

A glowing lightbulb is the central focus, set against a background of a sunset or sunrise with warm orange and yellow tones. Below the lightbulb, there is a blue grid pattern that curves across the bottom of the image. The text is overlaid on the top left.

February 3, 2021

# Creating STEAM by Design: Beyond STEM and Arts Integration

# Who we are



**Danah Henriksen**  
Associate Professor,  
Educational Leadership & Innovation



**Punya Mishra**  
Associate Dean  
Scholarship & Innovation

**Foundations of design and design thinking**

**What design thinking is**

**Design thinking and STEAM**

**Teaching, STEAM and design thinking**

**Wrap up**

**Q & A**



# Design Thinking

**Design**

**We live in a**

**Designed world**



**We live in a**

**Designed world**





**We live in a**

**Designed world**

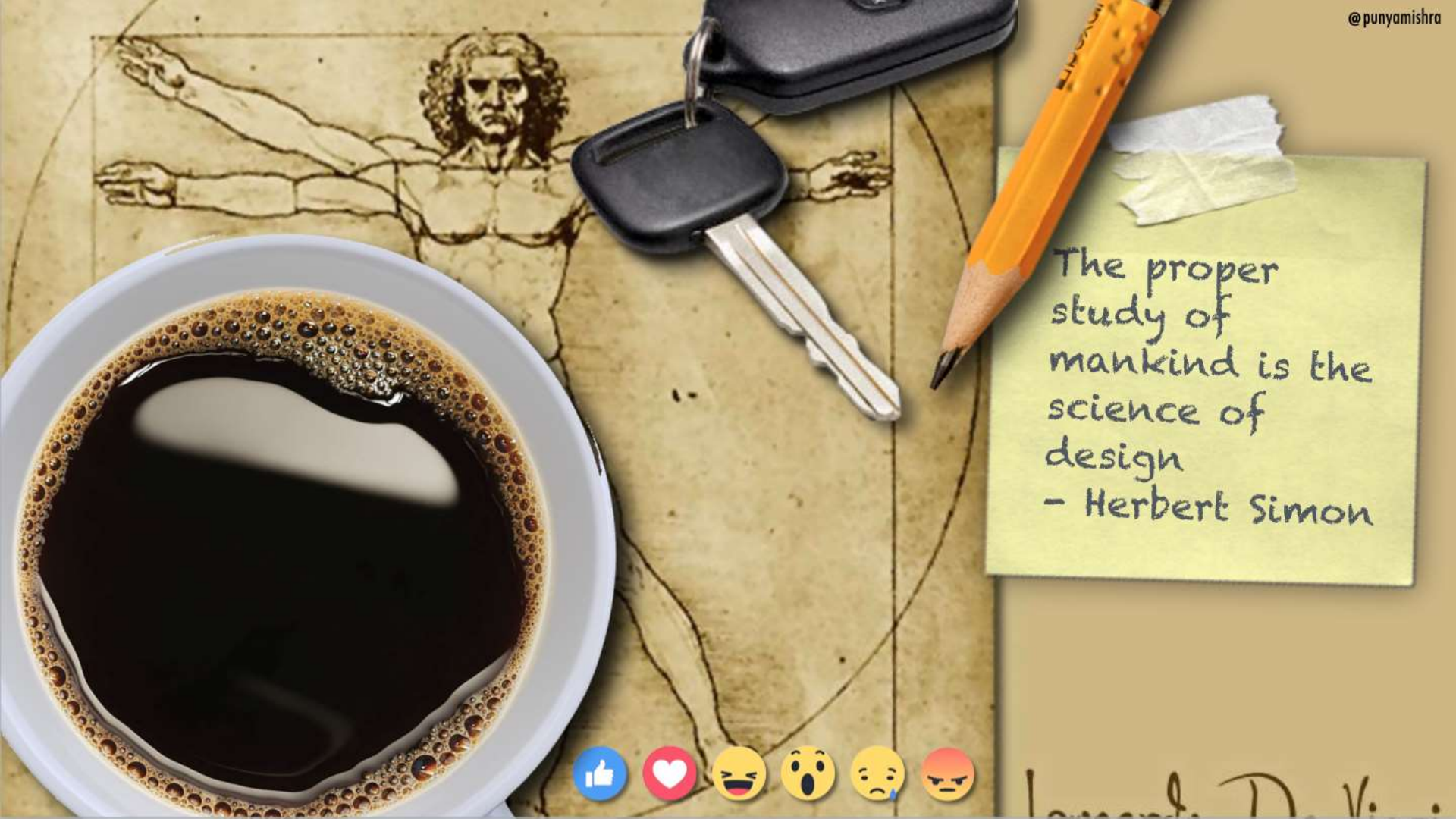
**99% invisible**



	<b>Sciences</b>	<b>Arts</b>	<b>Design</b>
<b>What to study?</b>	Physical Phenomena	Human experience	The artificial / the human created world

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<b>What we care about? (Values)</b>	Objectivity, rationality, neutrality, universalism, organized skepticism, and a concern for 'truth'	Subjectivity, creativity, commitment, imagination, a concern for "justice"	Practicality, empathy, ingenuity and an emphasis on the "particular"



The proper study of mankind is the science of design  
- Herbert Simon



Leonardo Da Vinci



A large, stylized question mark cutout is centered in the image. The cutout reveals a forest scene with trees and foliage in shades of green, brown, and yellow. The background of the entire image is a textured, painterly forest scene with similar colors. The question mark is a simple, bold shape with a circular top and a rectangular base.

**What is design**



**Defining design**

**Structure adapted to a purpose ~ David Perkins**





Defining design

# Structure adapted to a purpose ~ David Perkins



**Who designs?**



**Who designs?**

**Everyone designs who devises courses of action aimed at changing existing situations into preferred ones ~ Herb Simon**

**Why?**



**Who designs?**

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**How?**



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**Who?**



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Life can be much broader once you discover one simple fact: **Everything around you was made up** by people that were no smarter than you and you can change it, you can influence it, you can build your own things that other people can use.

Once you learn that, you'll never be the same again  
~ Steve Jobs





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Every aspect of education is **made up**







Every aspect of education is **designed**

Teachers  
are designers



# Teachers are designers

**of activities**



# Teachers are designers

of lesson plans





Teachers  
are designers

of curricula

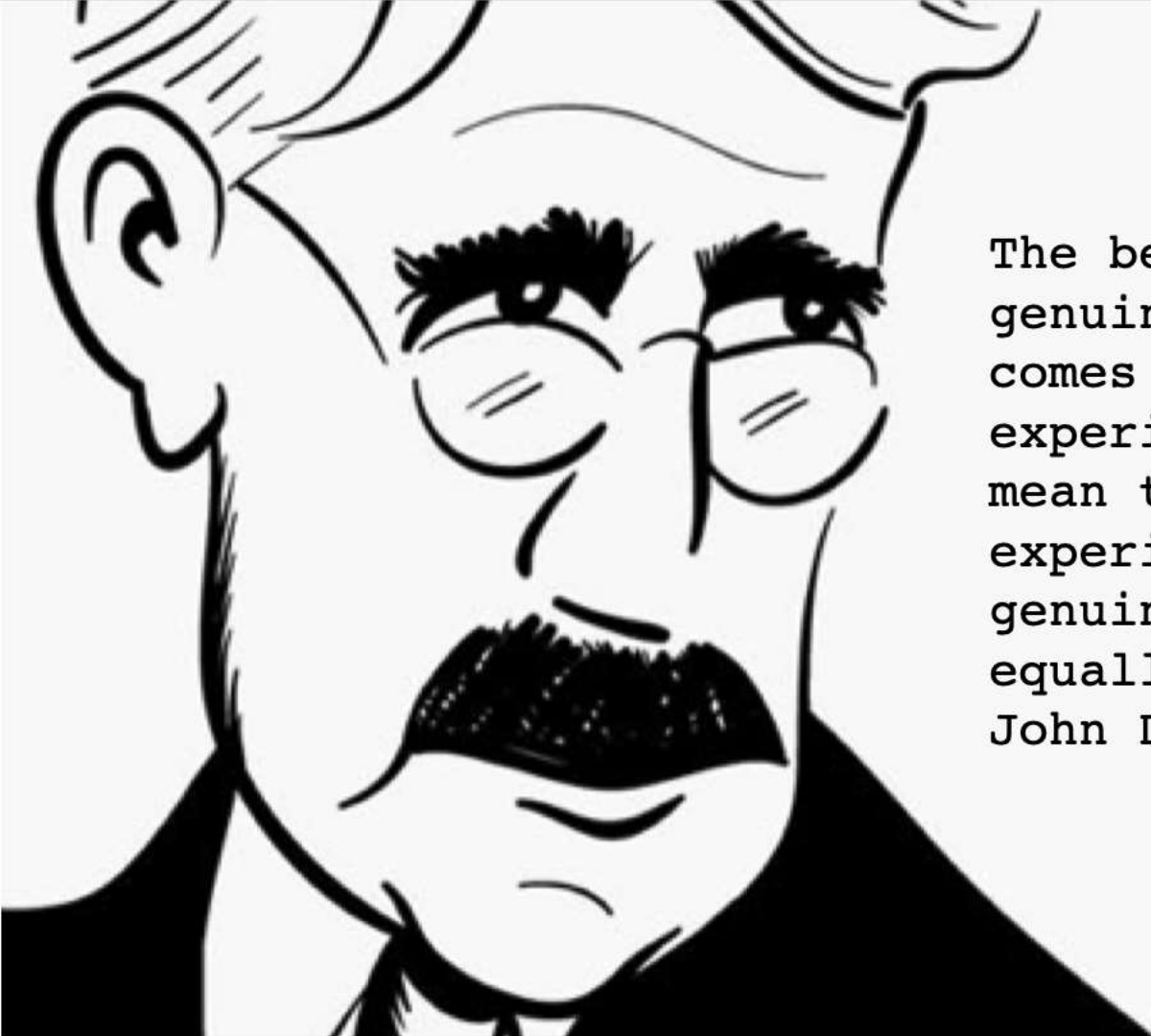




# Teachers are designers

of learning experiences





The belief that all  
genuine education  
comes about through  
experience does not  
mean that all  
experiences are  
genuinely or  
equally educative –  
John Dewey

