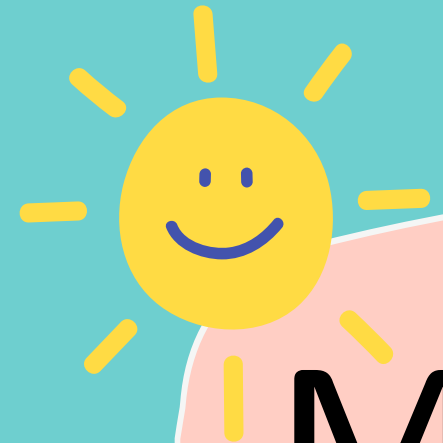




มหาวิทยาลัยมหิดล  
สถาบันนวัตกรรมการเรียนรู้



MODEL-BASED

MODELING

INSTRUCTION



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# OUTLINE

This session aims to introduce "the modeling instruction" for improving the learner's conceptual understanding. The audiences will have direct experience in learning with "modeling instruction".

What is model-based and modeling instruction?

How to teach modeling instruction effectively?





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# What is a model?





# NATURE OF MODEL

## Scientific model

- Simplified objects and/or processes
- Explain phenomena



## NATURE OF MODEL

### Benefits of models in science education

- Construct conceptual understanding
- (Self-)Assess conceptual understanding

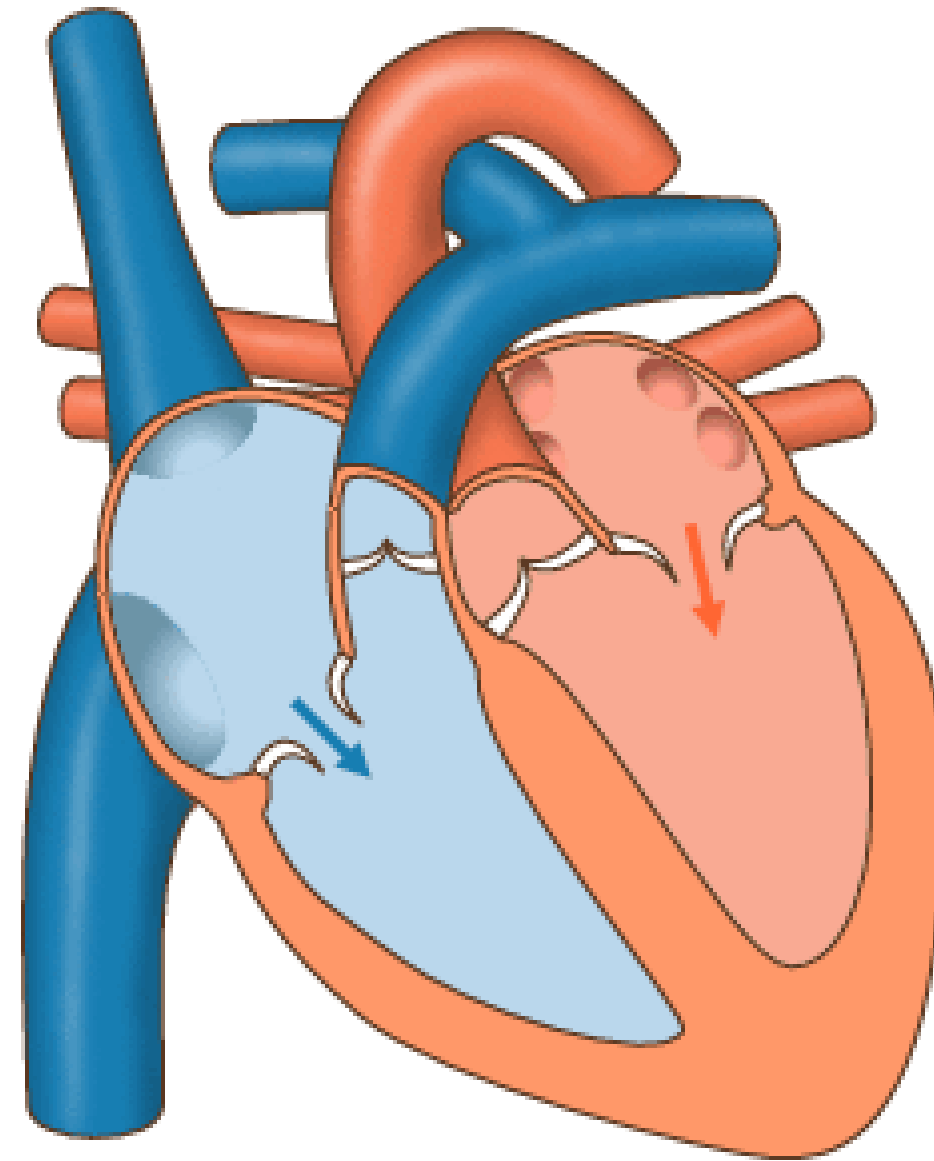


# Characteristics of a Good Model

- Coherent with existing knowledge
- General within its scope
- Accurate despite its limitation
- As simple as possible but no simpler
- Useful application in the real world

