Active Learning Methods

"The development of novel pedagogies in pharmacy and chemistry"

Dr Tim O'Sullivan

School of Pharmacy and School of Chemistry

Active Learning – why?

- 2006 Introduction to Pharmaceutical Chemistry (65-70 first year Pharmacy students)
- Students practice
- Measure learning
- Provide feedback
- Formative assessment
- Commercial packages e.g. OWL, Ace Organic

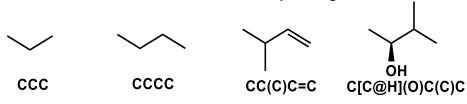
An Alternative?

- Requirements
 - Draw and interpret molecules
 - Economical to implement
 - Rapid feedback
 - Flexible
 - Tailored
- Components
 - Blackboard or Moodle
 - MarvinSketch applet
 - Drawing package

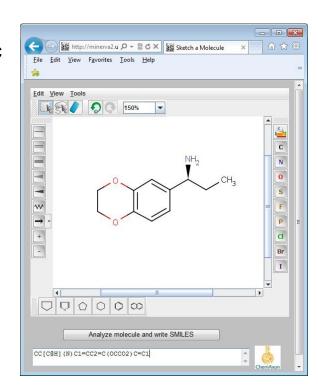
Implementation with SMILES

- Simplified Molecular Input Line Entry Specification
- Algorithm for converting chemical structures to ASCII

Selected molecules and corresponding SMILES

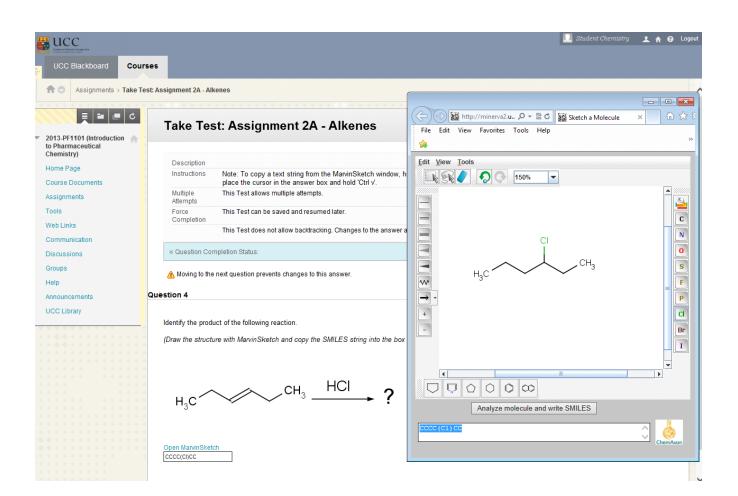


- MarvinSketch from Chemaxon
 - Free for academic use
 - Readily converts structures to SMILES
 - Available as JAVA applet
 - Run from any web browser



Student Interface

- Fortnightly assignments split into two batches
- Each batch contains 4/5 questions



Flexibility and Feedback

- Questions tailored to discipline
- Rapid feedback to students

Question

Compound X is an anti-histamine compound used to treat hay-fever. What is the structure of Compound X?

(Draw the structure with MarvinSketch and copy the SMILES string into the box below. DO NOT draw any inorganic by-products.)

Response Compound X is Carbinoxamine, sold under the tradename of Palgic. The alcohol is deprotonated with sodium hydride to form the alkoxide, a good nucleophile. The alkoxide Feedback: then undergoes an S_N2 reaction with the primary alkyl chloride to form Compound X i.e. Carbinoxamine.

Potential Pitfalls

Multiple answers

Q. Provide the structure of reactive Intermediate Y in the following reaction scheme.

• Plagiarism?