# Dewey's 4 impulses for learning

## Inquiry



Finding things out

## Construction



Making or building things

## Communication

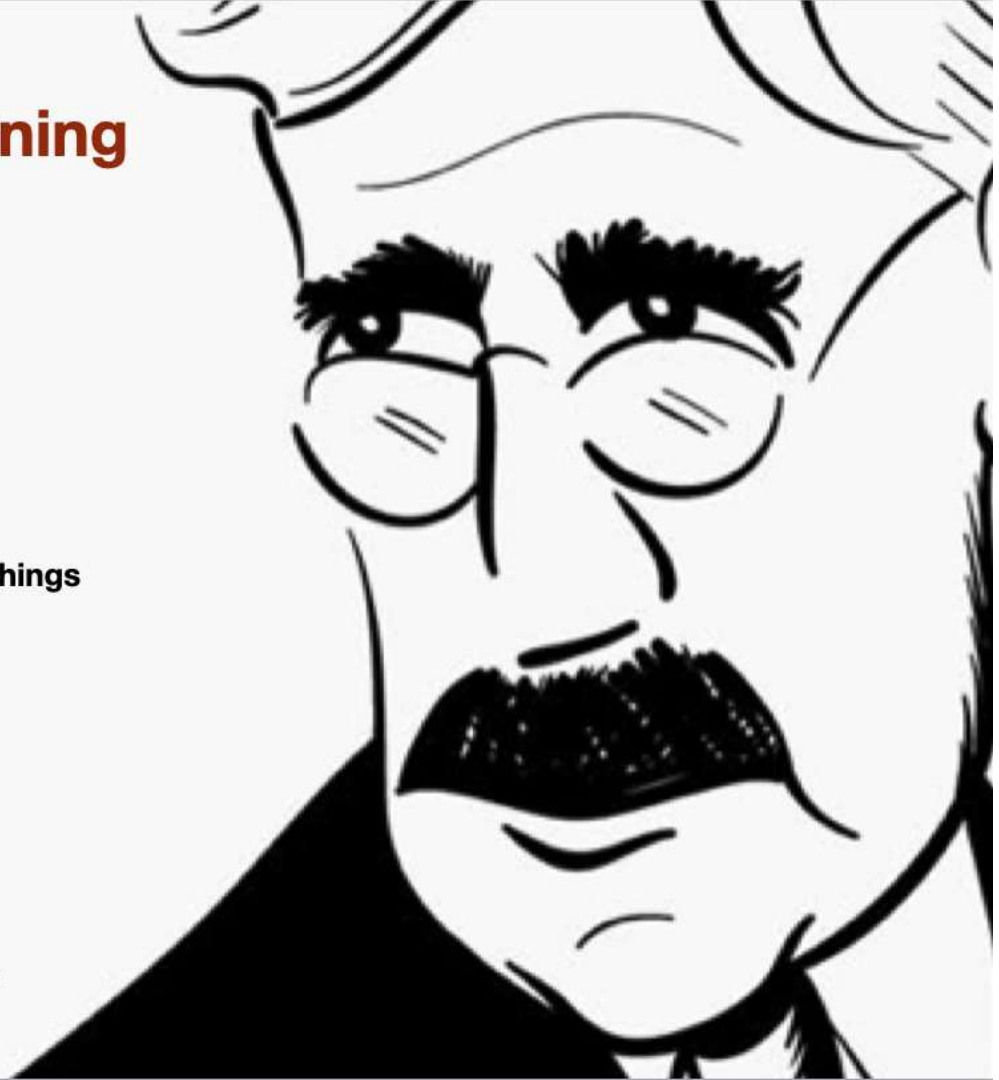


Interacting with others

## Expression



The artistic touch





Creative,

**interdisciplinary,**

**human-centered**

problem solving





**What is design  
thinking?**



# What is design thinking?





# What is design thinking?

Design thinking refers to the **cognitive, strategic and practical processes** by which design concepts are developed.

~ Wikipedia

# What *is* design thinking?

Design thinking is an iterative process seeking to **understand the user, challenge assumptions, and redefine problems in an attempt to identify alternative strategies and solutions** that might not be instantly apparent with our initial level of understanding.

~ Interaction Design Foundation, 2020

**UNDERSTAND  
THE PROBLEM**

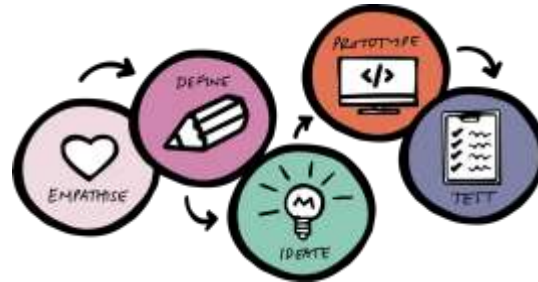
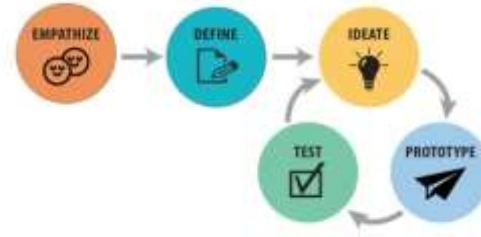
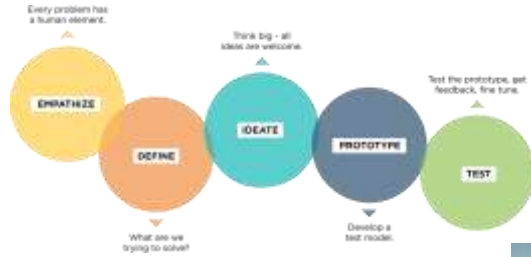
**DEVELOP POSSIBLE  
SOLUTIONS**