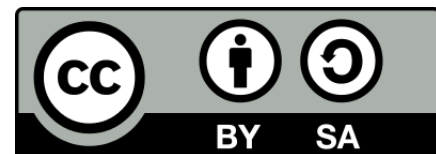
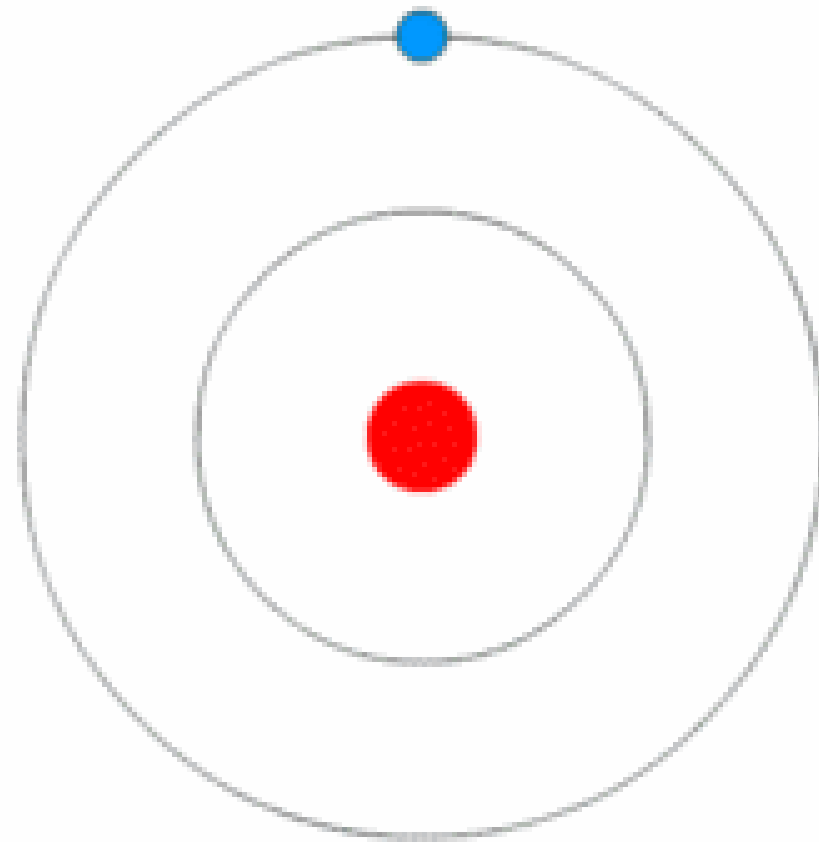


# MODEL'S EXAMPLE





# MODEL'S EXAMPLE



Bohr's model of a hydrogen atom. Image by Kurzon.





