

How to make Microbiology Teaching interesting to students?

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Submitted: March 12, 2021

Reviewed: March 16, 2022

Approved: March 25, 2022

How to cite: Sabesan G. How to make Microbiology Teaching interesting to students? *Microbes Infect Chemother*. 2022; 2: e1382.

Keywords: microbiology teaching, medical education, narrative based teaching, story telling, poems in teaching.

Introduction

Teaching is a noble profession. It is more important to blend the art of teaching with the science of learning. The current educational system focuses more on impactful learning. Microbiology is an amazing subject when presented effectively to students; it can also be made into a lively and fun-filled subject with a little creative effort from the teachers.

Teachers teaching Microbiology can use novel ways to create enthusiasm and attention in their classrooms (1&2) . I would like to share my real-life experiences and personal stories in this article.

One of the Professors I know wears a purple shirt and pink tie on the day he demonstrates Gram staining. Besides explaining the principle of Gram's staining with the differences in the cell wall structure, he also says the shirt is bigger (so more peptidoglycan in Gram positive cell), so purple in colour whereas the tie is smaller (less peptidoglycan), so gets decolorized, so pink in colour.

Use of Poem to teach general concepts of fungi and the infections caused by them in humans (Mycoses)

After completing a lecture series on Medical Mycology, I created this poem for the tutorial session and asked them to guess each of the learning outcomes or concepts that are hidden

in the poem.

For example, for the line, 'under the wood lamp's ringworms can cast' they need to remember that wood lamp is used for diagnosis of ring worm infection caused by dermatophytes. The teacher, who has a flair for creative writing, can use this technique to teach the students. Such innovations help to break the boredom of a normal classroom.

Fungi love a musical name (Malassezia furfur)
Fungi play the dimorphic game (M-Y Shift)
Fungi can be a blast (Blastomyces dermatitidis)
Under the wood lamp's ringworms can cast
Fungi can have a 'histo'ry (Histoplasma capsulatum)
Fungal infection can be an unresolved mystery
Fungi can be p(r)icked from the thorn of roses (Sporotrichosis)
Fungal diseases can pick their name from places (Madura foot)
Provided opportunity, fungi (Candida) loves to cause the oral thrush
Persistent dandruff can make anyone blush

Fungi can have maiden names like twins: Cocci and Paracocci
When host is immuno-compromised, a fungus always wins...
Culprit of the notorious Salem witch trials
Concept of 'fairy ring' tales

Fungi at times do not even spare your nail (tinea unguium)
But can also churn out magic portions that heal
Fungi can swirl the Captain's wheel
Invariably fungi are irresistible; as a delicious & fabulous meal
Learn Medical Mycology with zeal...
Fungi (Fun 'Guy') can also be a great feel!

Use of mnemonics in a lecture on *Vibrio cholerae*, *Helicobacter pylori* and *Campylobacter jejuni*

The lecturer uses mnemonic words which are actually characters from Marvel to address the salient points of microorganism. This is done best while summing up the key points at the end of discussion about each organism.

For example Venom is used to describe *Vibrio* sp. The first letters of the character and pathogen were purposely matched before the choice of the Marvel character is decided. V is common for Venom and *Vibrio* (also because *Vibrio* produces a toxin; toxin and venom is synonymous to remember). Similarly, the character of Captain Marvel is used as a mnemonic for describing *Campylobacter* while Hulk is used for *Helicobacter*. Interestingly, Captain Marvel can fly, while *Campylobacter* has a flying sea gull appearance. Hulk is destructive in nature which

suits the description of *Helicobacter* which also disrupts the lining of GIT to cause ulcers (Tabla 1).

Table 1

Examples of mnemonics

Example 1	Example 2	Example 3
V -Vibrio	C - Campylobacter	H - Helicobacter
E -Enterotoxin	A - Appearance (sea gull)	U - Urease , Ulcers (PUD)
N -Negative – Gram	P - Polar flagellum	L - lophotrichous flagella (four to six)
O -Oxidase positive	T - Temperature - grows in Camp Agar at 42°C	K – Keep in mind facts (Diagnosis-stool antigen test, urea breath test, Virulence factors-VacA and Cag)
M -Motility – Darting	A - abdominal cramps, Bloody diarrhea	
	I – Identification tips (oxidase positive)	
	N – Negative (Gram Stain, Fermentation)	
	M - Microaerophilic	
	A - Avoidance of unpasteurized dairy products, uncooked chicken	
	R – raw meat (improperly cooked chicken)	
	V – Virulence factors	
	E - Convalescent excretion (transmission)	
	L – Limiting (self), but can lead to Guillain-Barré syndrome	

Use of Anecdotes (narrative based teaching)

Use of anecdotes in teaching is an effective way of communicating Microbiology concepts to students. The following anecdotes are a few examples of how to draw attention of the students to important facts/concepts during the lecture by using famous characters/ natural occurrences as inspiration.

a. Dimorphism

The comparison of conversion of Hulk with dimorphic fungi is a best example. Hulk has the ability to exit in two forms – Bruce Banner and the Incredible Hulk. The factor that governs the conversion is anger. The dimorphic fungi can exist in two forms as mold (saprophytic, at 25 oC) and as yeast (parasitic at 37oC). The lecturer now asks

which is the factor that governs conversion of Mold to Yeast (MY) shift, the students reply as temperature. The lecturer now explains the process is reversible just by changing temperature. To add fun to the description, the lecturer asks the student what Black Widow says to Hulk to bring down his anger. The students say 'Hey Big Guy, the sun is getting real low?! Now, the lecturer asks what song is suitable for converting Yeast to Mold. After a little pause, the lecturer then says 'the temperature is getting real low (37oC to 25 oC)'. This brings laughter in the class. The lecturer can use pictures of Hulk and Banner to make the class lively.