**IMPLEMENT**



**PROTOTYPE, TEST,  
& REFINE**

# So many design thinking models...

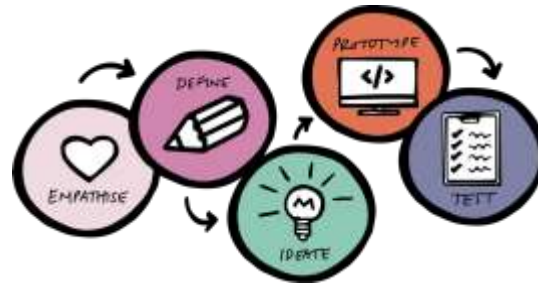


# So many design thinking models...

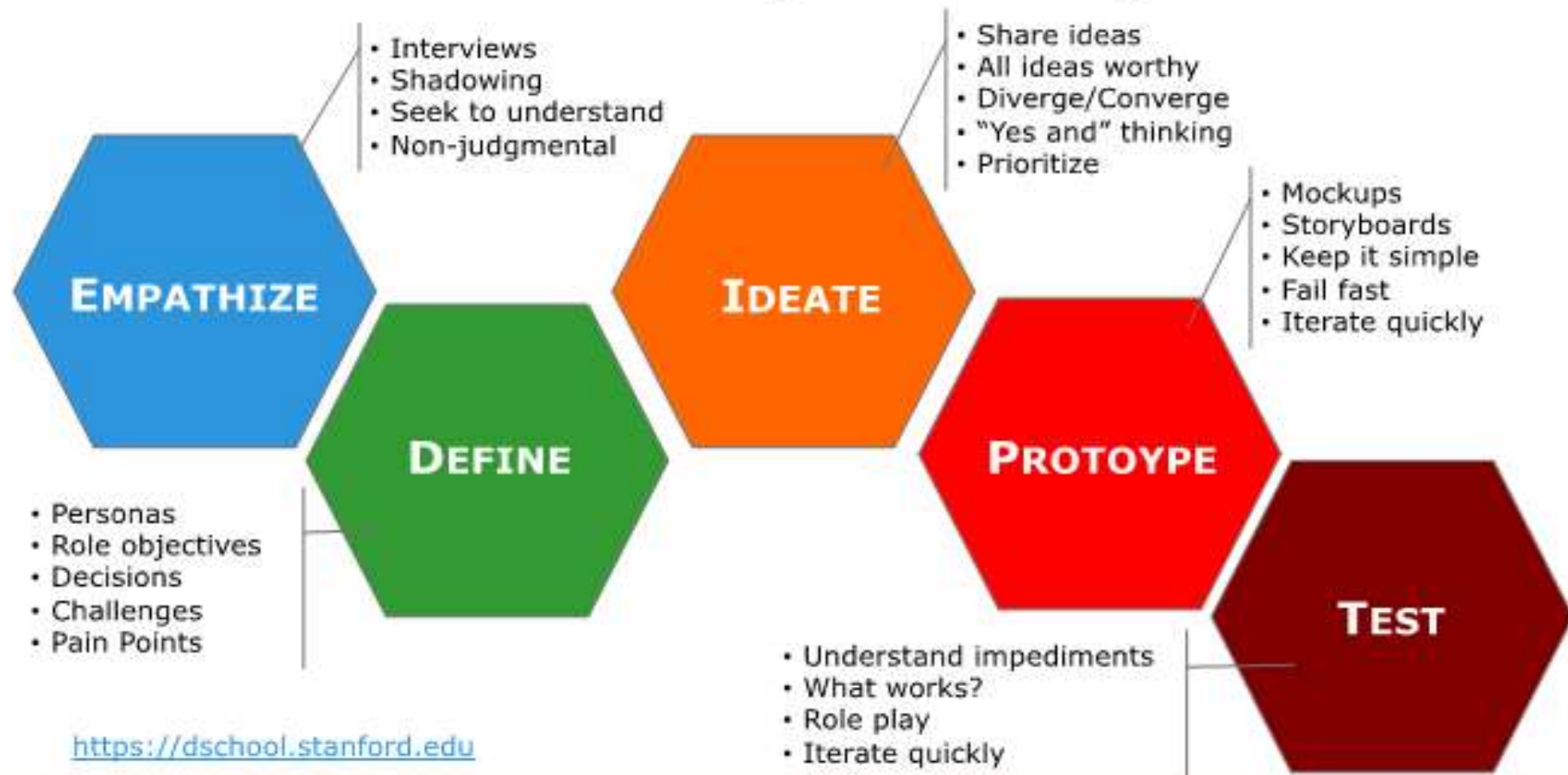


**...but most are really similar**

**DESIGN THINKING**



# Stanford d.school Design Thinking Process





EMPATHIZE



EMPATHIZE

DEFINE

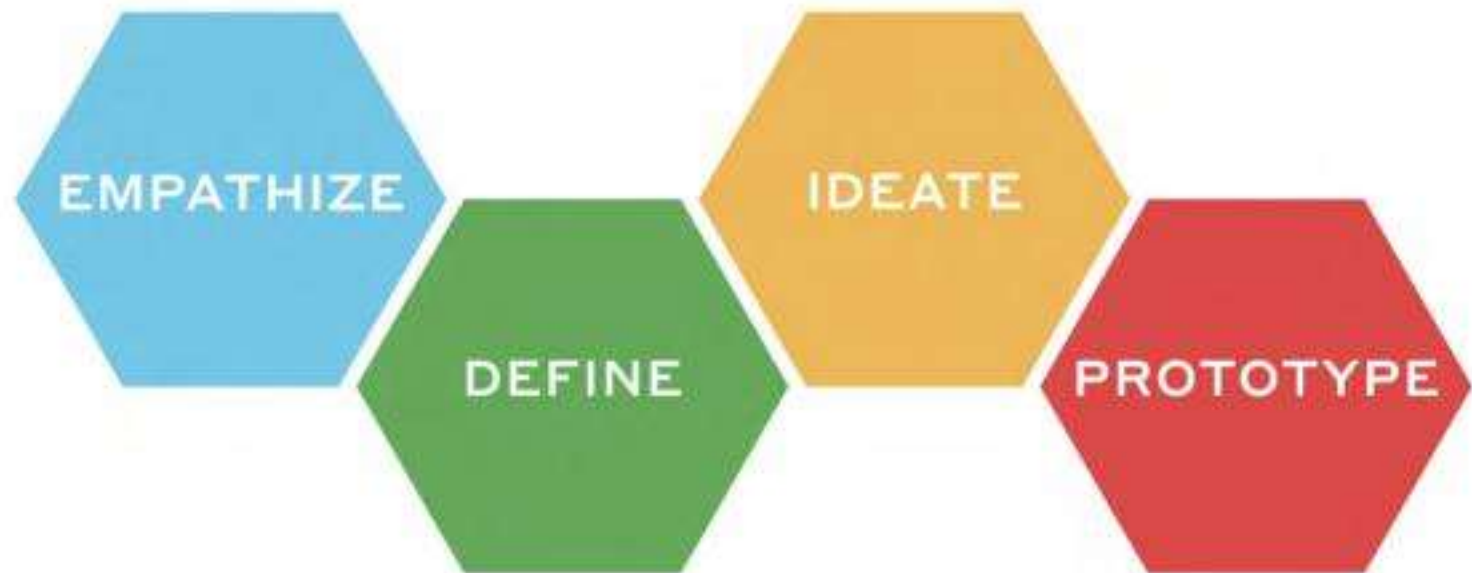


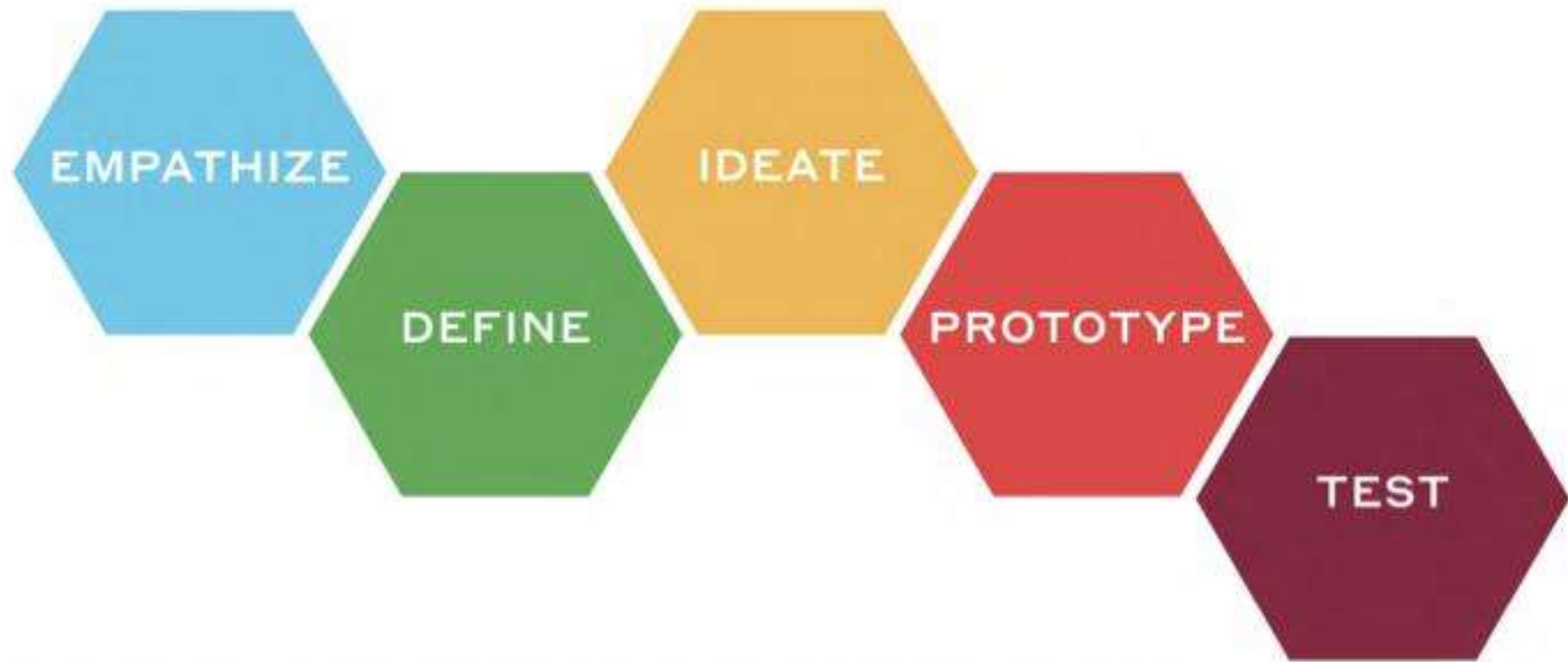


EMPATHIZE

DEFINE

IDEATE







**Why**

**design thinking**

**and STEAM?**



# Dewey's 4 impulses for learning

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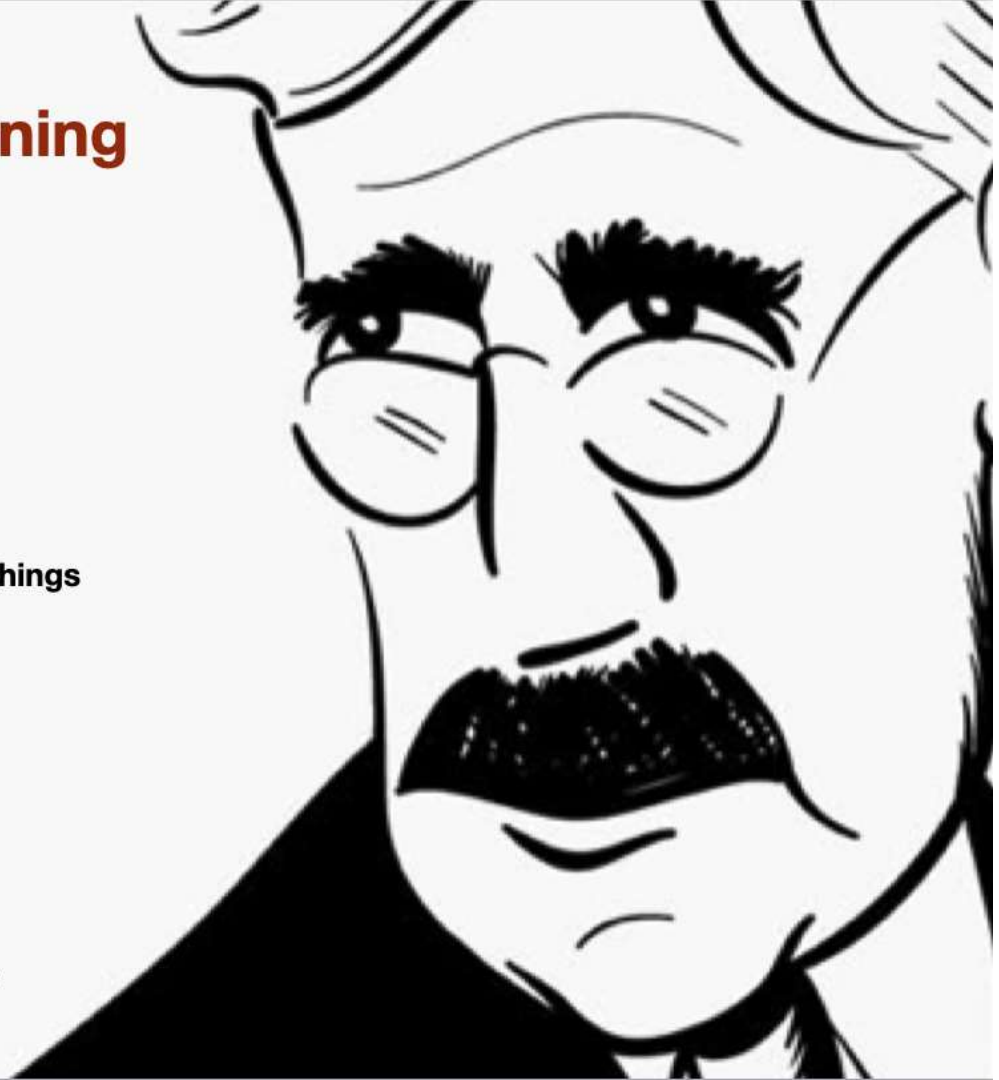