# MODEL'S EXAMPLE

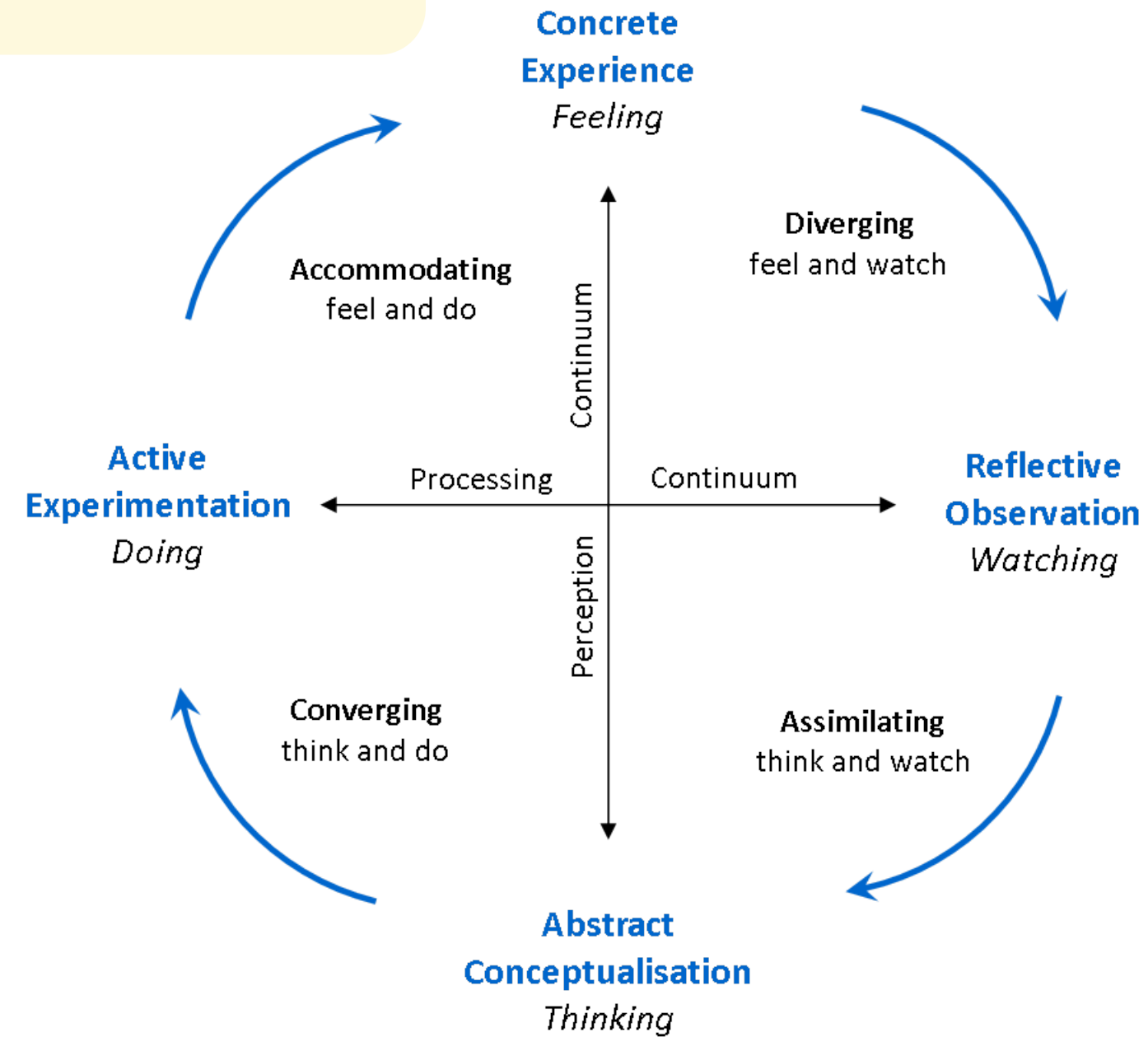
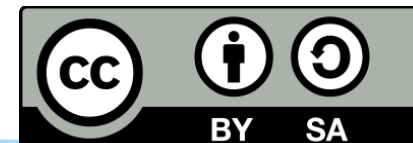
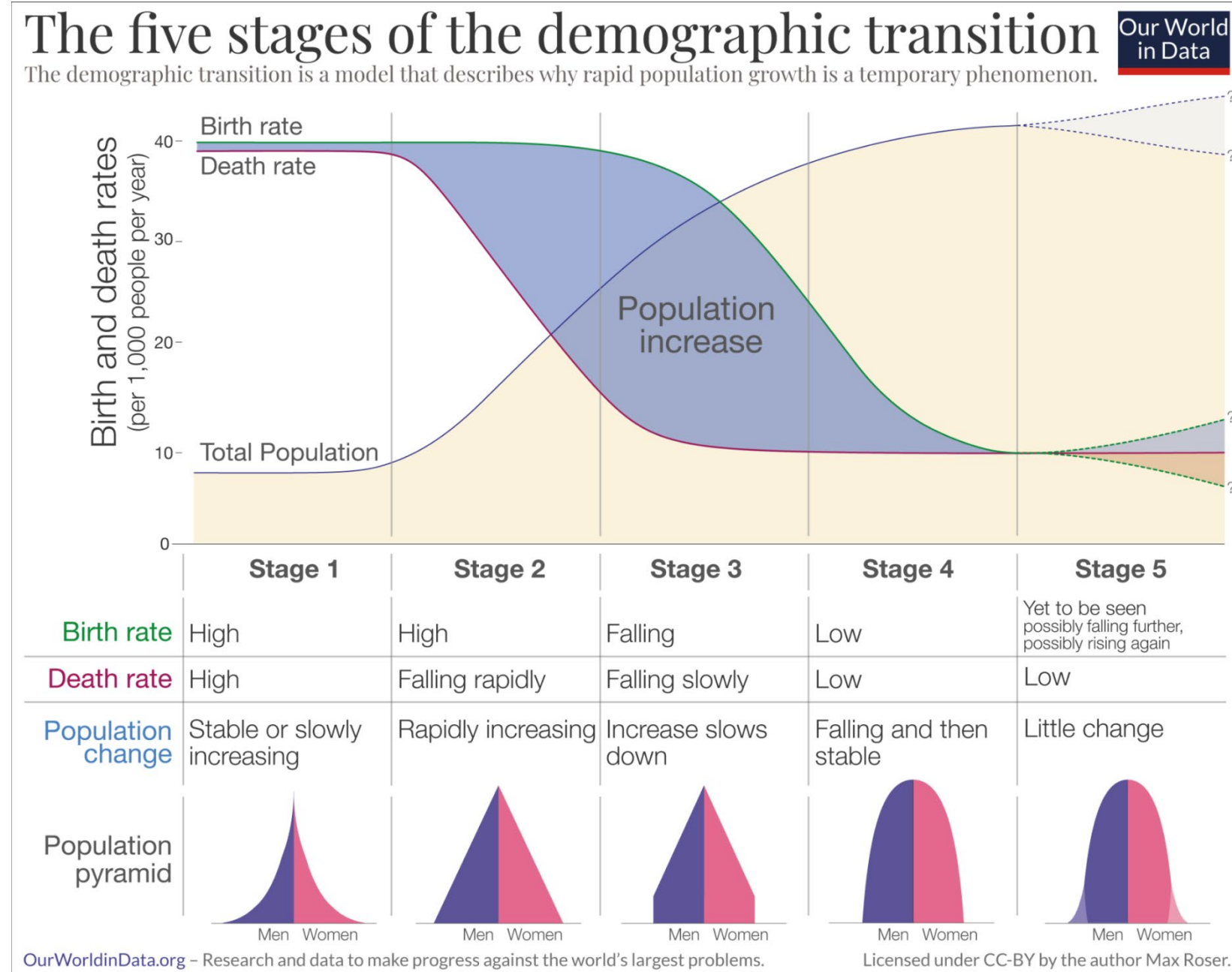
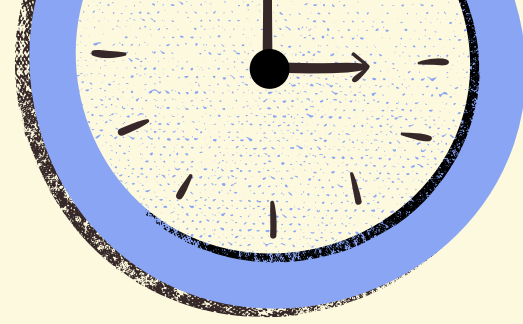


