

# DIVERSITY AND ACHIEVEMENT IN SCIENCE AND MATHEMATICS CLASSROOMS

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PD Module 1 of the MasDiV project

# Aims of the session

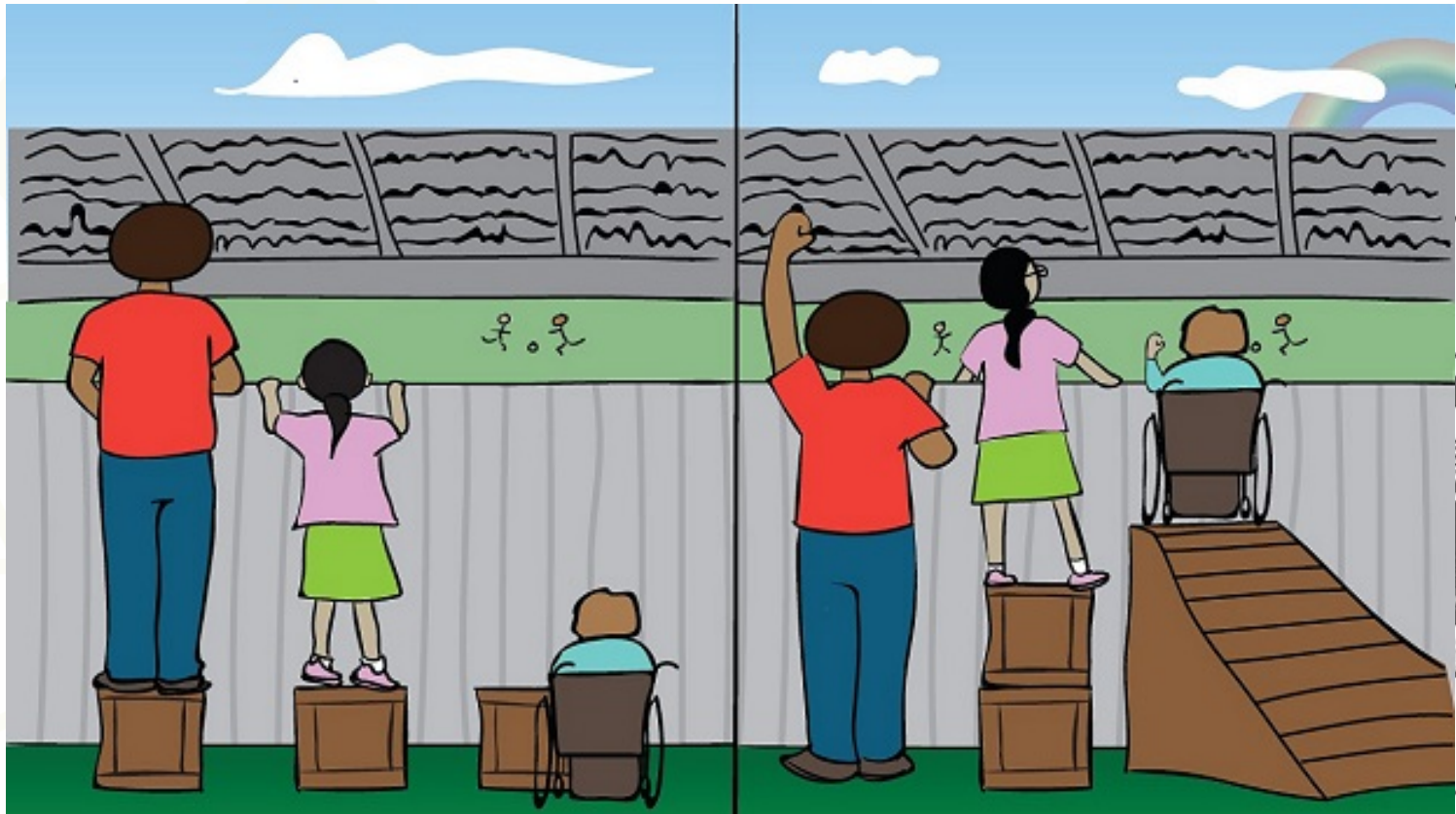
- Discuss beliefs and practices for addressing diversity in science and mathematics
- Explore resources and teaching methods that take the opportunity of diversity in achievement in the classroom
- Learn about the relation between diversity and inquiry-based learning
- Prepare a lesson plan

# ACTIVITY 1

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**Introduction and exploring experiences  
with diversity (30 minutes)**

# Experiences with diversity (act 1)



Artist Unknown

## Experiences with diversity

- Think of two students in your class, one who is particularly strong and one who is finding the work very difficult
- Describe to your neighbour the students' strengths and difficulties and include the evidence for your judgements (e.g. test results, responses during lessons, student work, ...)
- In what ways do your experiences with these students affect your lesson planning? Give examples

# ACTIVITY 2

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## Characteristics of inclusive education

# Diversity asks for inclusive education

- What could be characteristics of inclusive education?