Interacting with others

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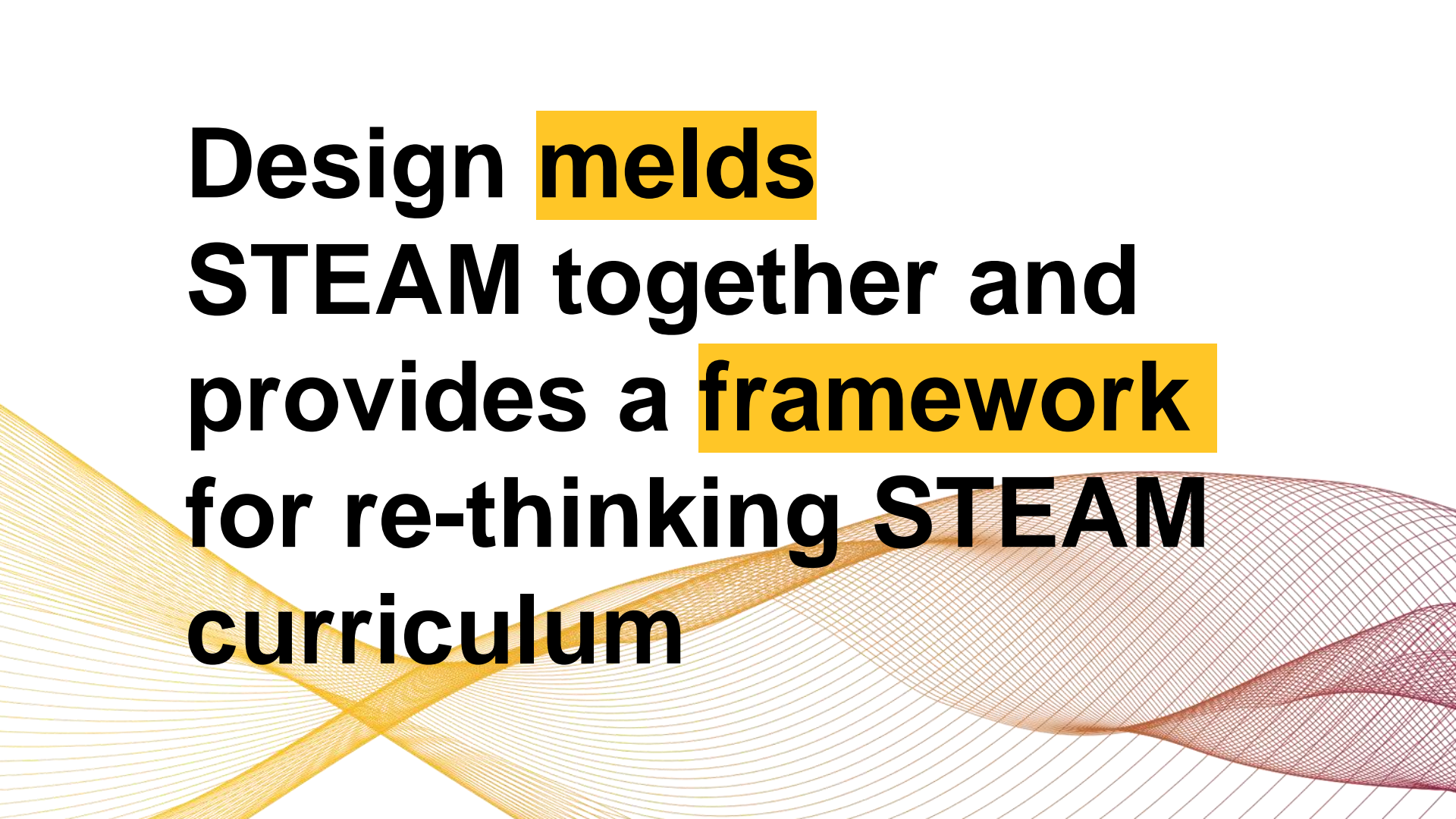


**design thinking**  
**is STEAM?**

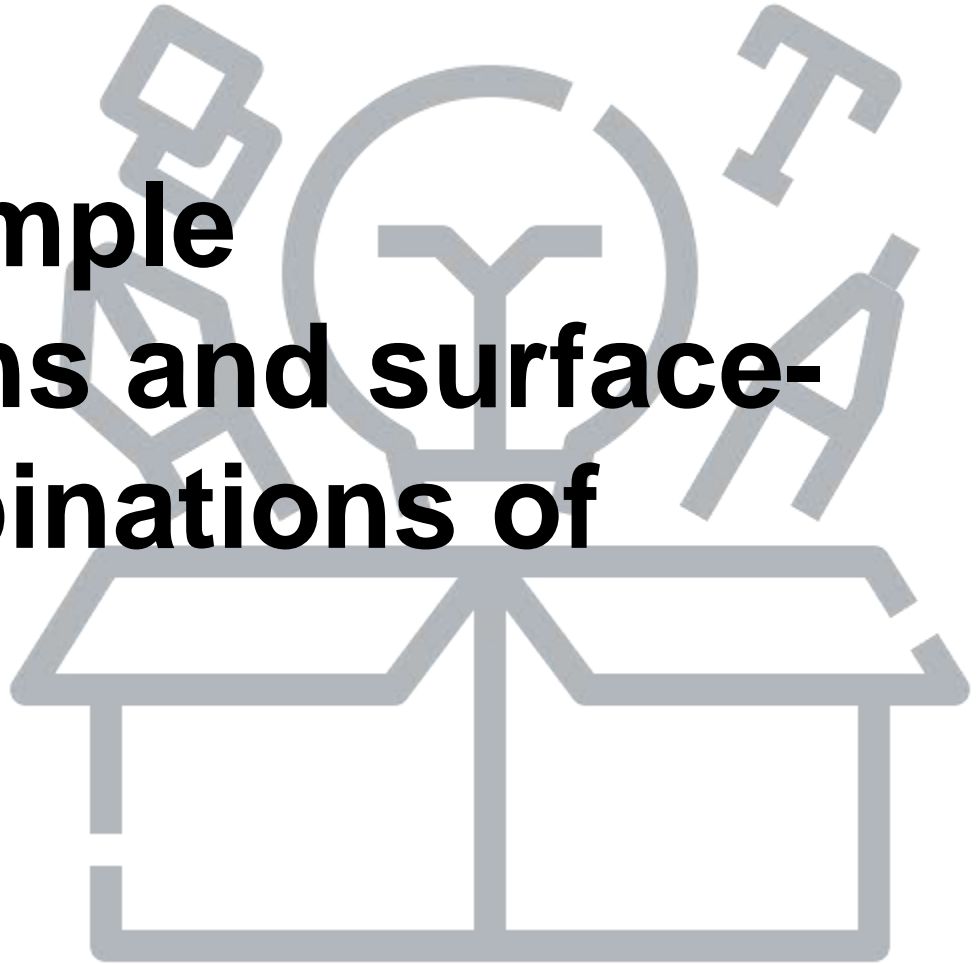
## Design thinking

An purposeful, analytic and creative process that engages a person to experiment, create and prototype models, gather feedback, and redesign.... **Goes beyond disciplinary boundaries**

**Design melds  
STEAM together and  
provides a framework  
for re-thinking STEAM  
curriculum**

The background features a decorative design of wavy, overlapping lines in shades of yellow and orange, transitioning into a fine grid pattern of red and orange lines that curves across the bottom right of the page.