Photo credit: <https://emia6.wordpress.com/2013/03/>

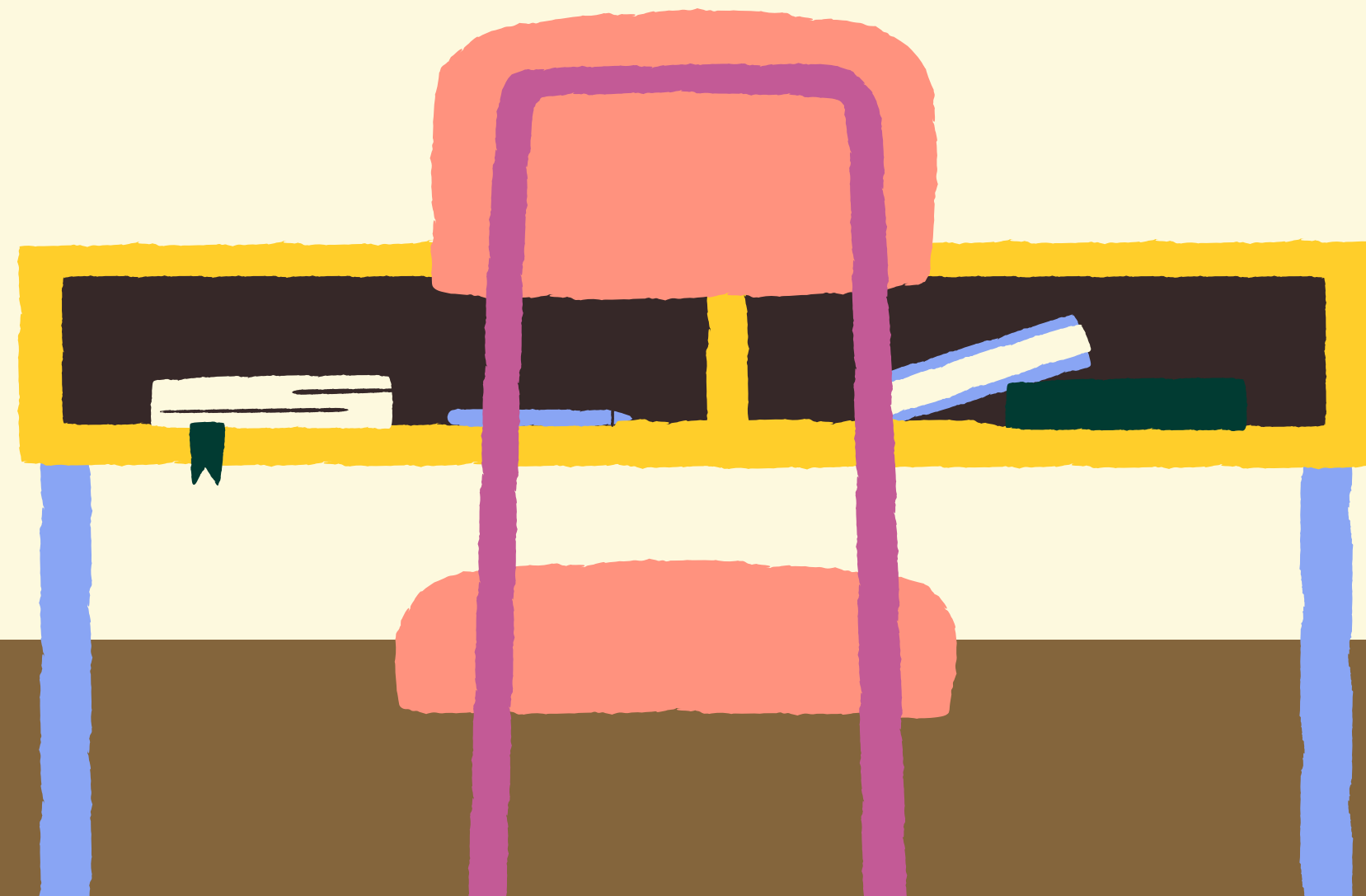
# MODEL'S EXAMPLE



Demographic transition model by Max Roser



Explain your experiences  
relating to models in learning





MODEL-BASED  
INSTRUCTION

VS

MODELING  
INSTRUCTION



## Model-based Instruction<sup>2</sup>

Using model in teaching and learning for improving the conceptual understanding.

The selection of the model is done by considering several aspects of the instructional context along with the instructional goals of learning.

## Modeling Instruction<sup>1</sup>

Model-based instruction that brings together information resources, learning activities, and instructional strategies intended **to facilitate mental model-building** both in individuals and among groups of learners.

- Gobert, J.D. & Buckley, B.C. (2000). Introduction to model-based teaching and learning in science education. *International of Science Education*, 22(9), 891–894.
- Gurvitch, R. (2008). Chapter 1: Researching the adoption of model-based instruction–context and chapter summaries. *Journal of Teaching in Physical Education*, 27, 449–456.



