

Context/Problem Based Learning to Deliver Biological Mass Spectrometry to Year 1 Bioscience Students

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The Challenge

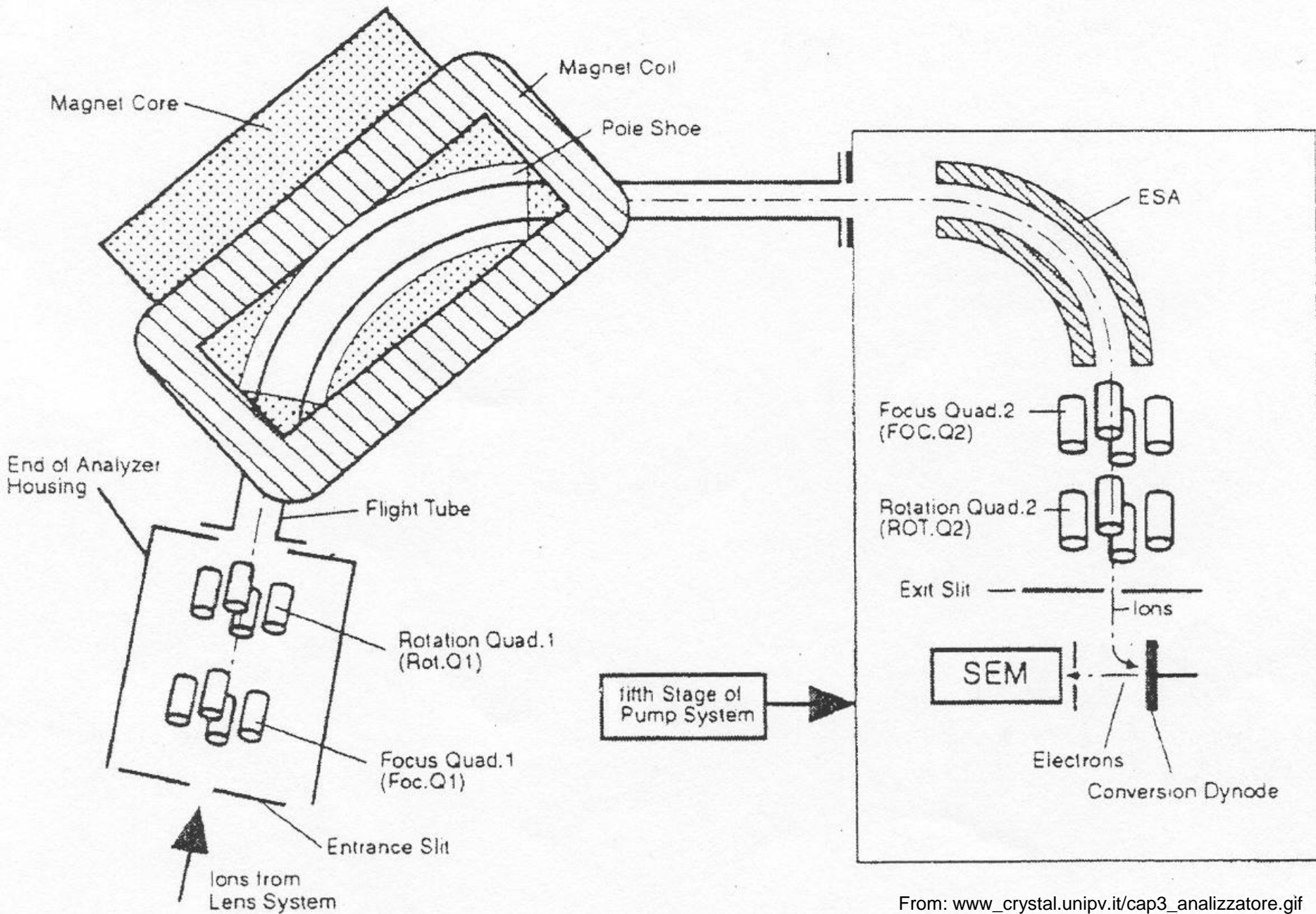
Mass spectrometry taught at A-level is taught from a chemistry point of view & not always relevant to a biological context