- Random order
- Prohibit backtracking
- Release feedback after deadline
- Question Pools
- Bank 1000+ questions

Student Feedback

Questionnaire at end of term

MarvinSketch/Blackboard User Survey

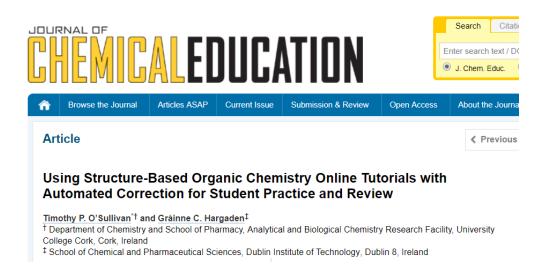
	Strongly agree	Agree	Neutral/ No opinion	Disagree	Strongly disagree
I found MarvinSketch/Blackboard (M/B) easy to use.					
The initial training/instructions provided for M/B were clear.					
The material covered by M/B was closely related to the material taught in class.					
The explanations/feedback for wrong answers was clear.					
M/B was a useful revision tool.					
M/B aided my understanding of 'curly arrow' mechanisms.					
Overall, I found M/B a beneficial learning experience.					
The level of difficulty of the questions in M/B was: (circle as appropriate)	Very hard	Hard	ок	Easy	Very easy
A total number of 9 assignments is: (circle as appropriate)	Far too many	Too many	ок	Too Few	Far too Few

g and

On average, how much time (in hours) did you spend completing each online assignment



- DIT Chemistry
 - Dr Gráinne Hargaden
 - Final year undergraduate Chemistry students
- University of Limerick
 - Dr Peter Davern



From first year to final year...

- Dr JJ Keating and Dr Eileen O'Leary SOP
- Re-emphasise fundamental science in final year

Highlight links between chemistry and clinical practice

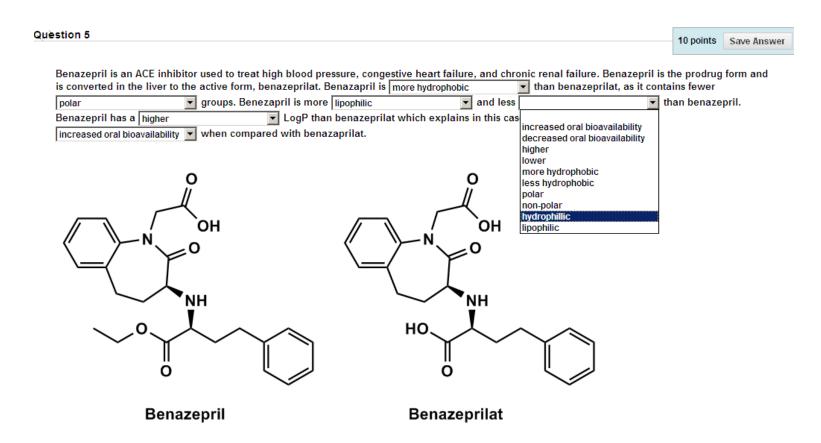
Feedback from external sources

Implementation

- Three Interventions
 - Videos, online assignments, student MCQs
- Panopto video narrated slides & PPT
- Three topics
 - Drug metabolism, Lipophilicity, pKa/distribution
- 15-30 minutes duration
 - Theoretical underpinnings
 - Practical applications
- Online assignments Drug class

Question types: Jumbled Sentence

Relating structure to physicochemical properties



Question types: Calculations

Pharmaceutical calculations and information retrieval

Question 3

10 points Save Answer

Zestoretic 10 mg/12.5 mg tablets contain lisinopril dihydrate (an ACE inhibitor) and hydrochlorothiazide (a diuretic).



Examine the SPC for Zestoretic tablets and determine the number of milligrams of

(Your answer should be correct to one decimal place. Do NOT include the units.)

