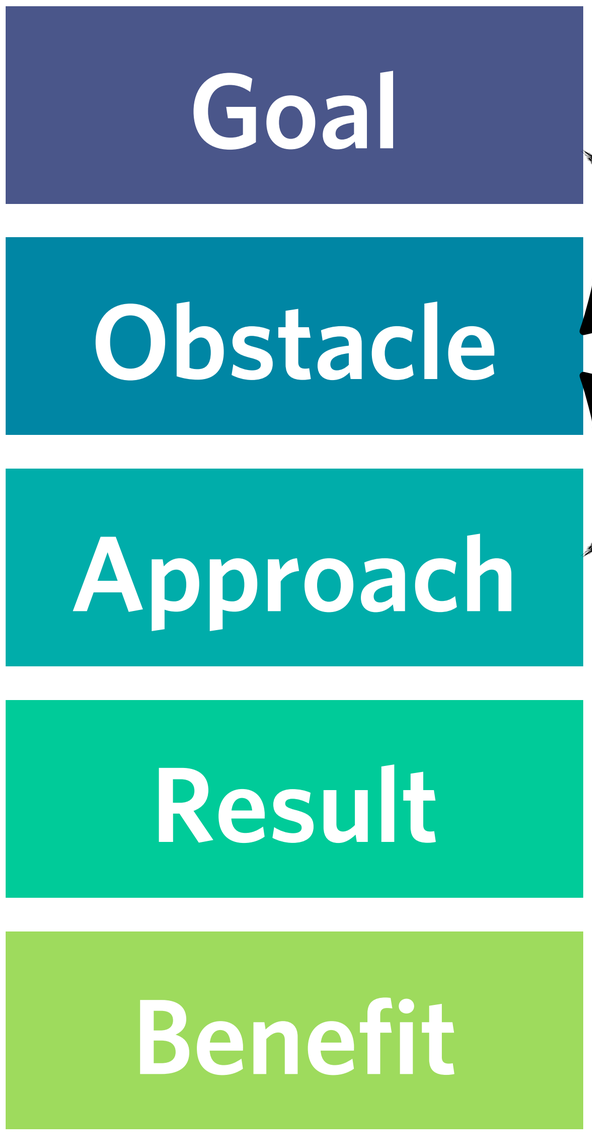
“Why is that hard? Why hasn’t it been done?

To fill in the gaps, ask yourself these questions:



“What are the benefits of that solution?”

To fill in the gaps, ask yourself these questions:



"Why do you want to solve that problem?"

"Why is that hard? Why hasn't it been done?"

"What problem does that solve?"