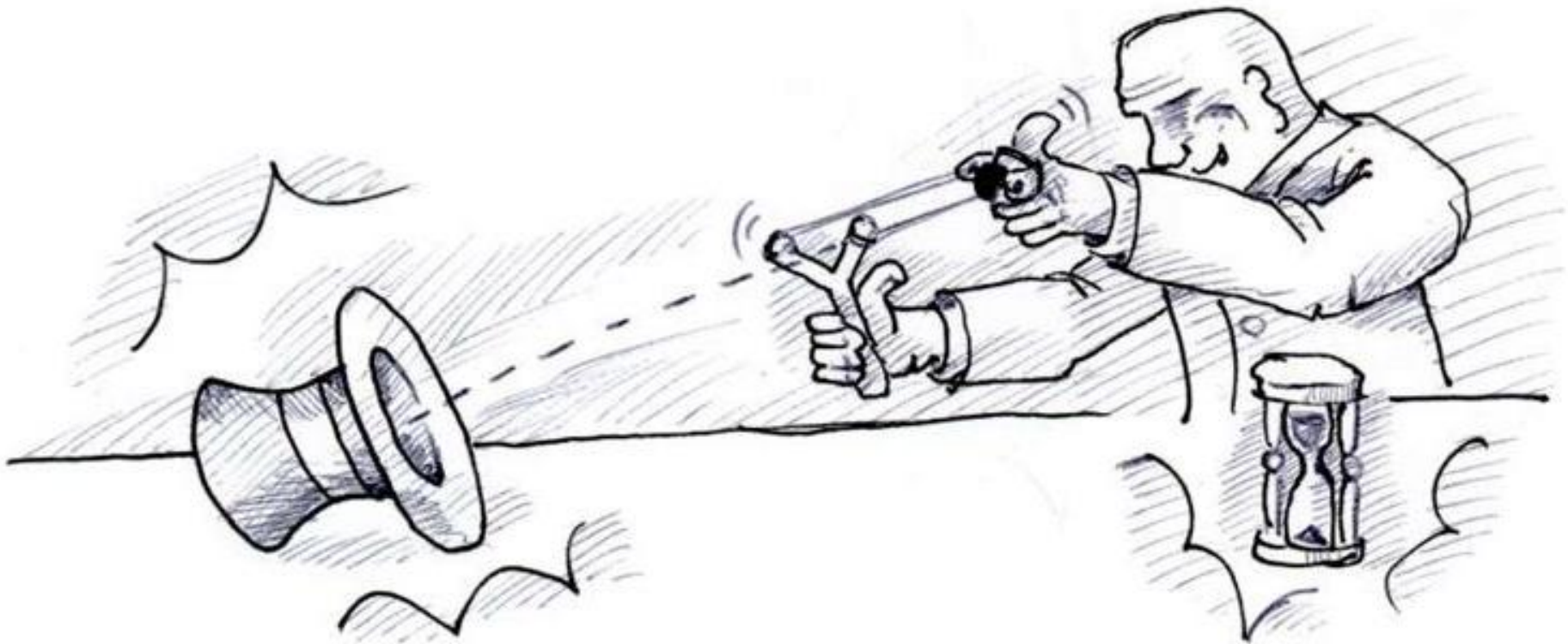
Students need to re-orientate toward ionisation methods and mass analysers relevant to bioscience applications

Year 1 provides an introduction to complex analytical methodologies

Magnet Sector

ESA Housing





Time of Flight



Ion Trap



HPLC

Context/Problem Based Learning in Chemistry

Using a context-based approach to undergraduate chemistry teaching – a case study for introductory physical chemistry

Belt et al (2005) *Chemistry Education Research and Practice* 6, 166-179

Active Learning: Models from the analytical sciences – Context-based case studies in analytical chemistry.

Belt and Overton (2007) *ACS Symposium Series* 970, 87-99.

Students Were Provided With...

Relevant chapters in the module textbook

Lecture notes from previous academic year

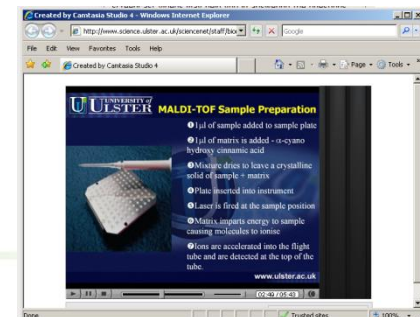
Screencast lecture of the above

Brief introduction to what would take place during the three-hour C/PBL session

Online quiz to test their knowledge of MS before coming to class

Students assign themselves to one of four groups before coming to class

Students provide mobile numbers (optional) to be updated about the activities.



