TEACHING SESSION PLAN

Module: Materials Science and Processes	**Level / Stage (6,7,8)** **8** **Year: 1-2**

Title of session/ topic: Mixtures, Solutions and Phase Diagrams
Length of session: 2 Hours

Mark the type of session:

Lecture X **Tutorial ☐** **Lab ☐** **Studio ☐** **Workshop ☐**

Module Outcome (What module outcome(s) is the class/session aligned to)**:**

Outcome 3- microstructure

Outcome 5 – phase diagrams, mixtures, solutions.

Class/Session Outcomes: Upon completion of this session, you should be able to: (Share with students e.g. Write on board /slide/ project image at beginning of lecture for students)

1. Distinguish physically the difference between mixtures, solutions and phases
2. Explain what is meant by the term “material phase”
3. Interpret, construct and analyse a phase diagram
4. Identify and name distinct phases in a phase diagram
5. Calculate the amount of a phase present at a particular temperature
6. Identify temperatures where solidification begins and completes
7. Determine the composition of a phase.

Select & Prioritise Your Content:

For the session, decide what material is used in class and what material the students should study independently and/or online. To do this, think about the material and its relative importance and prioritise and list in the appropriate quadrant.

	In class / live (online) Support Learning	Independent Learning (student completes)
Priority (need to know)	1st half: experiment using salt (or rice) and water to physically demonstrate the differences between solutions (and mixtures) 2nd half: covering theory and working through exam type problem as a group based on what was covered in 1st half	Student can complete these tasks simply in their own homes (instructional video will be uploaded to moodle) Can study lecture slides (via moodle) before attending lecture Encouraged to complete assignment at end of lesson before the next lesson
Supplementary (nice to know)	Microstructural development (covered in next lesson) Temperature dependence: not physically demonstrated but will be talked about and demonstrated in a problem-based question in second half of lecture	Videos relating to heating and cooling and its effect on solutions. PowToon animation relating to the phase diagram of steel will be uploaded at the end of this lesson in preparation for next

Material in quadrants 1 and 3 typically become the focus during classes. Quadrants 2 and 4 represent material students could study themselves and use the VLE/Moodle and online learning objects to support this learning.

Think about how you might incorporate *Technology Enhanced Learning Tools and Blended Online/Digital Learning Objects,* that will develop students learning and engagement with the module.

Time	Teacher Activity	Student Activity	Resource Used
0-5min	Explain to students what the lesson will entail – what the learning outcomes will be, what they will be able to do by the end of the session.	Listening	
5-10 min	Demonstrate adding rice to bottle of water what a mixture is	1 student can help, others observe	1x water bottle 1x sachet rice
10-25 min	Present with slides to introduce concepts – mixtures, solutions, solubility, phases	Listening and note taking	Powerpoint Slides
25-35 min	Split class into 4 groups. Distribute learning materials. Explain task to students	Naming their team. Assignment of roles within team (e.g.): 1x note taker 1x add materials 2x mixers 1x clean-up	For each group: 1x bottles of water 10x sachets of salt 1x cloth for clean-up.
35-45 min	Guidance and advice to students as they measure and mix salt into 1 water bottle and rice into another	Addition of salt to water bottles. Mixing of water with salt. Recording of number of sachets of salt that can be dissolved into 400ml water	*Video demonstration of this entire task will be made available via moodle for recap purposes / students who may have been absent or struggle in the classroom environment
45-50 min	Recording numbers given by teams on whiteboard Observe salt and water solution	Clean-up and calling out of numbers for teacher	
50-60 min	10 minute break: Chance for students to use padlet to add comments / questions regarding experiment	Using padlet Approaching teacher for questions is encouraged Taking a break	Padlet
60-65 min	Recap and show students dissolved salt + undissolved salt at bottom of bottles Link back to solubility limits and phases theory	Listening, note taking	Learning materials listed above
65-75 min	Introduce Phase diagrams for a 2 phase material, referring back to experiment Engage students by asking where on the phase diagram we are for different stages of our experiment	Listening, note taking, answering questions	Powerpoint
75-95 min	Work through a practical example of an exam type question on phase diagrams. Ask students directly for numbers from the diagram and to perform all calculations and call out	Writing, note taking, performing calculations and answering questions	Whiteboard and powerpoint