Home | About | Links | Help medicines.ie Search for: Search Medicine or Company Name Search Full Document AstraZeneca Pharmaceuticals (Ireland) Ltd College Park House, 20 Nassau Street, Dublin 2, Telephone: +353 1 609 7100 Fax: +353 1 679 6650 Medical Information Direct Line: 1800 800 899 Freephone Medical Information e-mail: medical.informationuk@astrazeneca.com Customer Care direct line: +353(0)1 609 7100 Supply & non-medical enquiries Medical Information Facsimile: +44 (0)1582 838 003 Summary of Product Characteristics last Zestoretic 10 mc Table of Contents 1. NAME OF THE MEDICINAL PRODUCT 2. QUALITATIVE AND QUANTITATIVE COMPOSITION 3. PHARMACEUTICAL FORM 4. CLINICAL PARTICULARS 4.1 Therapeutic indications 4.2 Posology and method of administration 4.3 Contraindications 4.4 Special warnings and precautions for use

4.5 Interaction with other medicinal products and other forms of interaction

4.6 Pregnancy and lactation

5. PHARMACOLOGICAL PROPERTIES
5.1 Pharmacodynamic properties
5.2 Pharmacokinetic properties
5.3 Preclinical safety data
6. PHARMACEUTICAL PARTICULARS
6.1 List of excipient(s)
6.2 Incompatibilities
6.3 Shelf life

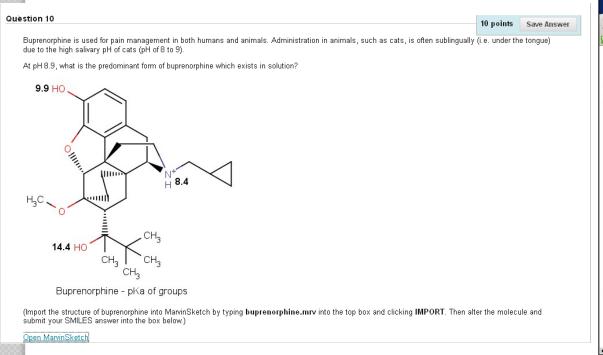
6.4 Special precautions for storage 6.5 Nature and contents of container

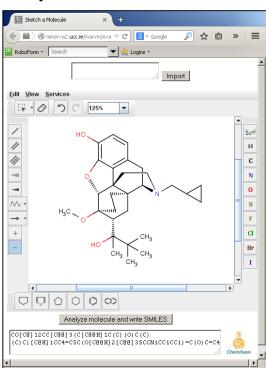
4.8 Undesirable effects 4.9 Overdose

4.7 Effects on ability to drive and use machines



- Identify and draw drug metabolites
- Given prodrug, identify and draw active compound
- Assign stereochemical configuration and draw specific stereoisomers
- Identify predominant form at particular pH







Marks and feedback following deadline

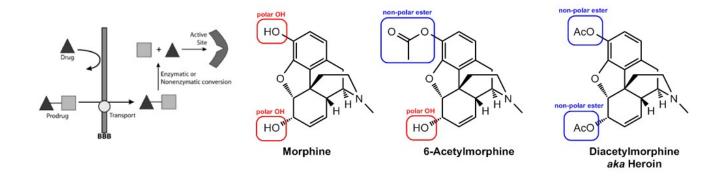
Selected Answer: When we compare morphine and Compound A, we find that Compound A has 4 times the analgesic effect of morphine. This may be rationalised in terms of the compounds' differing pharmacokinetics.

Compound A has a **higher** LogP than morphine and, being **less** polar, quickly crosses the blood-brain barrier. The blood-brain barrier is fatty, so **lipophilic** compounds cross the blood-brain barrier more quickly than **non-lipophilic** compounds.

Finally, comparing the structure of morphine with Compound B, would lead us to suggest that Compound B is less polar than morphine.

Response Compound A is 6-acetylmorphine and can be considered a prodrug ester of morphine, where the polar phenol group is masked as a non-polar ester group. This means that 6-feedback: acetylmorphine is less polar than morphine. Accordingly, 6-acetylmorphine is more lipophilic and has a higher LogP than morphine (i.e. LogP of 1.55 vs LogP of 0.89). Being more lipophilic, 6-acetylmorphine crosses the fatty blood-brain barrier more quickly, and hence has a more potent analgesic effect.