The Context...

You are the laboratory manager of a major, commercial analytical facility....

One of your clients who has a research interest in protein biomarkers of disease contacts you for advice on how they should go about the process of conducting proteomic studies, particularly involving mass spectrometry to identify large proteins...

Firstly, give your company a name:

Activity 1

1. Outline for your client (as a flow diagram) the strategy for identifying proteins from a diseased tissue using analytical techniques.
2. Identify what new instrumentation will have to be purchased to allow this work to take place
3. Identify potential suppliers of this equipment, and if possible get an idea of costs.

You have 30 minutes to complete this activity!

BioSpec Ltd.

Separated
Proteins

Digestion

Sample
Clean-up

Cost
Mass Spectrometry
(MALDI-TOF)

£30,000

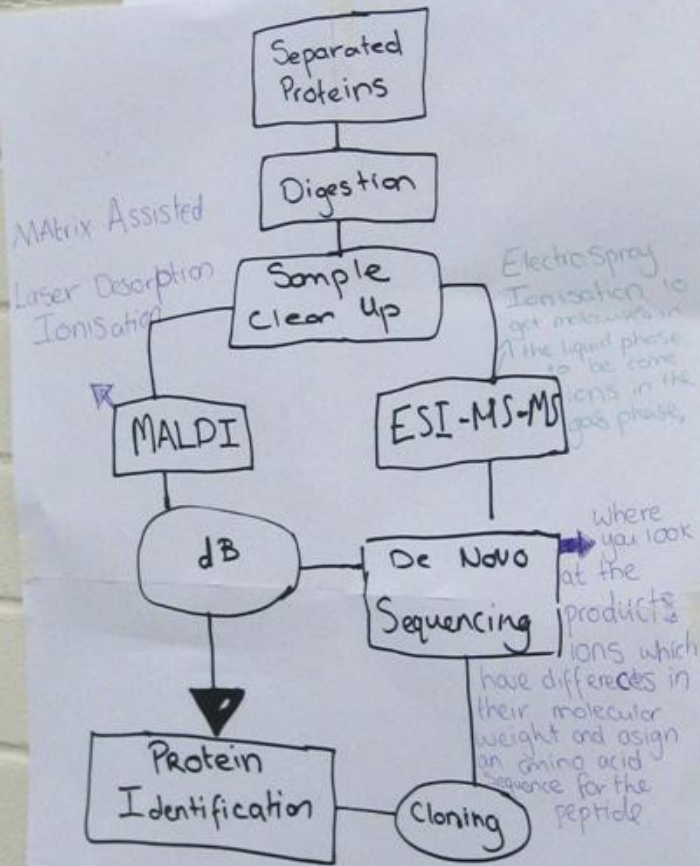
Maldi ESI-MS-MS

Protein
Identification Cloning

dB

De novo
sequencing

CRAIG AND CO.



Instrumentation

- pipette
- Sample plate
- laser
- Mass Spec
- Data analysis system [Computer + Appropriate System]
- Matrix - (choose fit for purpose System)

Applied Biosystems
ESI 4000

Activity 2 - Context

On your advice your client has successfully purchased new mass spectrometry systems, and some of the staff has been trained in the use of this equipment.

However, they feel that the training course delivered by the manufacturer did not provide much background on the theory behind some of the techniques and come to you for help.

Activity 2

Your group has been asked to run a brief lecture on a specific topic; this will be found in the envelope in your pack. The lecture will be delivered to your entire client group; BMS106.

The lecture must be no longer than 10 minutes duration.

You should prepare the talk using overheads (supplied)

Lecture Topics

“How Electrospray Ionisation Works Particularly When Applied to Peptides”

“What Goes On Inside an Ion Trap Mass Spectrometer”

“How To Sequence Peptides by MS/MS and Software Tools”

“How MALDI-ToF Mass Spectrometry Works Particularly When Applied to Peptides”

Peer assessment of group presentations

Activity 3 (after the classroom activities) – Building a Mass Spec. Knowledgebase

Your company is dedicated to customer service and so you have a 24 hour on-call policy! In the next week you will receive a text (or email if you did not supply a mobile number) asking you to check your Ulster email address for a client query that must be answered within 24-hours of receiving.