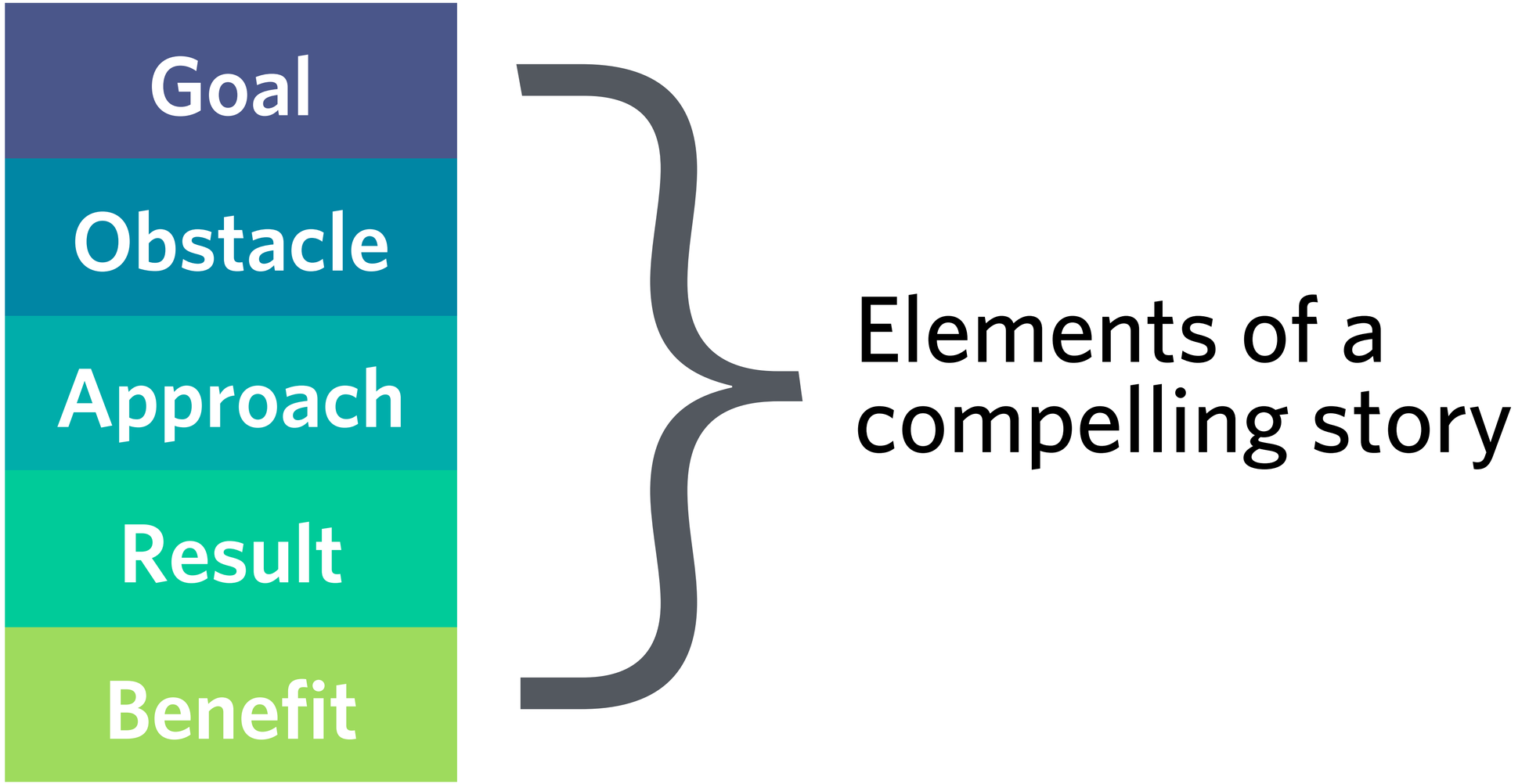
"What do you do?"

"What happened when you did that?"

"What are the benefits of that solution?"