# Why modeling instruction?

- Improve the conceptual understanding compared to traditional class (Brewer et al, 2010)
- Moving students toward more scientist-like views on the nature of science (Brewer et al, 2009, 2013)
- Positively impact students' view of their own capability and success (Sawtelle et al, 2010; Goertzen et al, 2012)



# How to teach modeling instruction effectively?





- 1 Choose phenomenon needing **explanation**
- 2 Let learners observe the phenomenon or perform experiment resulting in that phenomenon
- 3 Carefully record the results while emphasizing the phenomenon
- 4 Let learners construct model to explain the phenomenon
- 5 Instructor helps learners reflect on whether and how well the model explains the phenomenon
- 6 Repeat steps 4-5 and perhaps 2-3 also if learners could not see the key points of the phenomenon
- 7 Summarize how well the final model explain the phenomenon and point out the limitations of the model

## Modeling instruction guideline

Can be combined with other active-learning techniques





# Zone of Proximal Development

- The agenda/question should not be too easy or too difficult for students (maybe the hardest to do)
- If it is, try breaking down into smaller pieces
- Use discrepant questions to scaffold students toward the target model



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# Experiencing Modeling Instruction





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## Practicing Constructing Model from the Clip

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<https://www.youtube.com/watch?v=3CnAQzEiuvQ>



# Group

Draw a model to explain how an egg is cooked focusing on heat transfer / protein denaturation (white vs yolk)





# Share

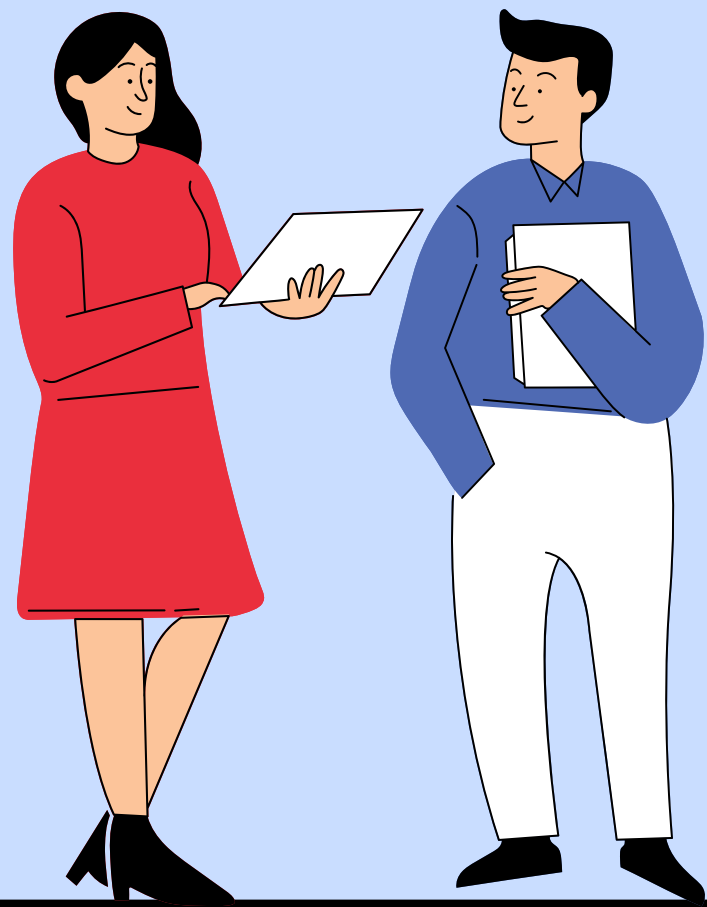
Share with other groups by  
posting the group's model