**Beyond** simple  
connections and surface-  
level combinations of  
subjects...







Creative,

**interdisciplinary,**

**human-centered**

problem solving

# Design Thinking

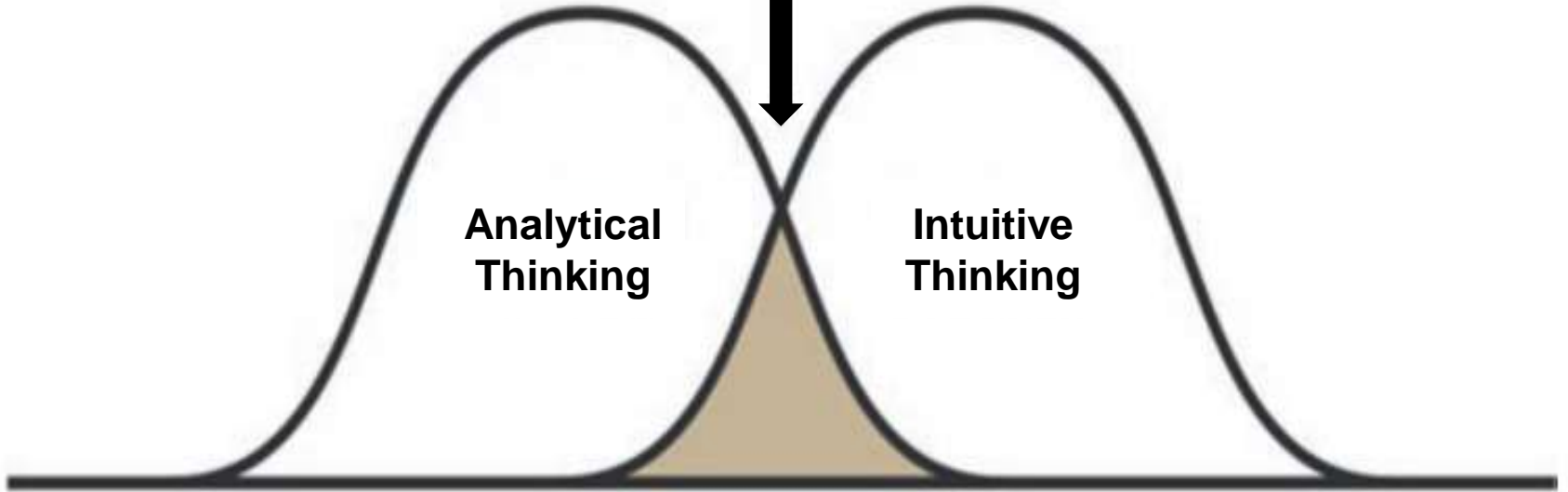


Analytical  
Thinking

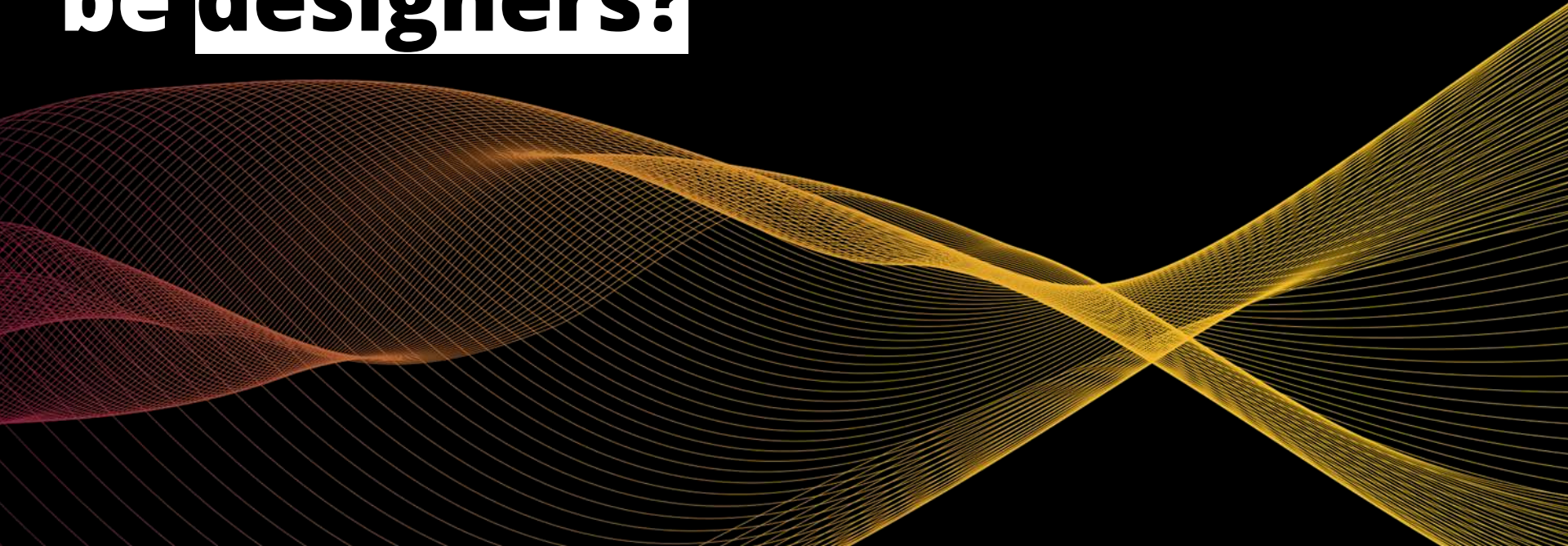
Intuitive  
Thinking

High  
Reliability

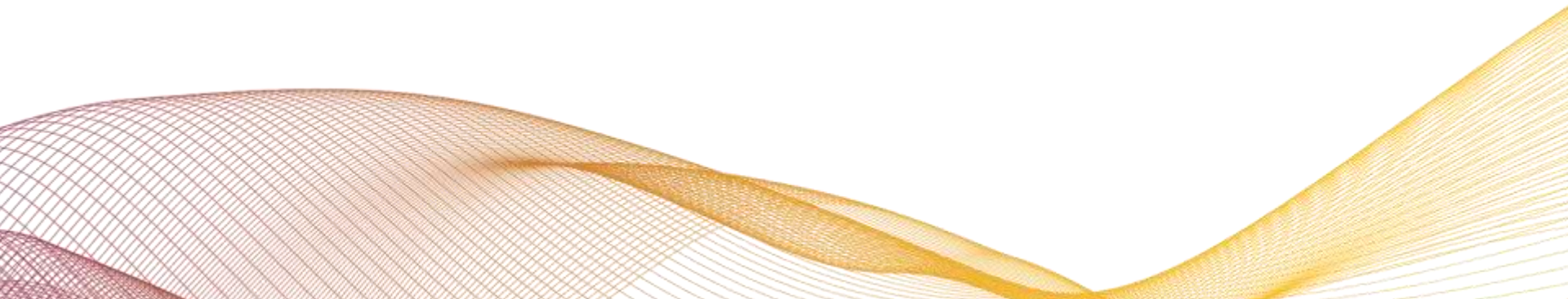
High  
Validity



**What does it mean for  
educators and learners to  
be **designers**?**

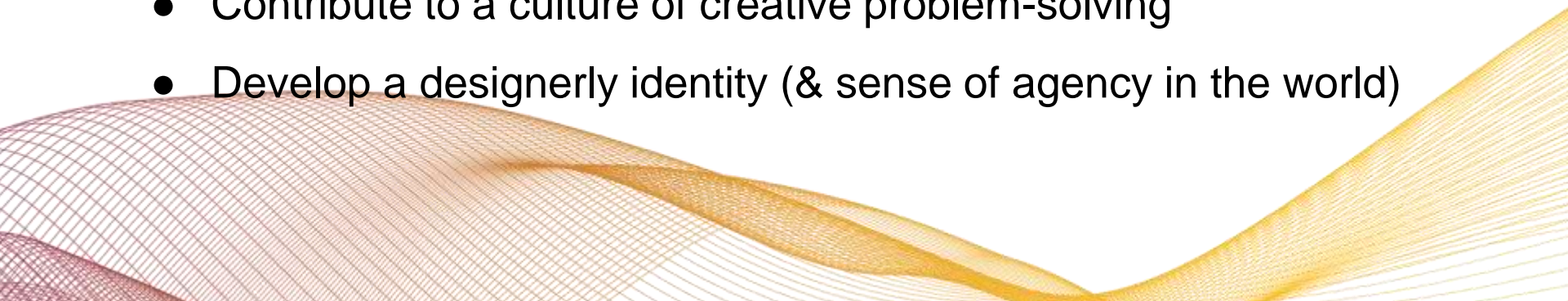


# **Educators as designers**



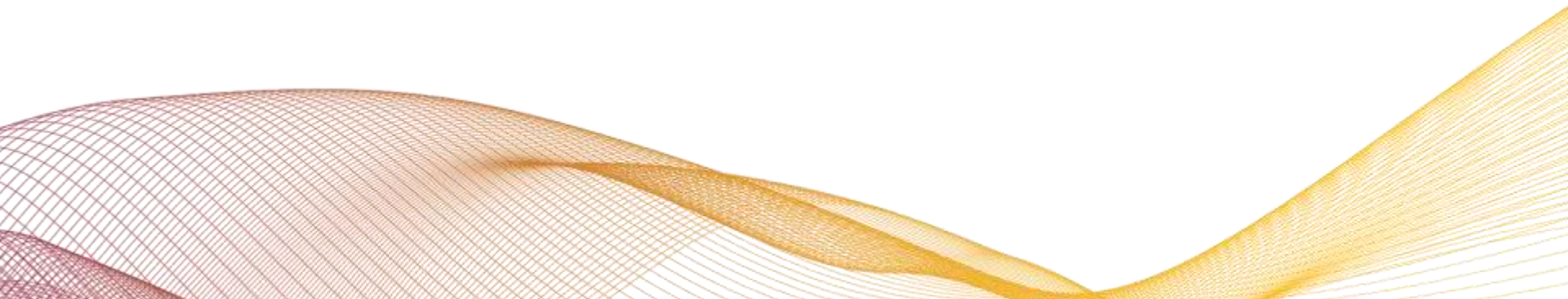


# Educators as designers

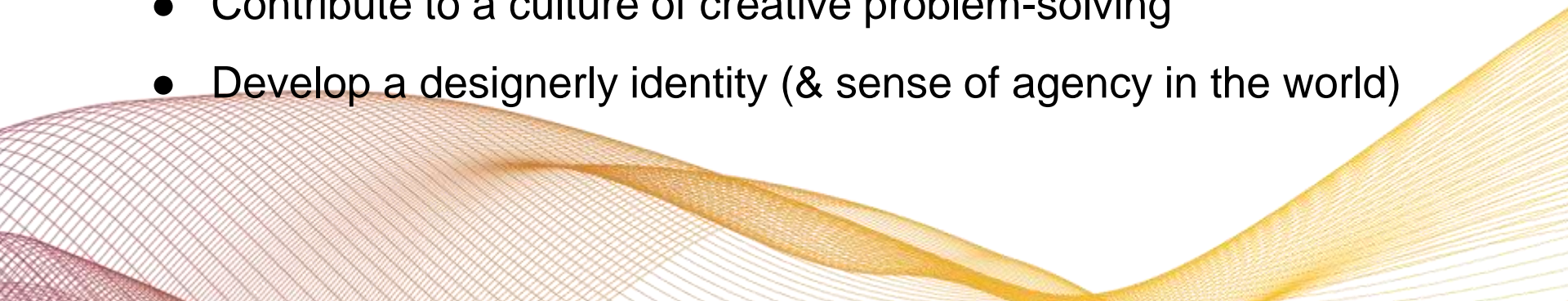
- Engage with authentic, interdisciplinary and real-world projects
  - Build resiliency and problem-solving ability
  - Cultivate an open-minded and creative approach
  - Develop a deeper understanding of self, others, and the task at hand (through empathy and inquiry)
  - Contribute to a culture of creative problem-solving
  - Develop a designerly identity (& sense of agency in the world)
- 
- The bottom of the slide features a decorative graphic consisting of several overlapping, wavy lines. These lines are rendered in a light orange or yellow color and create a sense of movement and depth, resembling a stylized landscape or a series of ripples. The lines are most prominent on the left and right sides, curving upwards and then downwards towards the center.



# Learners as designers



# Learners as designers

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# Teachers are designers

of learning experiences





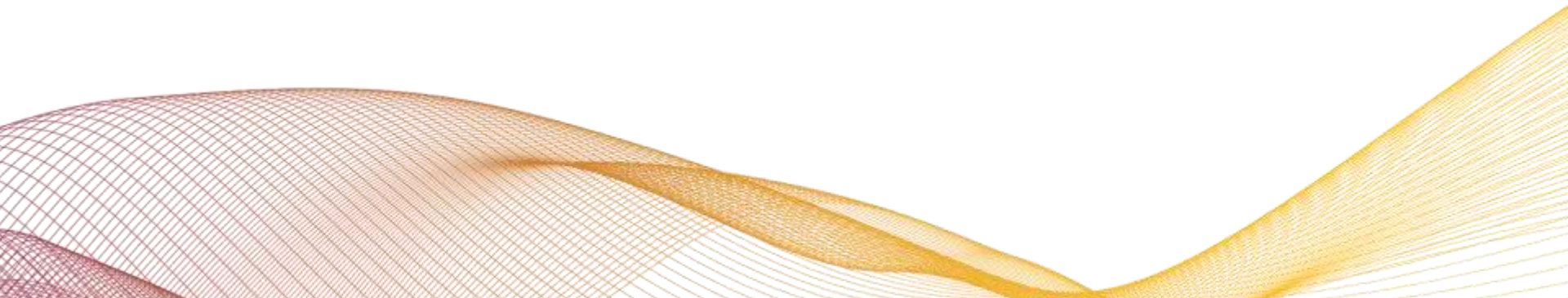


**Design snapshot:**  
***Blending disciplines in a  
real-world shoe design  
project***



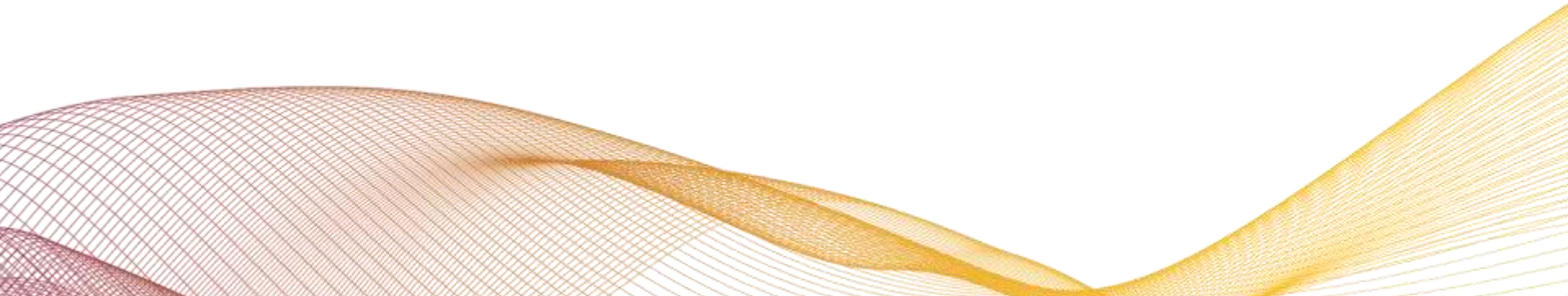
## Disciplinary integrations: 4th grade students

- “Fancy feet” project
- STEM and aesthetics come together in shoe design
- Developed with ideas from the *Teach Engineering* website
- 9-year-olds explored the roles of designers and engineers in shoe manufacture, experimented with materials, and then designed and constructed their own pairs of shoes.