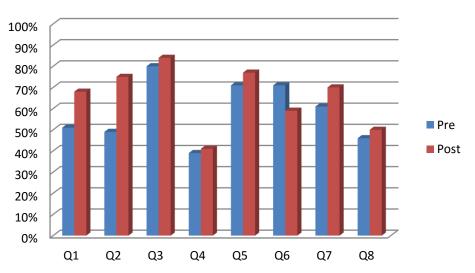
Compound B is diacetylmorphine, better known as heroin. Diacetylmorphine is even more lipophilic and less polar than morphine, because both the phenol and the secondary alcohols are masked as non-polar ester groups. The LogP for diacetlymorphine is 1.58.



Outcomes – Student Performance

- Pre- and post-assignments MCQ
 - Pre-intervention average 58.5%; Post-intervention average 65.5%

Pre- and post-intervention MCQ marks



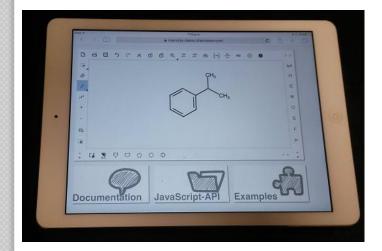
- 82% found it an 'enjoyable way to learn'
- 77% are 'more confident in discussing pharmaceutical chemistry concepts'
- Minimal use of videos



- Phasing out of Java-based MarvinSketch (client side)
- Replaced with Javascript-based MarvinJS (server side)

-±,⁄, •,□

- Questions fully integrated into Blackboard
- Tablets in class?



Stion 6

Perindopril is sometimes formulated as its salt to improve its aqueous solubility. Draw the salt which results when perindopril is reacted with 2-methylpropan-2-amine CH₃

Perindopril

Alter the molecule and submit your SMILES answer into the box below.

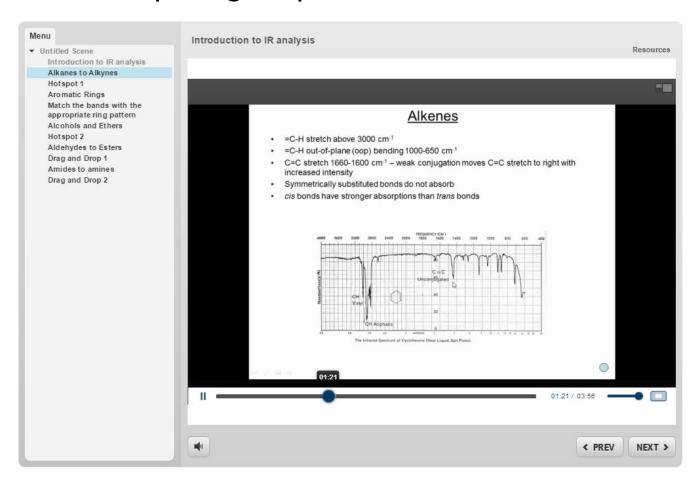
 \leftarrow

Technology-enabled flipped classroom

- Flipped classroom reverses the traditional learning environment
- Students watch online lectures and engage in problem solving in the classroom with the guidance of lecturer
- PF2012 Pharmaceutical Analysis
- Interpretation of spectra
- Have students engaged with pre-classroom material???
- Online interactive videos