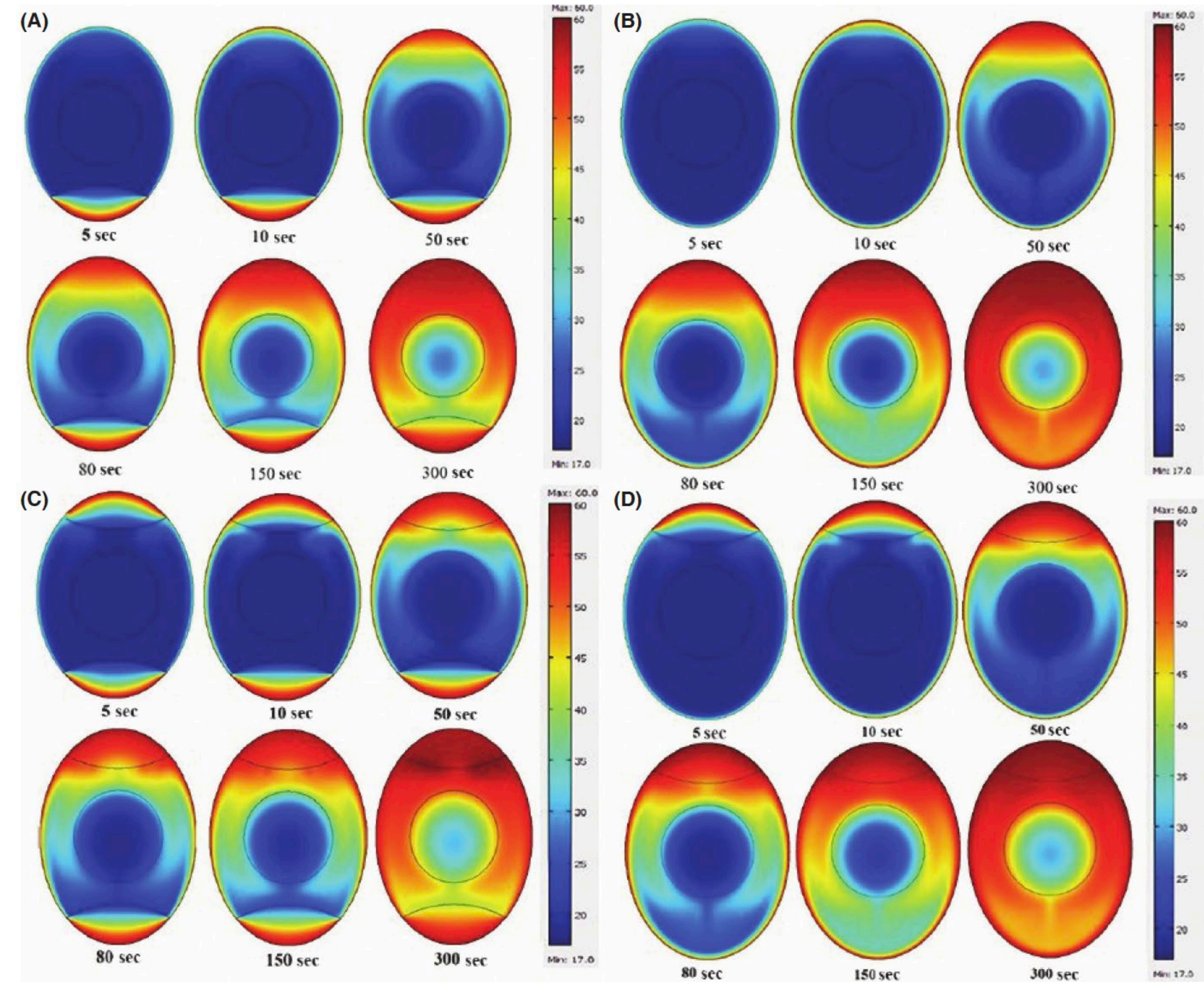




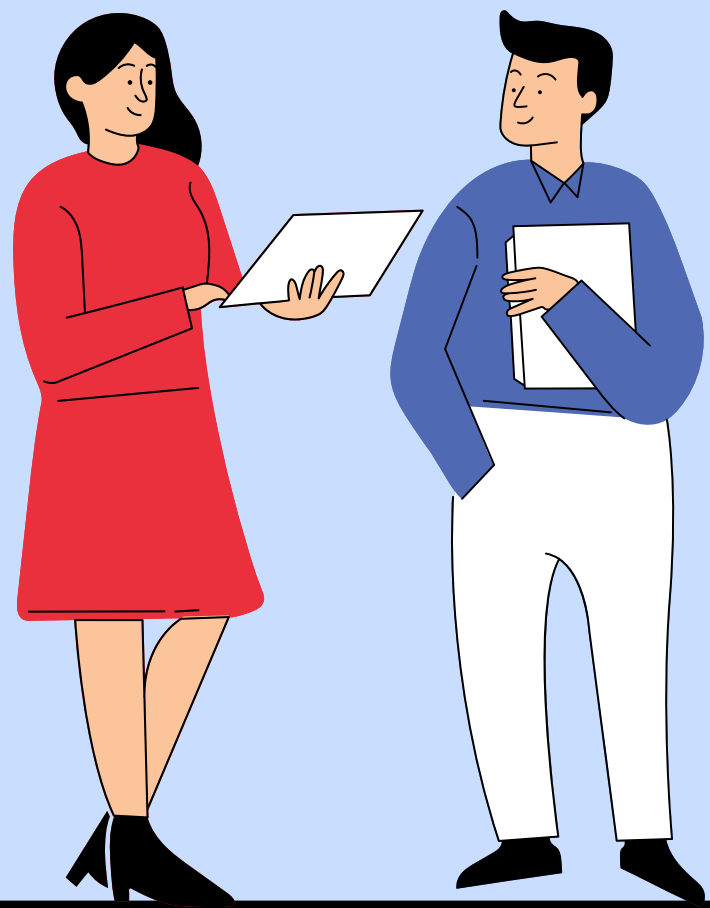
# Fulfill

- Rate other groups' models
- Give feedback/encouragement via suggestions/comments





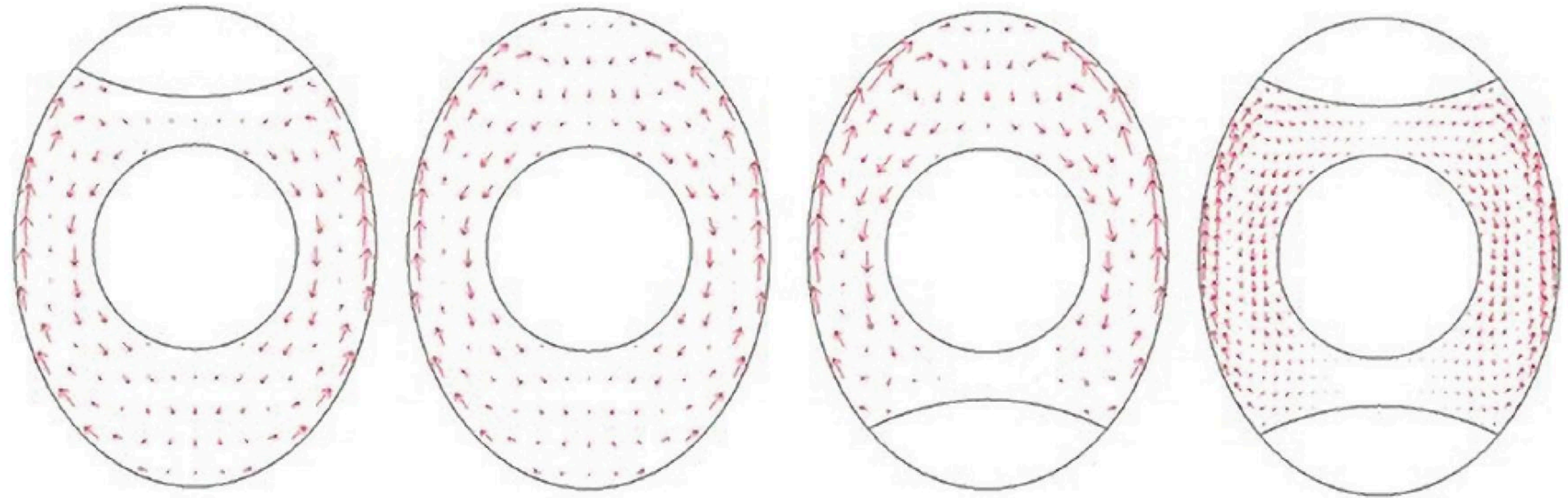
**Figure 3.** Temperature distribution of eggs having different air cell locations, during pasteurization process. (A) The air cells located at the bottom (B) Absence of air cell (C) two air cells, on top and bottom (D) The air cells located at the top.