## Disciplinary integrations: 4th grade students

- Students posed their own statistical questions to investigate their feet and shoes, and those of their peers
- Learned about “natural and processed” materials



## Disciplinary integrations: 4th grade students

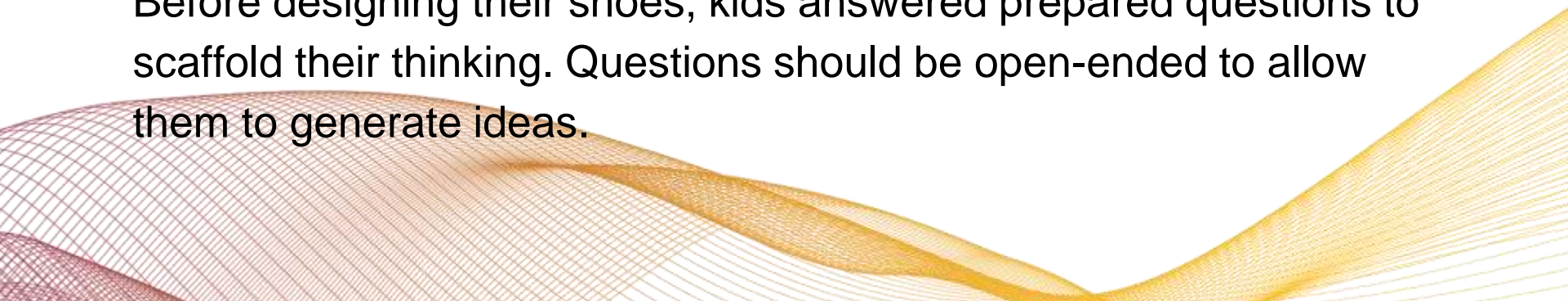
- Students (a) **identified a design need** (problem/challenge);
- (b) **identified properties of common materials** for shoe design;
- (c) applied design processes including **generating ideas, planning, and designing desired shoes**
- (d) **selected appropriate materials** for creating their shoes;
- (e) **constructed an initial model**, taking into account given constraints; and
- (g) **tested, evaluated, and suggested ways to improve their product**
- 

## Disciplinary integrations: 4th grade students

Students go through these phases or modes of design...but that's not all they are doing.

The teacher designed the project to ensure that opportunities to gather information and knowledge were embedded along the way

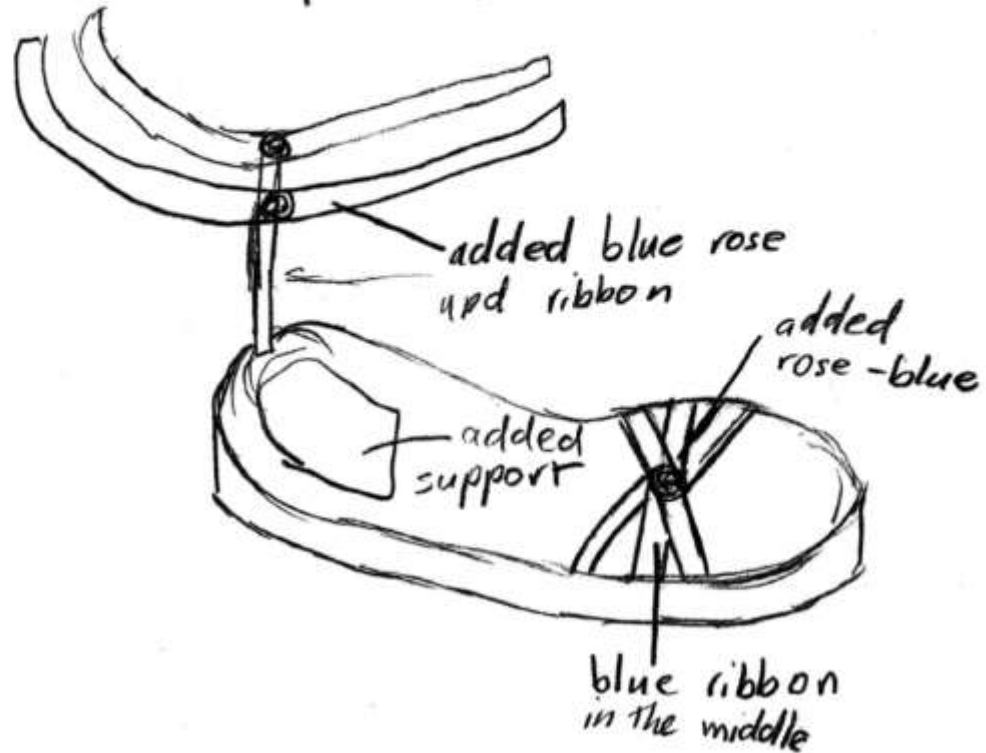
Before designing their shoes, kids answered prepared questions to scaffold their thinking. Questions should be open-ended to allow them to generate ideas.



**Fig. 3** A 3-D redesign sketch displaying both features and explanations

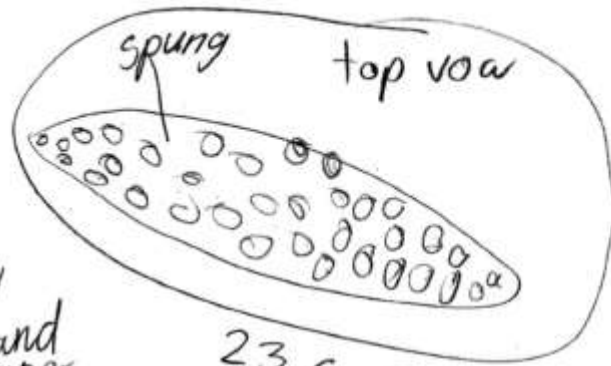
2<sup>nd</sup> design

All the blue additions were for beauty, the added support was for support.

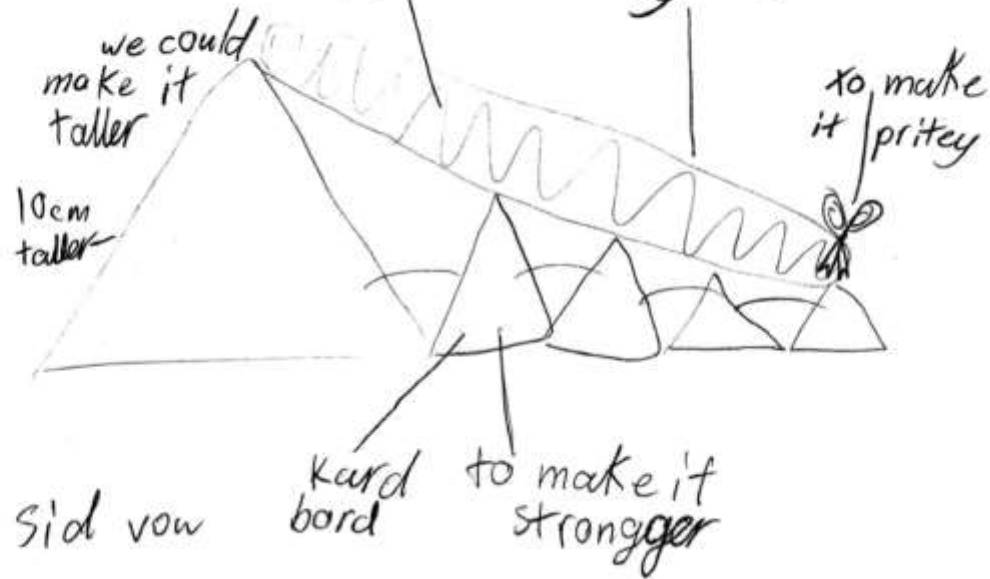


2<sup>nd</sup> design

put plastic  
around the howl  
thing.



23.6 cm  
long

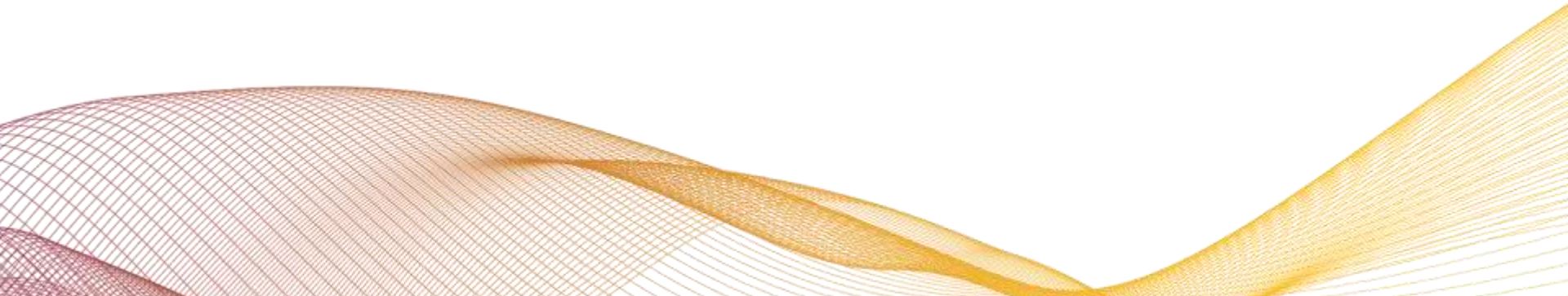


Side view



## Toward “Informed Design”

- Getting kids to learn while designing.
- Bigger picture projects over time
- Multiple disciplines connect in real-world types of tasks