## Diversity asks for inclusive education

- Explore what inclusive education involves according to Booth & Ainscrow:

<http://www.eenet.org.uk/resources/docs/Index%20English.pdf>

- Which point do you recognize in your practice and which are new to you?



# ACTIVITY 3

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Collecting information to build on what students know

## Diversity asks for information

- Teacher: "It's all very well telling us to build on what students know, but how can a busy teacher know what is going on inside 30 individual heads?"
- How would you respond?

## 'visible' reasoning (Handout activity 3)

- [http://primas.mathshell.org/pd/modules/6\\_Building\\_on\\_Knowledge/html/videos\\_c1.htm](http://primas.mathshell.org/pd/modules/6_Building_on_Knowledge/html/videos_c1.htm)
- How would you apply one of these strategies in your lesson next week?
- Discuss suitable topics and how to approach them → Peer feedback/suggestions.
- Design lesson plan/activity.

# Diversity asks for information

- Two examples for collecting and sharing information:
  - Use the mini whiteboard to:
    - Make a drawing that can be used to explain climate variations during the four seasons
    - Find rectangles that have value-wise the same area and circumference
    - Draw a velocity-time graph of a parachute jump
  - Use the poster:
    - Four groups order submarine sandwiches: 5 persons buy 4 sandwiches; 4 buy 3; 5 buy 3 and 8 buy 7  
Create a poster to illustrate in which group each of the persons gets most (when equally divided)
- Watch the videos on the use of mini whiteboards and posters and discuss their potential  
[http://primas.mathshell.org/pd/modules/6\\_Building\\_on\\_Knowledge/html/videos\\_c1.htm](http://primas.mathshell.org/pd/modules/6_Building_on_Knowledge/html/videos_c1.htm)

## Diversity asks for information

- Identify a topic that you have to teach shortly after this session that seems suitable for one of these approaches
- Discuss idea(s) with your neighbor(s)
- Formulate conjectures on how this method could help to collect information and to inform your further (inclusive) teaching

# ACTIVITY 4

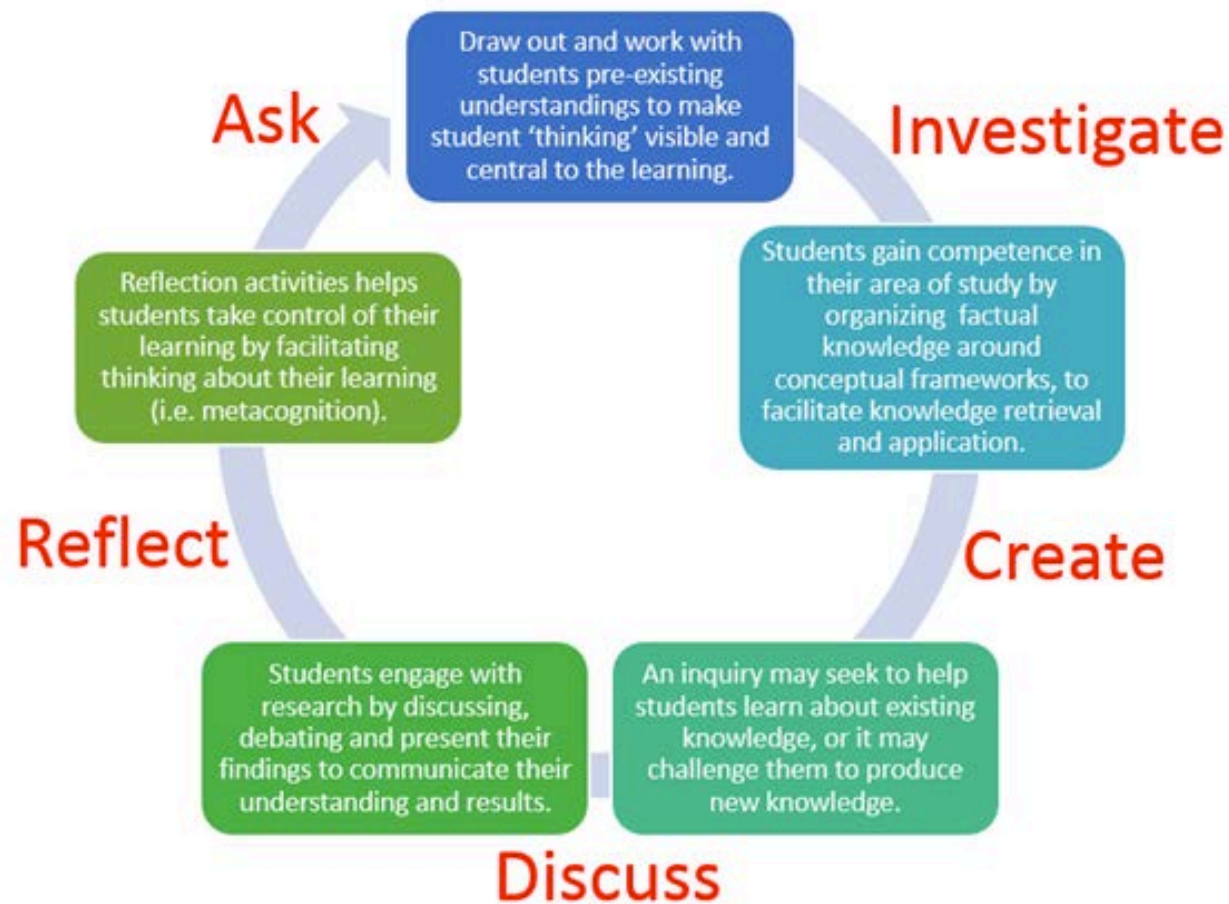
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## IBL and diversity in achievement