B. Abbasnezhad *et al.*

Numerical Modeling of Heat Transfer and Pasteurizing



**Figure 4.** White flow pattern of eggs having different positions of air cells at 50 s of the thermal process in 60°C.

Abbasnezhad, B., Hamdami, N., Monteau, J-V., & Vatankhah, H. (2016) Numerical modeling of heat transfer and pasteurizing value during thermal processing of intact egg. *Food Science & Nutrition* 4(1), 42–49.







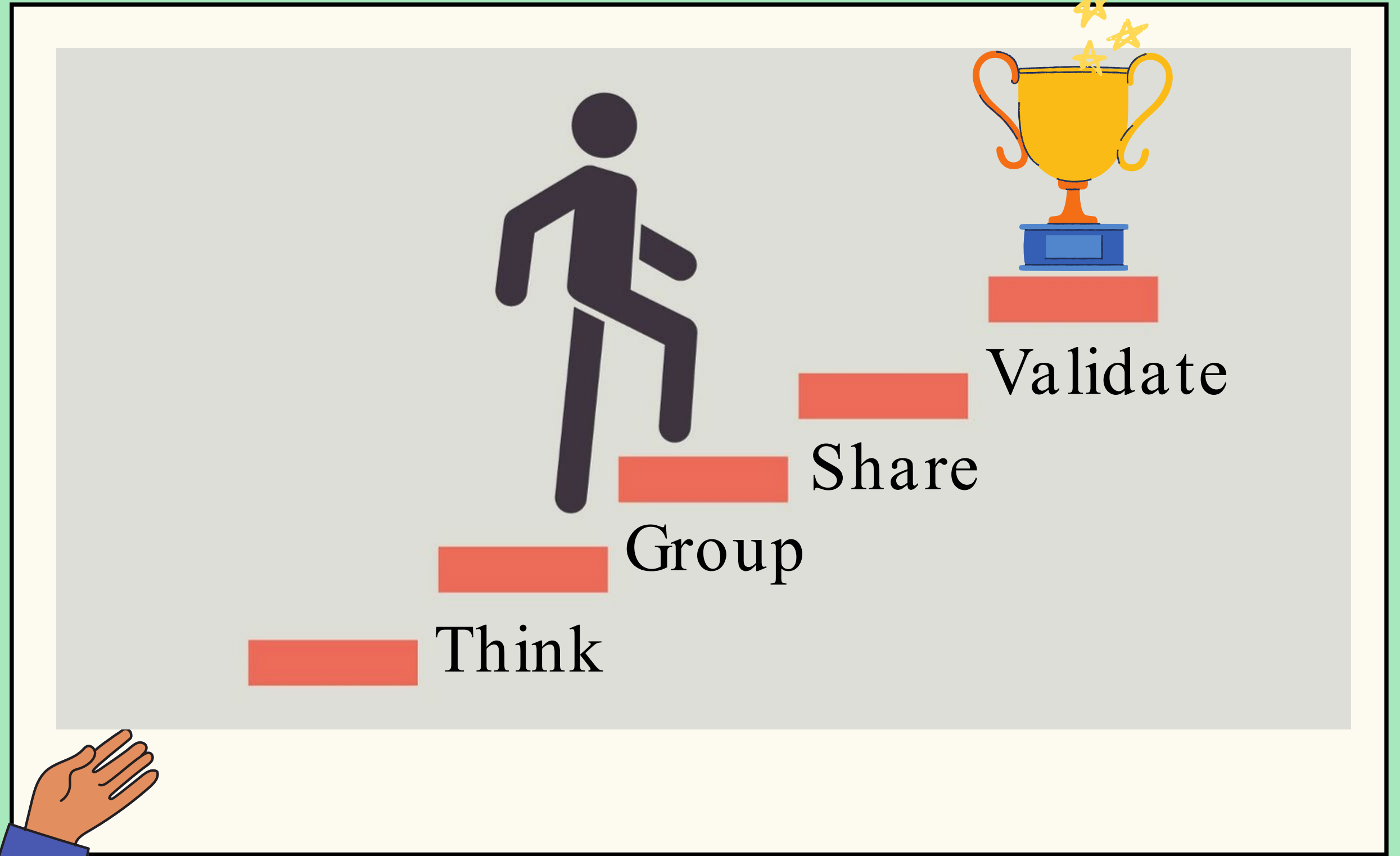
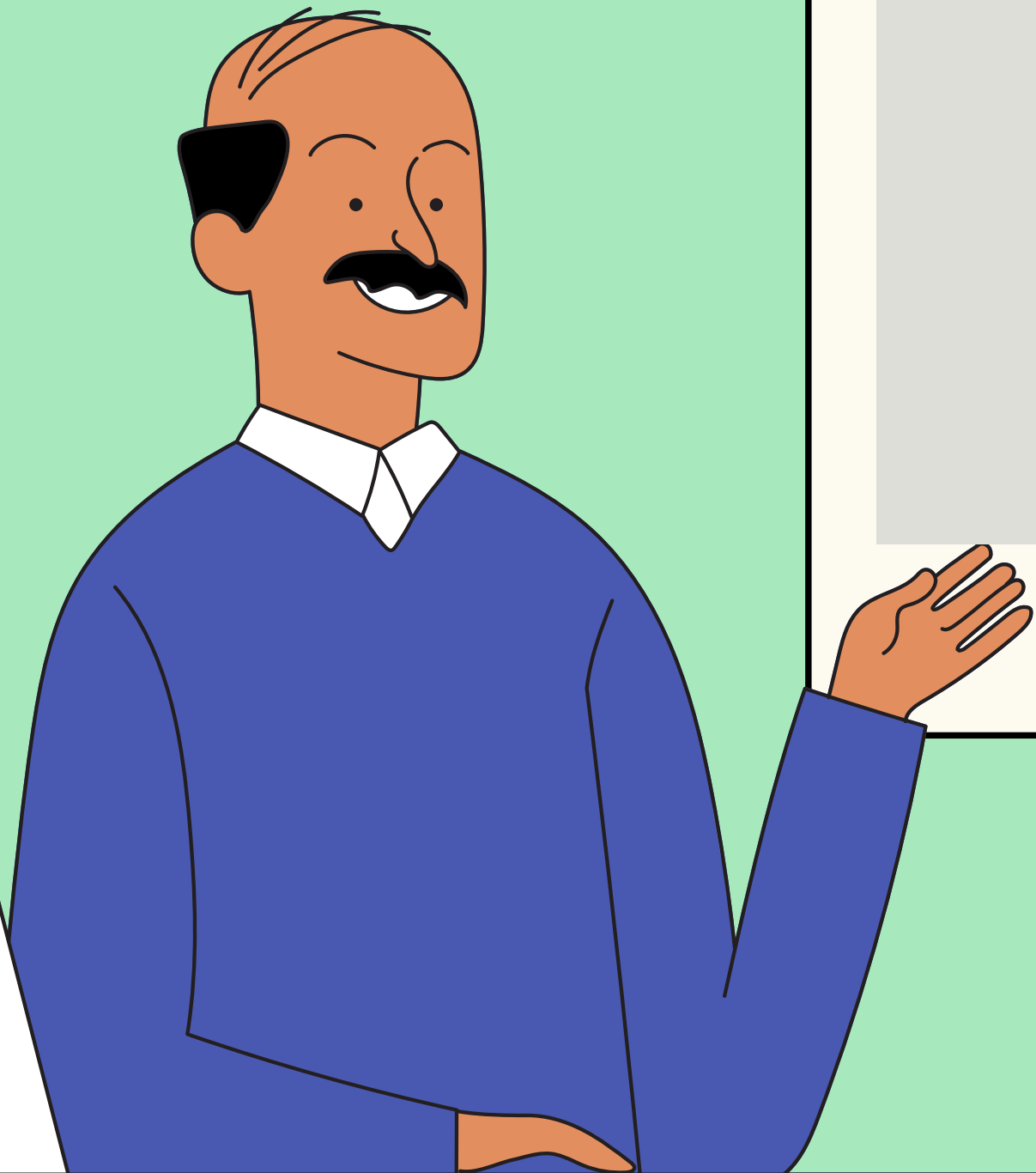
# Debriefing