Your own personal question will be in the email and must be answered by you individually!

Follow the instructions in the email to answer the question.....



Message

Attachments

Annotations

Raw view



Reply

Forward

Copy

Move

Delete

Print

Dige



From: "Stephen McClean" <s.mcclean@ulster.ac.uk>

To: [Redacted]

Subject: ON CALL!! Client Message Waiting!!

Date sent: Wed, 18 Mar 2009 15:42:20 -0000

Organization: University of Ulster

Priority: normal

Mass Spec. Activity 3 on BMS106.

Message for:

Student no: |

You have been sent the following question which you must answer before 10:00AM on Friday 20th March 2009 (being kind!)

The question is as follows:

In electrospray ionisation what magnitude of spray voltage is commonly used?

To answer your question you must use the forum at the following web address:

<http://tinyurl.com/bms106>

BMS106 Mass Spectrometry Knowledgebase

The BMS106 Bioanalytical Chemistry Mass Spectrometry Knowledgebase!
Your question should be entered as the subject of a "New Thread". Everyone in the module is encouraged to look at the answers supplied by their colleagues and post comments / queries where appropriate.

Thread	Last	Messages	
What does MALDI stand for?	B00461831	1	x
In which instrument can ions move in a V or a W trajectory?	B00469165	1	x
Which 2 amino acids have identical m/z values in a mass spectrometer?	B00467442	1	x
As well as b and y ions; what other types of ions are produced	B00438254	1	x
Which parts of a mass spectrometry system ARE under vacuum?	B00469247	1	x
What does the chromophore group on the MALDI matrix absorb from the la	B00469181	1	x
Which type of mass spectrometers should be calibrated daily?	B00472087	1	x
What is the m/z range for a typical benchtop ion trap mass spectromete	B00463162	1	x
In electrospray ionisation, which gas is commonly used for nebulisatio	B00438581	1	x
In terms of the number of charges imparted to peptides during	B00464842	1	x
Which sequencing method does not rely on a database when attempting to	B00513235	1	x
Which software tool is used to determine the sequence of a peptide...	B00460060	1	x
What is the MAXIMUM expected mass of a tryptic peptide?	smc	2	x
Following MALDI ToF analysis of a protein digest, which online search	smc	2	x
What is the average molecular weight of a tryptic peptide?	B00470690	1	x
Which ionisation technique results in multiple charged states being fo		1	x
what do mass spectrometers measure?	smc	2	x
Does modern ion trap mass spectrometer contain a magnetic field?	B00460953	1	x
How many electrodes make up an ion trap mass analyser?	B00472342	1	x
Which ionization technique do you associate with columbic explosion?	smc	2	x
What is the inert gas usually found within the collision cell of a QTO	B00475415	1	x

Student Evaluation – What Aspects Could be Improved

the scoring, the other members of the class contributing to the marks could be biased.

do it more often!!

More time to complete the different parts of the activity.

Students should be given more information about what the task is about before they arrive to the lecture.

Smaller groups so everyone has to do something.

Student Evaluation – What Did You Think of C/PBL? Like to do it again?

yes, definitely a great method for teaching. 3 hours is a long time so reading lecture notes becomes very boring, this kept everyone engaged!

No, I didn't particularly enjoy it and as a result would prefer not to see more of it!

Yeah it was really enjoyable- as well as learning the lecture it was fun to interact with other members of the class. It was memorable which will make the content of the lecture memorable.

Student Evaluation – What Did You Think?

I really did enjoy it, I went home and bragged about having a great class.....sad I know but true.

I would love to see more classes like that, it's a lot better than someone just reading the lecture from the screen and it really shows an understanding of the subject by working out the problems and working as a team.

so a definite thumbs up stephen!!!! =D

I enjoyed working as a group, because we rarely get to do that outside of practicals.

Personal Reflection

Highly engaging method of teaching

More preparation required than for standard lecture

Learning spaces for such activities need to be thought about (space & noise etc!)

Posters, presentations & knowledgebase were a good way to gauge student understanding of topics covered