## IBL and diversity

- Take a look at a lesson in which students inquire:  
[http://primas.mathshell.org/pd/modules/1\\_Student\\_led\\_inquiry/html/videos\\_1.htm](http://primas.mathshell.org/pd/modules/1_Student_led_inquiry/html/videos_1.htm)
- What are students doing?
- What elements of doing research yourself do you recognize?
- How are the teacher and the task supporting students' inquiry?

# IBL and diversity





## IBL and diversity

- What is the relation between IBL and dealing with diversity?
- Design a lesson with IBL characteristics (task, resources, teaching method, learning goals) inspired by the Building a School situation.
- Compare the lesson plans and discuss the differences and similarities (in groups).

## Findings from research

- Minner et al. 2010
- Bruder & Prescott, 2013, Amaral et al. 2002
- Deci & Ryan 2002
- EU working group (EC 2015, 2013)

# ACTIVITY 5

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Teaching methods that involve all students

# Teaching methods

- Methods to address diversity are:
  - Creating level groups and using differentiated materials
  - Providing out of school support for low- and/or high achievers
- What are advantages and disadvantages of these approaches?

# Teaching methods

- What methods can you think of that involve all students to participate?

## ACTIVITY 6

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Addressing diversity by providing  
students sample work

## Peer review

- Diversity in achievement levels can be addressed through organizing (peer) feedback
- The key issue is to provide students with information they can act on and that improves their learning
- Peer review assignments helps them to appreciate and learn from different solution methods

## Peer review – watch video

[http://primas.mathshell.org/pd/modules/7\\_Self\\_and\\_Peer\\_Assessment/html/videos\\_b.htm](http://primas.mathshell.org/pd/modules/7_Self_and_Peer_Assessment/html/videos_b.htm)

Consider the following questions:

- What aspects of the provided work do students attend to?
- What criteria do students use as they assess the sample work?
- What do students learn from assessing the sample work?



## Peer review

- Discuss possible concerns
- What criteria would you use for choosing sample work to use with students?

# ACTIVITY 7

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**Design and prepare a lesson for your diverse classroom**

## Summary

- Differentiate in teaching methods
- Differentiate in level and type of tasks
- Differentiate in time for a learning route
- Use open inquiry tasks (with low floor and high ceiling) on which all students can work on their own level of performance

## Prepare a teaching activity (homework)

- Be explicit about aim, tasks, teaching methods and learning goals
- Identify in advance some (e.g. three) students in your classroom on different performance levels
- Plan how to use, build on or take account of contributions of these students in your lesson plan
- Include a reflective activity for all students

# Annex: Escape room challenges

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See activity 5: Teaching methods

# Challenge 1



- To avoid staying clueless solve this "puzzle"

## Goal:

- Small but mentally challenging jigsaw puzzle for example "Wasgij".
- Clue on the back of the puzzle (lettering), and extra piece with number on it (which they need in the final assignment)

<http://www.wasgij.co.uk/>

<http://www.wasgij.co.uk/online-puzzles/mini-puzzle-4>

## Challenge 2

- My liquid content shall not be touched
- Use simple physics to get my solid matter clutched



### Goal

- An opaque liquid is given with this text. Extract the object “solid matter” with help of the magnet to reveal a note with a number (contributing to final assignment) and the code for translation  $A=Q$  (in this example)