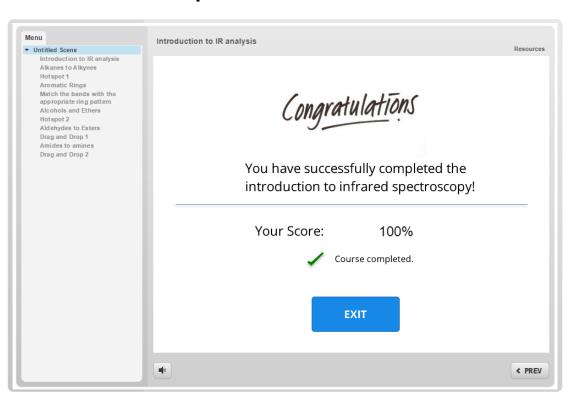
Interactive videos

- Created using Articulate
- SCORM package imported into Blackboard



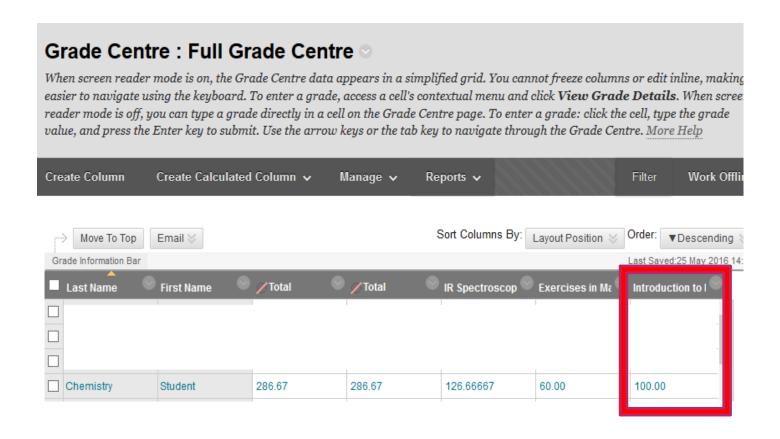
Questions

- Video interspersed with questions
- Based on previous material



Analytics

SCORM returns completion data to Grade Centre



Classroom problem sessions

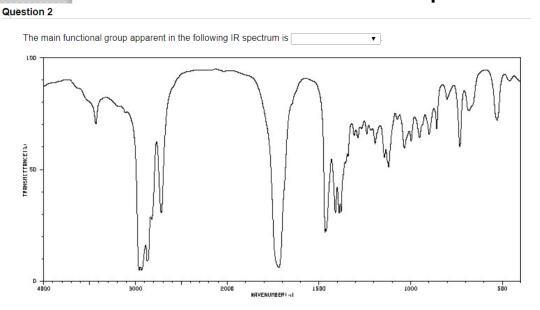
- Students work through problems of increasing complexity
- Integration with other modules via 'Pharma Family'

Q: **Cora Pharma** is a 72 year old female who has a 10-year history of dyslipidaemia (abnormal amount of lipids) and is now being treated for angina. She currently takes Simvastatin 40mg tablets. The IR spectrum of Simvastatin exhibits several bands above 1600 cm⁻¹. Match the bands with the appropriate functional group.

- 3547 cm⁻¹ (m, br)
- 3050 cm⁻¹(m)
- 2969 cm⁻¹ (m)
- 1724 cm⁻¹(s)
- 1698 cm⁻¹ (s)



- Assess student learning via Blackboard
- Additional practice
- Identifying features in spectra, predicting absorbances, drawing fragment ions etc...
- Marks and feedback positive



Draw the fragment ion of mass 142 which appears in the EI mass spectrum of pregabalin.

H₃C

CH₃

OH

(Draw the structure with MarvinSketch and copy the SMILES string into the box below.)

| CH₃
| Pho | P

Acknowledgements

- Dr Gráinne Hargaden, DIT
- Dr JJ Keating and Dr Eileen O'Leary, SOP
- Peter Flynn, LTU
- Patrick Kiely & Claire Fennell
- Tom O'Mara, Tara Duggan & Ilse Corkery
- NAIRTL, National Forum for the Enhancement of Teaching and Learning in Higher Education