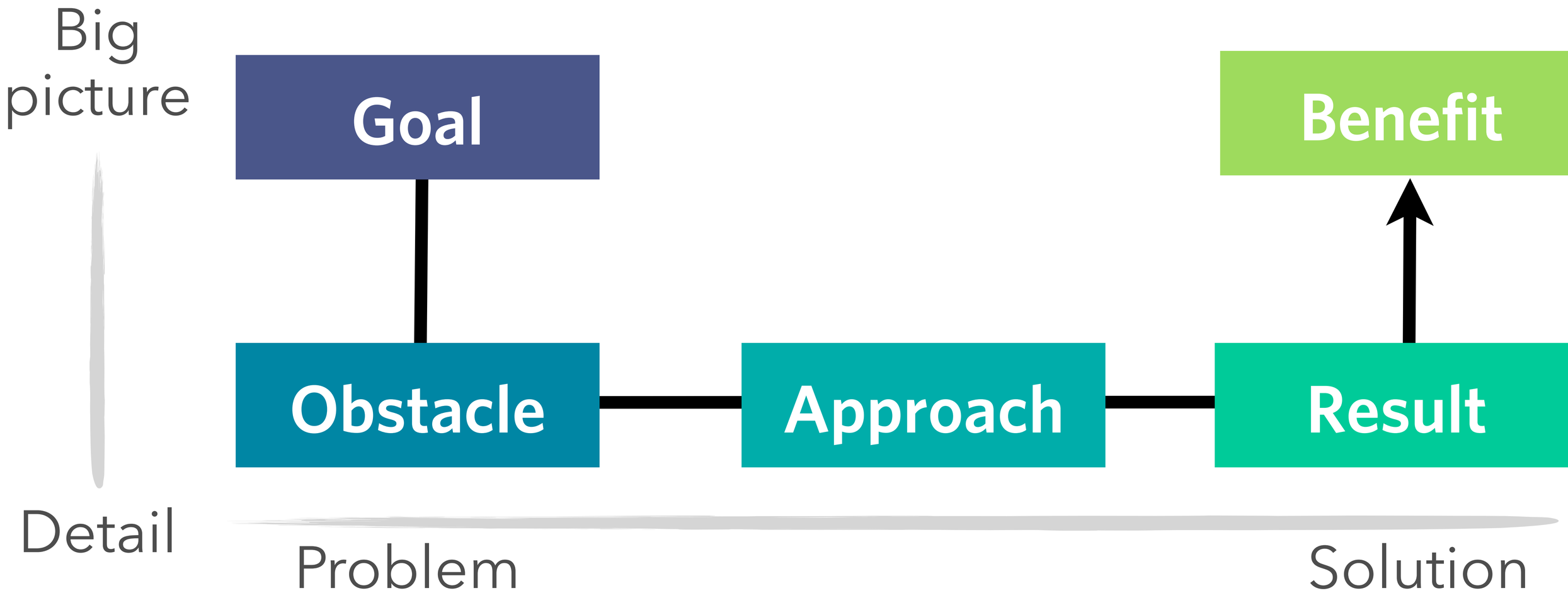
Summary

Stories prompt us to include critical information



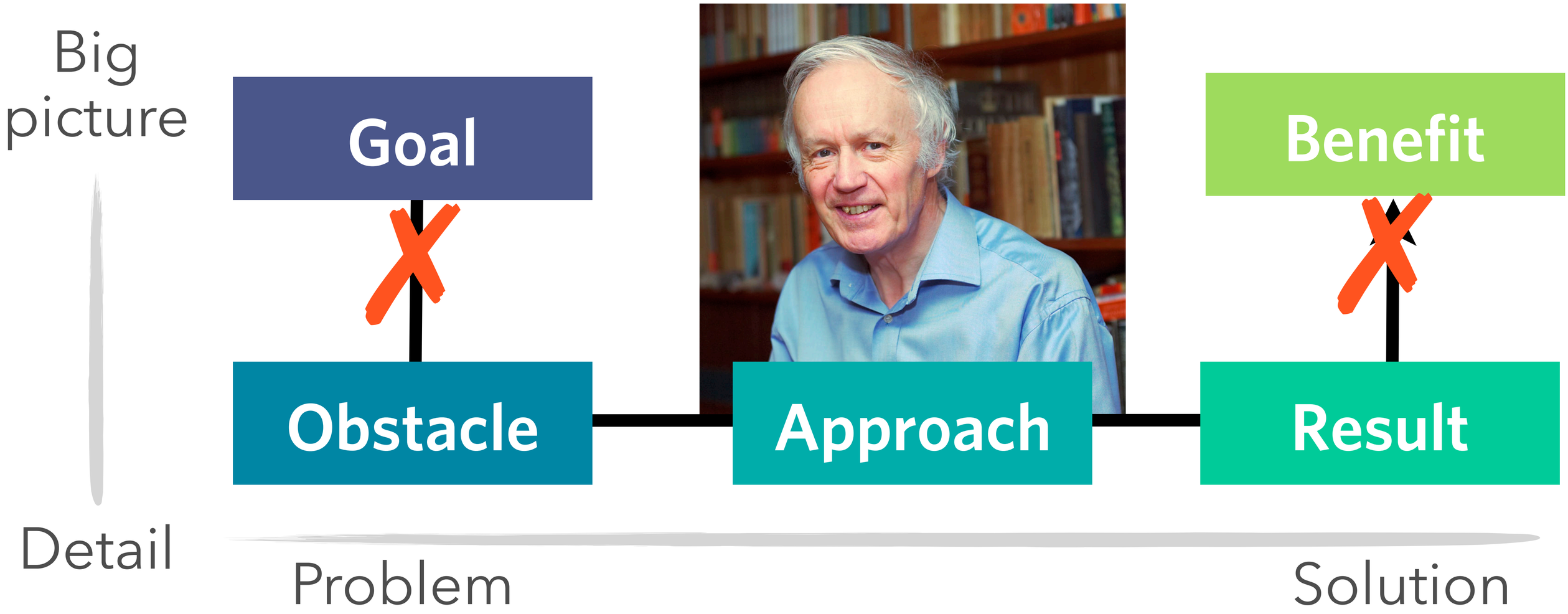
Summary

We can think of alternate paths through a 2D story



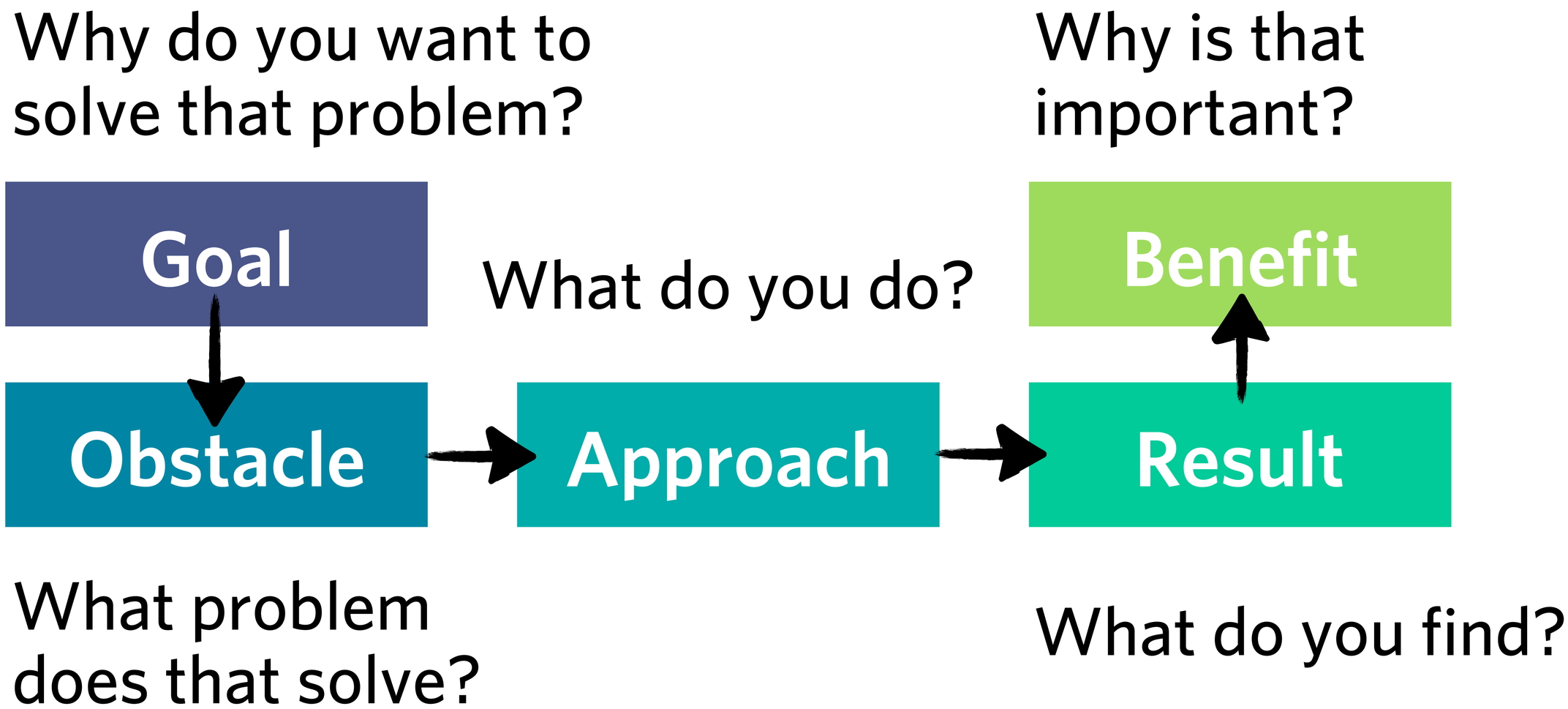
Summary