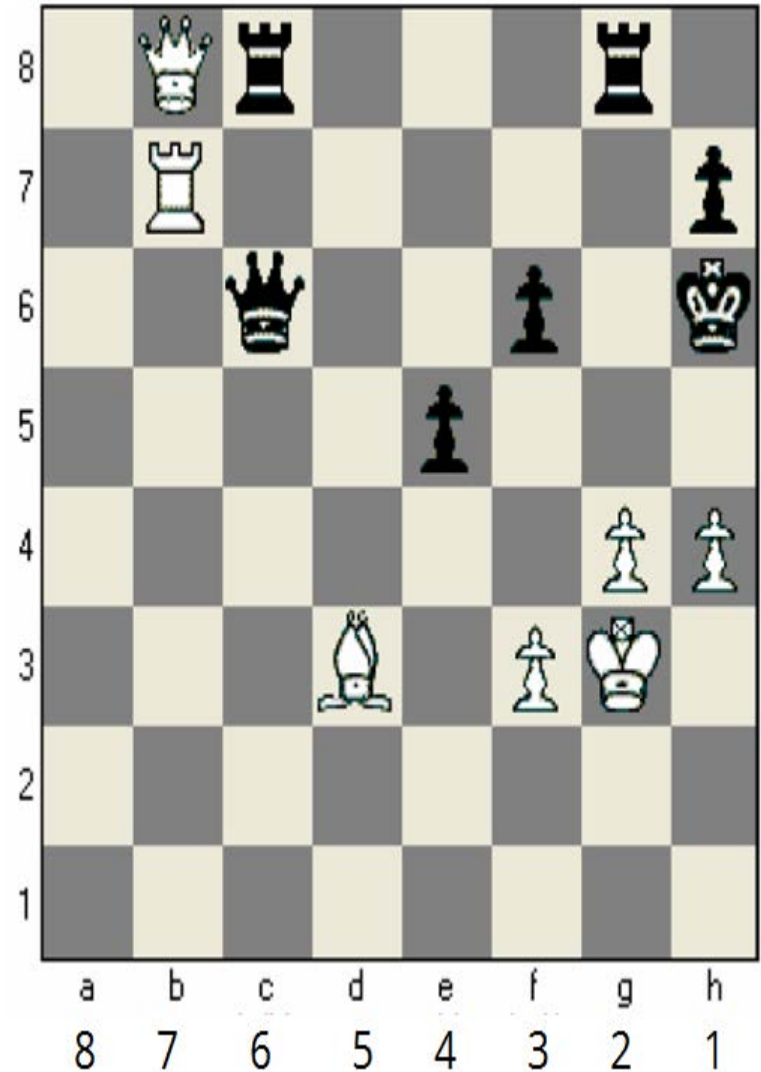
# Challenge 3



White's move to win?!

Goal:

- Figure out which move generates the win for white.
- Collect the number from that piece for final assignment.
- Get the first part of the incrypted code: Q1





## Challenge 4

- Sorted by atomic number, only use the first nine to complete

	H	B	He					
	He	O	Be	N		B	C	
	F	C			Li	He	H	
O	N	F	Li	H	He			C
		Li	F	O	C	N		
H			N	Be	B	O	F	Li
			C			H	Li	
	Li	H		He	O	C	Be	
	B	Be			N	F	O	

Goal:

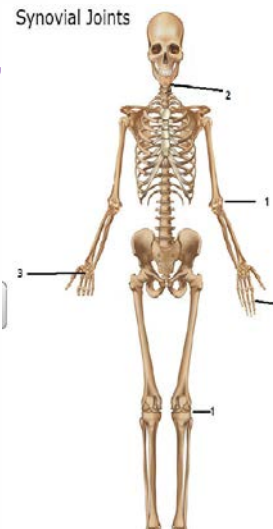
- The clue leads the participants to the elements-Sudoku (or hand it out to save time).
- Finished the puzzle? Get a number you will need in the final task and the second letter ring.

# Challenge 5

- I like to move it – move it!
- Part 1: Combine the models of the joints with the number on the skeleton. Which important synovial joint is missing?, add this to the table with model drawing.
- Part 2: Calculate the movement of joints you use in this dance:  
(shake your head to the sound) \* (swing your arms round and round) + (just wave with your hands) – (kick your leg in and out) – (show of your biceps!) + ( thumbs up!)= answer

## Goal

- Combine table with skeleton and knowlegde of joints
- Part 1 succeeded? Hand out Part 2 “calculate the dance” = number final assigment
- Get the second part of the incrypted code: A2



Types of Synovial Joints		Models of Joint Motion
Hinge joint	Number in skeleton	
Pivot joint		
Ellipsoid joint		
Saddle joint		
??? joint		

# Bringing it all together!

## Q1 (translated)

- Great Team effort!
- Bringing it all together to reveal the code

## A2 (translated)

- From the inside out
- Count on your teams and it will all add up

## Goal:

- Get all the teams to work together and try to figure out how their clues will fit in the bigger picture
- Crack the encrypted code → last clue combine all the collected numbers to open the lock.

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