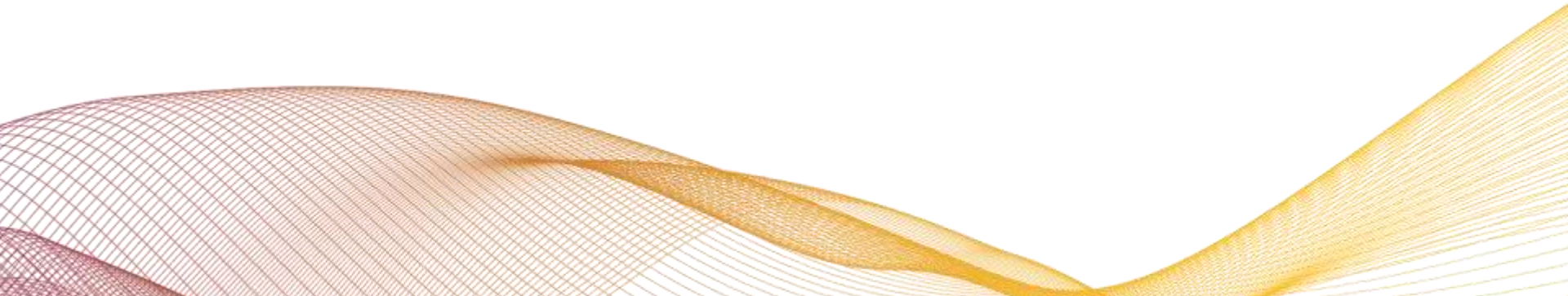


The background is a solid yellow color. Overlaid on this are several white, wavy, ribbon-like shapes that flow across the frame. A subtle white grid pattern is also visible, particularly in the lower right quadrant, where it appears to be formed by the intersection of the wavy lines.

**Design snapshot:**  
***Breaking traditions in  
Spanish and going to the  
real world***

## Katherine: 4th grade teacher

- Teaching elementary level Spanish lessons to introduce students to new vocabulary
- Seeking more interdisciplinary, engaging and creative lessons
- She worked through the design process to develop a creative STEAM project to teach the subject matter...and much more.

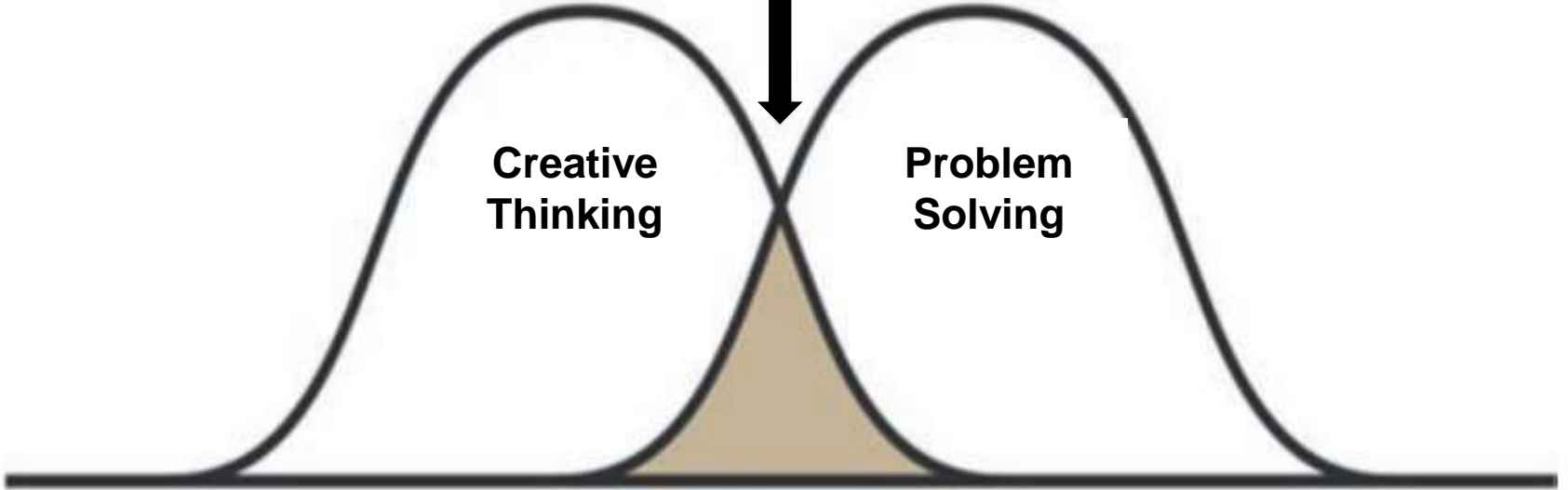


# Design Thinking

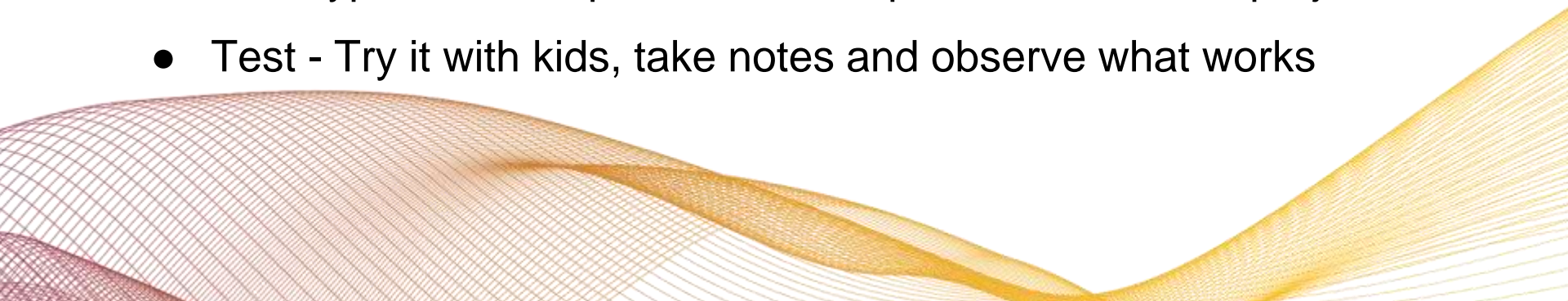


**Creative  
Thinking**

**Problem  
Solving**



# Design Processes for the Teacher's Thinking

- Empathy - Informal interviews/surveys to understand student motivations and interests
  - Define - Let kids spend time with issues to make connections between school and their world
  - Ideate - Brainstorm on an idea with several fellow teachers
  - Prototype - Come up with a lesson plan for first run of project
  - Test - Try it with kids, take notes and observe what works
- 
- A decorative graphic at the bottom of the slide consists of several overlapping, wavy lines in shades of orange and yellow, creating a sense of movement and depth.



# Clean water issues in Spanish speaking countries

**Initial goal:** A better Spanish vocabulary lesson

**Outcome:** Interdisciplinary STEAM project where students researched the scientific dimensions of water usage, and considered problems that happen in Spanish speaking countries, learning about the water cycle, and brainstorming to teach other students about the intersection of these issues.



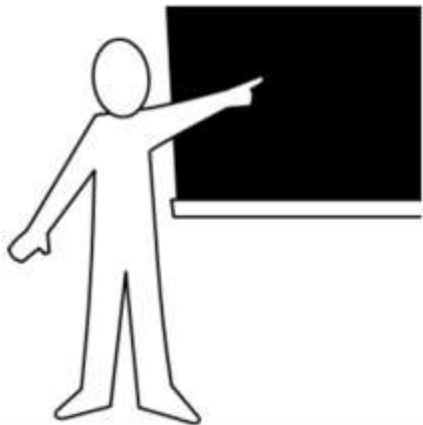
# Clean Water Project

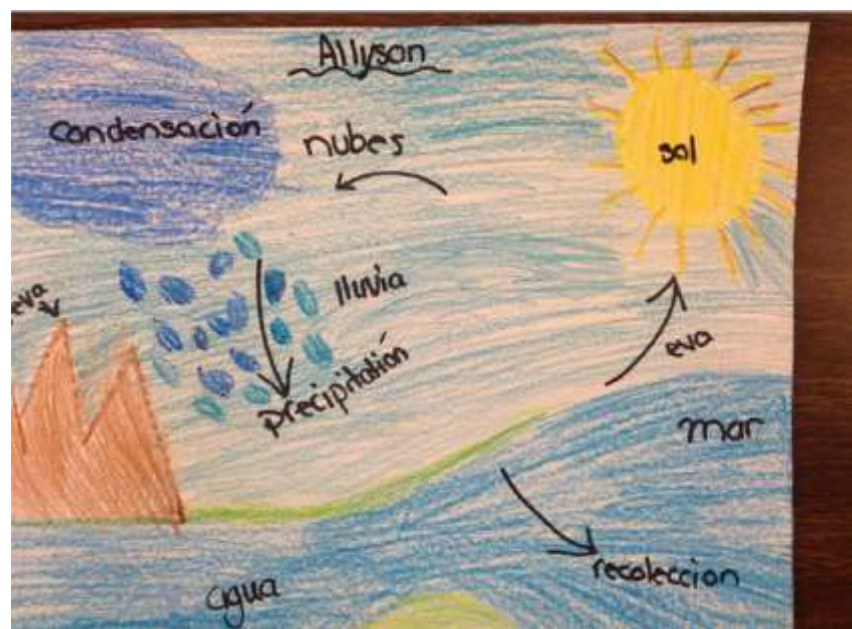
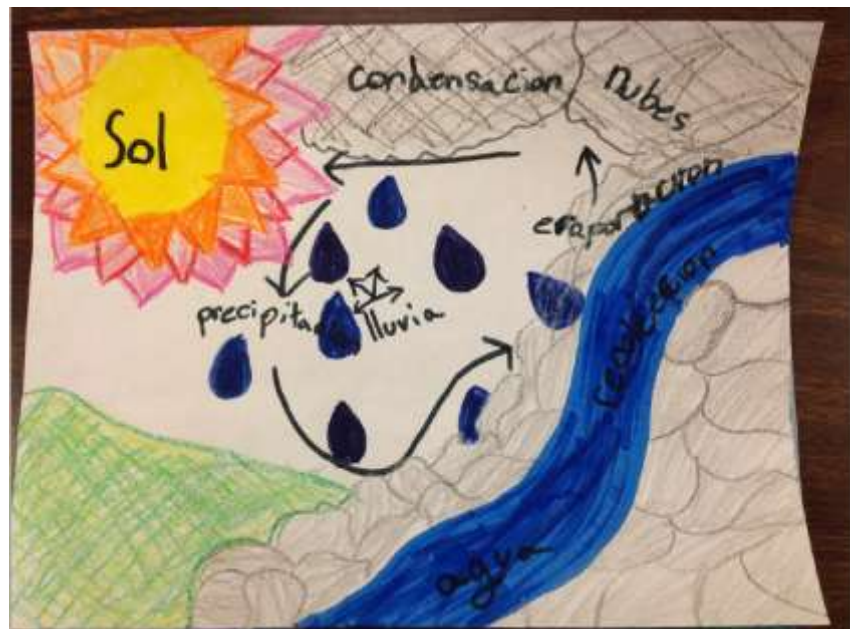
Search this site

[Home](#) [Introduction](#) [Task](#) [Process](#) [Evaluation](#)

## Task

You are responsible for teaching other students in the school about the water crisis in a Spanish speaking country. You will be researching information about a chosen country and designing a solution to their water problem.