Broken paths lead to failed communication



Summary

To fill in the gaps, ask yourself these questions:



Fall Semester

Oct 9, 12	Structuring Presentation
Oct 23, 26	Graphic Design
Nov 6, 9	Distilling Your Message
Nov 13, 16	Telling Science Stories
Nov 27, 30	Crafting Explanation
Dec 4, 7	Vocal Delivery

4:30 pm
Tue MI 411
Fri WH 8325

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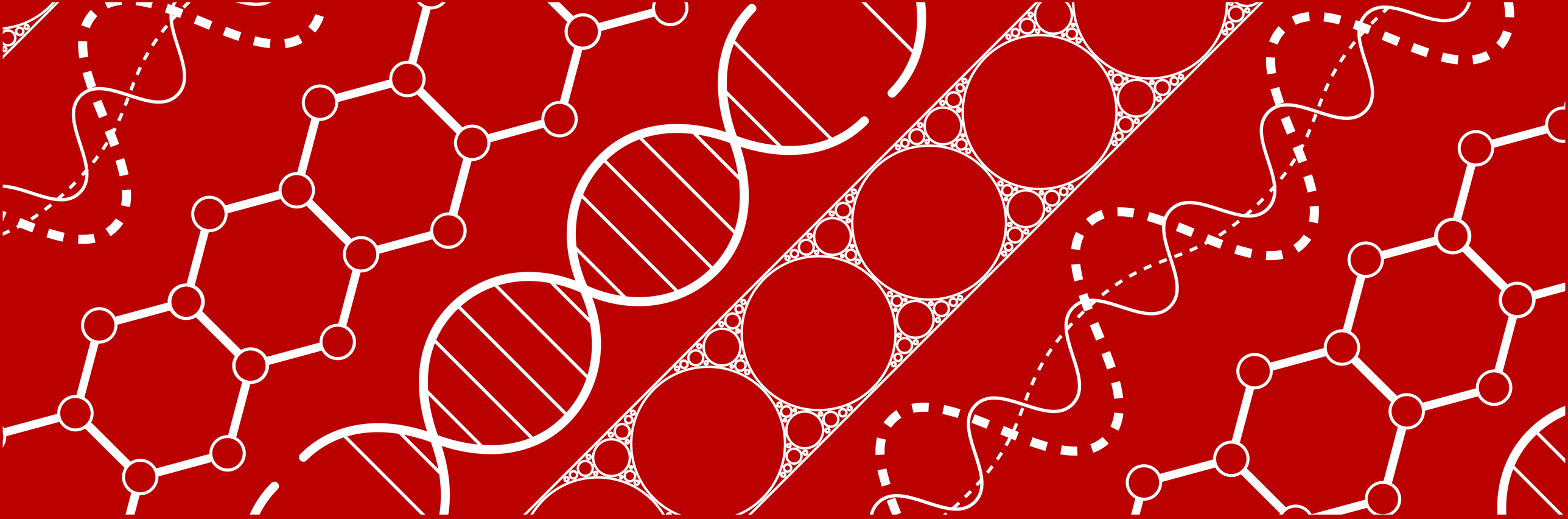

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Ardon Shorr, Ph.D.
AShorr@andrew.cmu.edu
Book appointment to visit MI 409G