b. Full moon day

The teacher starts the conversation as, “Have anyone had an 'opportunity' to have a moon light dinner on a full moon day?” Students give a mixed response. Few questions such as this

a. Have you ever observed a full moon?

b. Do you see a halo zone around the moon?

are asked to the students to kindle their curiosity. At this point, show a picture of a moon with a halo zone and a picture of India ink staining of *Cryptococcus neoformans* (figures 1 and 2). The student can now relate it clearly when the teacher compares the night sky with the dark background of India ink or nigrosine; the moon with the *Cryptococcus* yeast cell and the halo zone to the capsule. Further, the student is asked to relate the word opportunity used in the first conversation to the opportunistic infection (explain the term opportunistic pathogenic fungi with *Cryptococcus* as an example).

Finally conclude with the pun, that if you see a single full moon on a dark sky, you are on a full moon day. But if you see multiple moons on a dark sky with halo zones you are watching the negative staining of *Cryptococcus neoformans* (tell the students the importance of Indian Ink staining in a CSF sample, cryptococcal meningitis).

Symbolic representation: Moon – white – pigeons (Reservoirs of *Cryptococcus* species).

Moon with halo zone

Figure 1

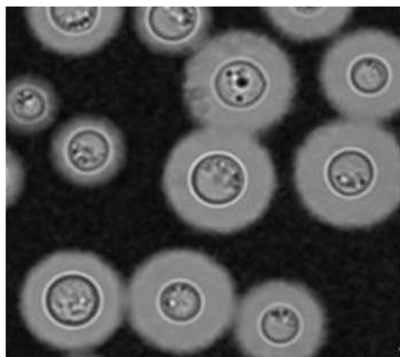
Moon with halo zone



Negative staining of *Cryptococcus neoformans*

Figure 2

Negative staining



Use of Problem based learning in Microbiology

Problem based learning (PBL) is an interesting method of teaching which is usually employed in medical schools all over the world. It can also be used effectively to teach General and Applied Microbiology to students in science colleges and universities.

In a PBL session, a small group of students (class can be divided into small groups of 8-10 students) shall be given a trigger. Each small group can be monitored by a facilitator (PG students/lecturers)

The trigger is a statement or a lead for the students to discuss further and come out with a set of learning outcomes which they need to learn (must know). Once the students brainstorm and arrive at learning outcomes, they are allowed to use books or the internet to find the answers themselves. This is a student-centered learning where the teacher just acts as a facilitator to oversee the process and brings the student back to focus if they go off track during the discussion (Table 2).

Example of a trigger and learning outcomes generated on a topic on Food spoilage.

Table 2

Example of a trigger and learning outcomes generated on a topic on Food spoilage

Given by the facilitator	To be found by the student group by brain storming	
Trigger	Cues	Intended Learning Outcomes
George finds out that the canned food he purchased in the supermarket is dented and showed bulging appearance	-Canned food	1. Explain the spoilage of canned food
	-bulging or dented appearance of a canned food	2. List the organisms that can cause food spoilage in canned food
		3. Explain the risks of consuming bulged/dented canned food
		4. Discuss the role of anaerobes in food spoilage.

Instead of directly going to a lecture topic on spoilage of food or Botulism, it will be innovative to create interest in the students first on the new topic and its significance with a trigger (can be a scenario – as stated above) and then allow them to brainstorm on their own.

Use creative material from the internet in technology enhanced learning

In its place of just saying that a macrophage is engulfed by a bacterium, you can embed a real YouTube video, to show the phagocytosis. It is also useful to use animations in PowerPoint to enhance the attention span of the students. There are plenty of interesting details available on the internet (free and paid). For example, the British artist Luke Jerram had crafted numerous models of bacteriophages, bacteria, and other viruses out of glass (<http://www.lukejerram.com/glass>). Such pictures can be used in lecture slides. Another amazing source of pictures/models is www.giantmicrobes.com. It is a company that makes and sells stuffed toys in the shape of disease-causing bacteria and viruses. My friend and former colleague, Prof PK Rajesh, currently the Deputy Vice Chancellor of Academics who had earlier visited the Micropia, the world's first museum dedicated to microbes at Amsterdam, in The Netherlands was flabbergasted and shared his wonderful experience with pictures. It is a dream-holiday tour plan for all Microbiologists. It is also worthy for the teachers to explore the several online apps to conduct quizzes in Microbiology to test the effectiveness of learning. Technology enhanced learning and use of social media applications like WhatsApp and facebook is the way forward in future T/L activities (3).

The kiosks for each organism in the Micropia encourages self directed learning by triggering curiosity.

Conclusion

Narrative medicine is an effective pedagogic tool with a clear and replicable structure and methodology (2, 4). Story telling and creative teaching is a key to successful teaching. Concepts are best understood by students with narration-based teaching. Further it employing new techniques help in better retention of knowledge and avoids boredom in classrooms.

Conflict of interest

Dr Gokul Shankar Sabesan, received the Best Teacher Award for 2018-2019 from Microbiologists' Society, India.

Funding

None.

Acknowledgements

Under Prof PK Rajesh, an inspiring and passionate

teacher. I have seen him wearing a blue tie with pink stripes during the teaching session on Mycobacterium tuberculosis (simulating acid fast bacilli staining).

To all my dear students in Manipal University College Malaysia and AIMST University Malaysia.

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