	answers as we work through the problem together		
95-105 min	Summary of findings Recap on learning outcomes Preparation for next lesson by a brief run through of very complex phase diagram showing students that they now have the tools to tackle this problem from knowing how to solve a very basic phase diagram problem		
105-115 min	Based on what we have covered, get students get back into their groups and write a sample exam question (part A, B, C, D) – theory and practical	Regrouping, revising what was covered, discussing, writing a question (theory / practical / problem based) and reading out to the class	
115-120 min	Write up this question and upload it to the class moodle page. This is now an assignment they must complete before the next lesson (for peer correction)		Projector, moodle page

Note digital student engagement tools required for this session/lesson:

Powerpoint presentation during class, projector and whiteboard used. Video demonstrating the experiment uploaded to moodle for students who struggle with the classroom environment (or recap / demo for absent students). Assignment uploaded to moodle page, POWTOON of phase diagram of steel will be uploaded at the end of the lesson for a recap and preparation for next lesson.

Teacher Reflection:

What worked well?

Several aspects of this lesson worked very well. Breaking the class into groups and getting them to come up with "team name" is a great way to get the interaction going between student and teacher. There is no "wrong answer" and it lets students break the barrier and become comfortable participating straight away. Assignment of individual tasks to each team member is important so no one is left out and encourages students to communicate with one another.

The practical exercise is secondary to the learning. It could be demonstrated by the teacher but having the students physically perform tasks involves their psychomotor domains of learning. The task itself is simple – to see how many sachets of salt dissolve in 400ml of water. Students add the salt, shake, add another, repeat. The task engages cognitive (comprehension, analysis, and synthesis of new information), affective (organizing, valuing) and psychomotor (perceptual, physical activities) domains of learning all at once. Engaging these domains at once allows for greater comprehension, allowing students to make use of the knowledge and apply it later when doing paper-based problems using phase diagrams, leading to a deeper understanding of the subject matter.

Breaking the class into groups was successful in so far as each group was competing with their neighbours. This form of peer feedback occurred throughout the experimental portion of the lesson.

What did not work well?

I try to let the experimental portion of this lesson be as "student led" as possible, but some of the students require extra help and supervision to get the task started. There is a tendency to want to add as much salt as they can as quickly as they can (race against their neighbours), which is not the point. The point is the observation of salt dissolving in the water as it is shaken, recording of the point at which salt stops dissolving (solubility limit), and observe what happens when more is added after this. Clearer explanation of this point is required for the next time the lesson is completed in order to avoid this. I prefer to let the students go ahead with the experiment as I observe groups and help out when needed instead of rigidly telling them "now add one salt sachet, now mix, now add another" etc. When they conduct and observe themselves in a student led way, they have much more ownership on the knowledge of the subject matter.

From a practical point of view, there is always some spillage of rice and salt which needs to be cleaned up. For future lessons I would bring a funnel.

To what extent did you address different domains of learning?

The experimental portion of the lesson engages cognitive (comprehension, analysis, and synthesis of new information), affective (organizing, valuing, peer-interaction) and psychomotor (perceptual, physical activities) domains of learning all at once. Engaging these domains at once allows for greater comprehension. The second portion of the lesson is where we apply this knowledge engaging more of the cognitive learning domain. Exam type problems are worked through together with the class while constantly referring back to the experiment. Students actively participate by

performing calculations and reading numbers for the teacher from the phase diagram which also engages them

What would I do differently next time?

More pre-task guidance could be used. Instead of talking them through what they will be doing, I would explain the point of the experiment more clearly to prevent students racing each other to see who could add the most salt the quickest. Highlighting this learning outcome with video of a nice science experiment on the topic could pique their interest in solubility limits and phases before they begin the task. Perhaps having students dissolving different things (salt, sugar, pepper) may prevent this and show differences between water's ability to dissolve different solids. Though I found having a table on the board with the team names worked well for a little healthy competition and peer-interaction and discussion during the lesson

It might be possible to bring a hot plate in future to show what happens when we heat the water (and cool it by the end of the lesson).