# Clean and Dirty Water Board Game

- Provided kids with clean and dirty water tokens
- Dirty water tokens exceeded the clean water tokens
- Rationing water
- Using empathy, helping if someone ran out





“Learning about design thinking came at a great moment in my teaching career. It allowed me to feel like a designer. I believe this process of design promotes creative thinking, collaboration, student ownership and responsibility of learning...you could take many different paths through and modify this process as needed.

Without it, I would have struggled creating this project for my students. As a designer, it was exciting to see the development and changes from start to end.”

~ Katherine

The bottom of the slide features decorative wavy lines. On the left, there are overlapping, semi-transparent lines in shades of pink and red. On the right, there are overlapping, semi-transparent lines in shades of yellow and orange. These lines create a sense of movement and depth, framing the text above.

# Design Thinking in Teacher Education

# Design Thinking in Teacher Education

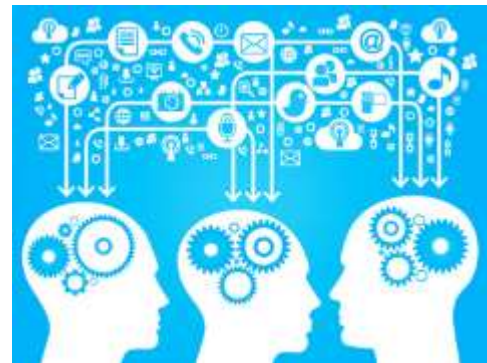


# Major Themes

Becoming Open to Uncertainty

Valuing Empathy

Seeing Teaching as Design



# Becoming Open to Uncertainty

“We think we know why problems occur. We think we have the answers. So often we skip empathizing and understanding and defining and jump right into a solution. We struggle to look at all the factors, reframe the problem, or **be okay with the uncertainty**.  
Fortunately, I see it now.”

# Valuing Empathy

“Understanding the people impacted by the design helps a teacher understand how to create a successful product. As I interviewed my class my students waved their hands in the air enthusiastically wanting their voice to be heard. In the past, I would turn to my mentor teacher for advice. **In the empathize phase I learned the importance of the student or user voice...**What I thought my class was thinking was not necessarily what they were actually thinking.”

# Seeing Teaching as Design

“I no longer see myself only as a teacher, but as a designer. After taking this class I realized misconceptions I had about design. I had always thought a design was based on an idea that popped into your head. I always thought people that came up with excellent design ideas were the people that just naturally had great ideas. This work has taught me that **everyone can be a designer and that there is a process. Teaching is design...**I was a designer without even realizing it.”



**To sum up...**



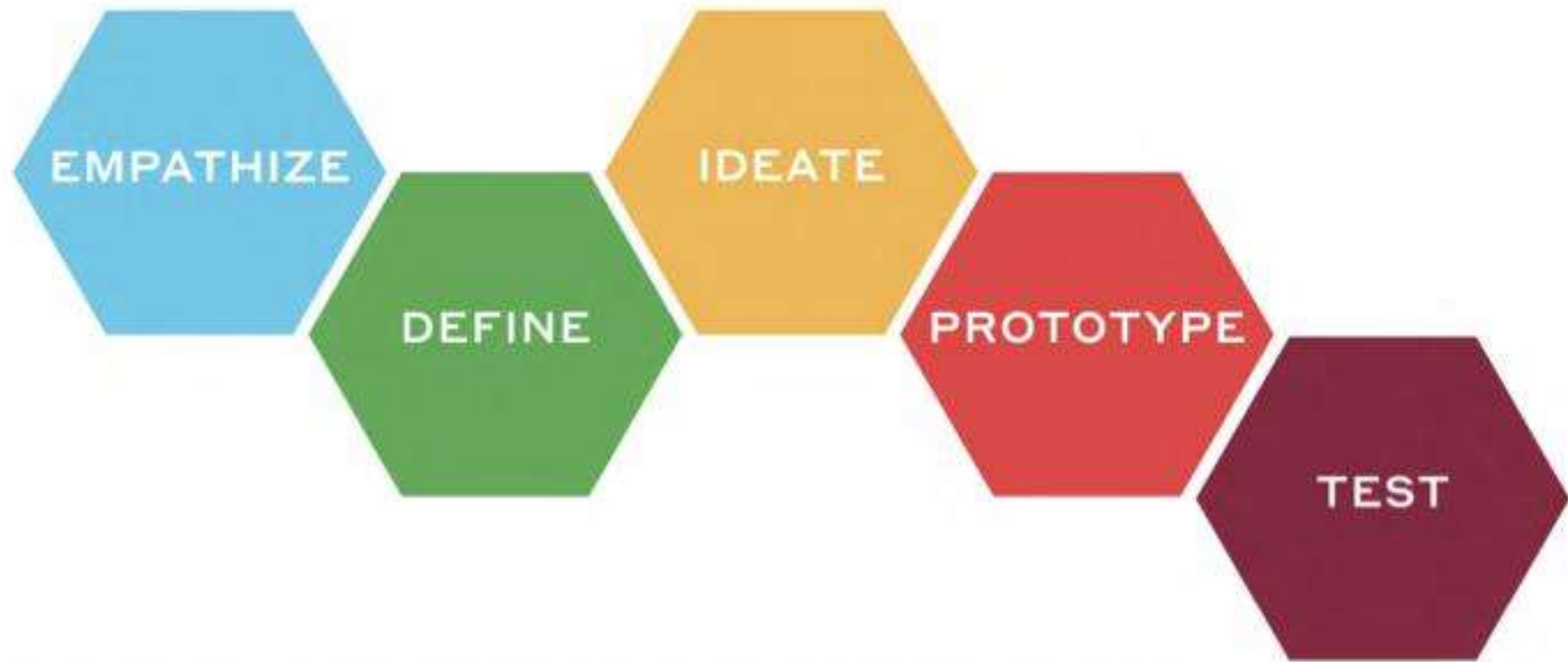


Every aspect of education is **designed**



Teachers  
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**Teachers &**

**Students**

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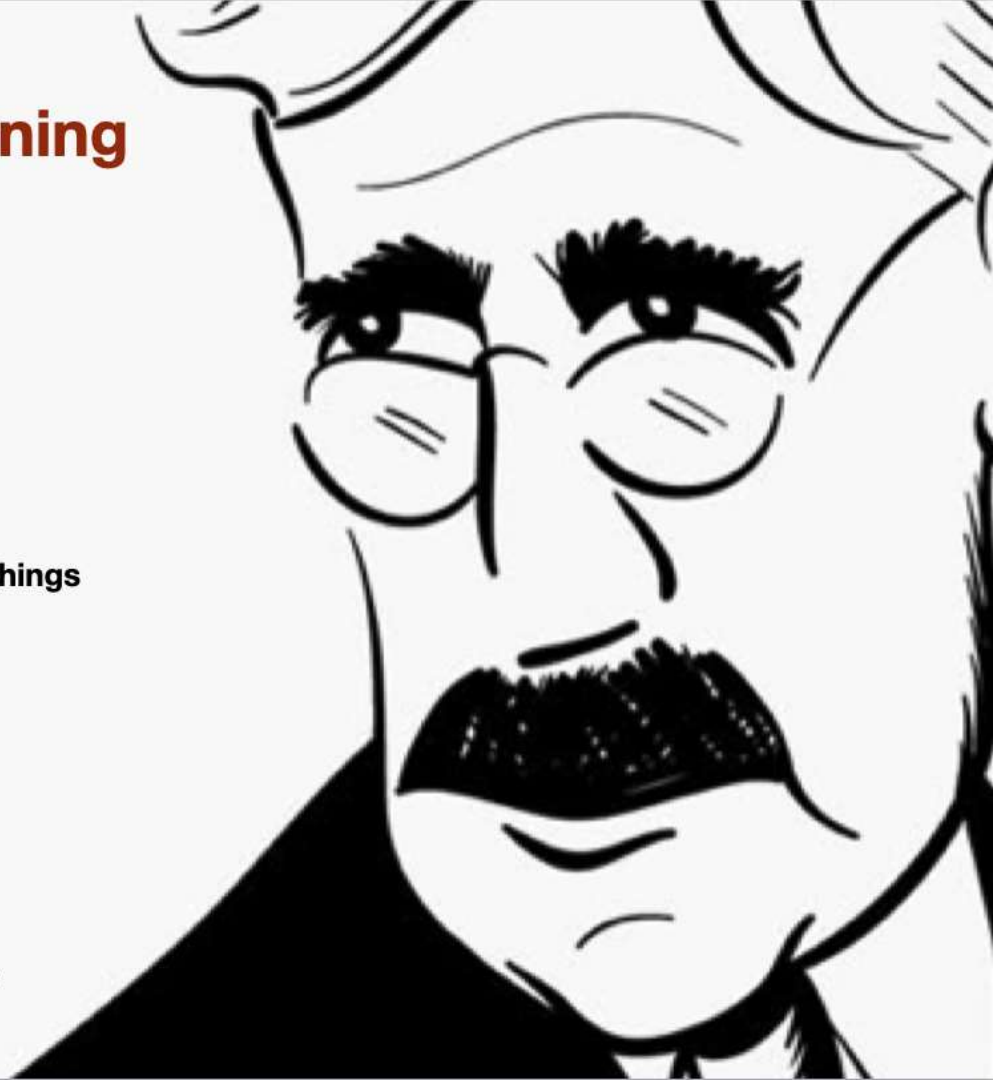


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# Thank you!

**Danah Henriksen**  
danah.henriksen@asu.edu  
danah-henriksen.com

**Punya Mishra**  
punya.mishra@asu.edu  
punyamishra.com