1

Model-based vs Modeling Instruction

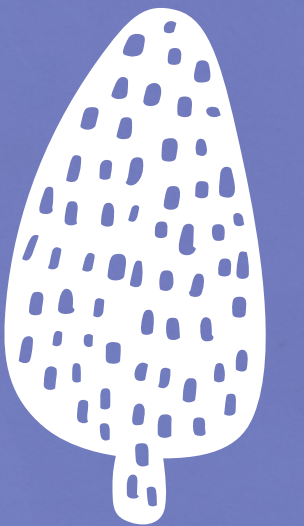
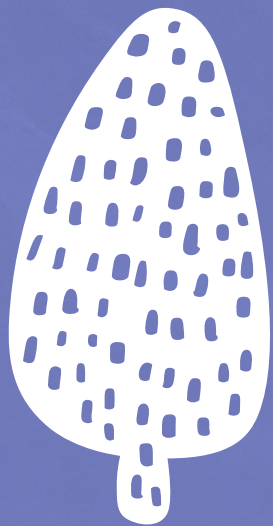
2

What do the students gain from this kind of instruction?



# Activity step

# Active Learning Techniques Used in This Session

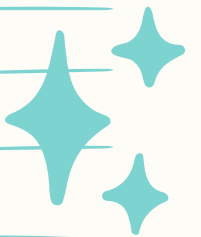




# Group working



- 4-6 members/group
- Make an agreement among members such as set roles, manage contributions, etc.
- Example of a cooperative strategy:  
Team-Game-Tournament, Jigsaw





# Gallery walk



- Select a topic
- Set a time limit
- Each group draws ideas on a poster
- Post the posters around the room
- Share ideas while visiting each poster





Thank you for sharing

Q & A