Active learning: 'Activating' students and students as active participants







Outline

- Challenges in teaching history & medieval history
- Personal background
- Teaching philosophy
- Case studies
 - The use of multiple means of action and entry points
 - The use of multiple means of expression for students
 - Differing approaches across differ years of study to activate learning
 - Alignment of differing approaches to gradual development of students as independent learners and researchers
- Discussion

Challenges in teaching history & medieval history

- Student profile
 - Entry points: CK101, 2017 346 points
 - Diverse student profile
- Subject of history
 - Relevance
 - Teaching history & teaching the skills
 - Employability
- Area of medieval history
 - Niche area
 - Relevance
 - Employability
 - Design new ways of thinking about old problems
 - Traditional skills of a historian (primary evidence & source analysis)
 - Digital repositories and experiential learning in non-classroom environments
- Teaching spaces

Personal background



KUL University, Lublin





University College Cork



- Part-time lecturing: Trinity College Dublin, University College Dublin, All Hallows College & the Open University.
- Heritage sector: 'Franciscan Faith: Sacred Art in Ireland' & 'Medieval Ireland' exhibitions, NMI.
- Digital projects: Material Culture of Irish Mendicant Orders (now in Irish Virtual Research Library and Archive) & Monastic Ireland Project (www.monastic.ie).
- Arts projects: *Friars Walk* performance & programmes on RTÉ Lyric FM.
- Collaboration: history, art history, archaeology, theology, heritage, digital media and arts.

National Museum of Ireland

The use of multiple means of action and entry points

Hi1005: Pilgrims and Crusaders

The use of multiple means of action and entry points: Popular culture

I hear Jerusalem bells a-ringing
Roman cavalry choirs are singing
Be my mirror, my sword and shield
My missionaries in a foreign field
For some reason I can't explain
Once you'd gone there was never
Never an honest word
And that was when I ruled the world

It was a wicked and wild wind
Blew down the doors to let me in
Shattered windows and the sound of drums
People couldn't believe what I'd become
Revolutionaries wait
For my head on a silver plate
Just a puppet on a lonely string
Oh who would ever want to be king?

I hear Jerusalem bells a-ringing
Roman cavalry choirs are singing
Be my mirror, my sword and shield
My missionaries in a foreign field
For some reason I can't explain
I know St Peter won't call my name
Never an honest word
But that was when I ruled the world







The use of multiple means of action and entry points: Popular culture

Kingdom of Heaven, 2005

Balian of Ibelin: What is Jerusalem? Your holy places lie over the Jewish temple that the Romans pulled down. The Muslim places of worship lie over yours. Which is more holy? The wall? The mosque? The sepulchre? Who has claim. No one has claim. All have claim.

https://www.youtube.com/watch?v=LzsQhiYblck



Israeli Culture Minister Miri Regev at Cannes opening gala, 18 May 2017







Israeli Culture Minister Miri Regev at Cannes opening gala, 18 May 2017 and web responses to the dress.

The use of multiple means of action and entry points: Politics

6 December 2017

Steve Bell on Donald Trump and Jerusalem cartoon

Donald Trump has defied overwhelming global opposition by declaring US recognition of Jerusalem as the capital of Israel, but insisted that the highly controversial move would not derail his own administration's bid to resolve the Israeli-Palestinian conflict



https://www.theguardian.com/commentisfree/series/guardian-comment-cartoon?page=2

Exercise

Group work

●7:50 PM

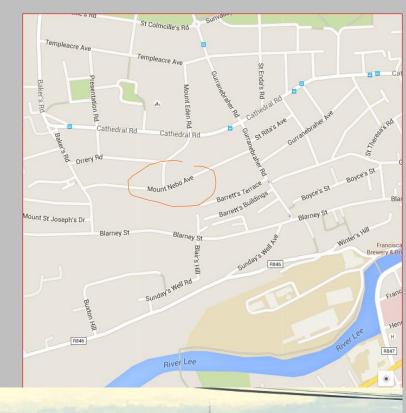
• Image study: description and interpretation

Making medieval history relevant: New information and memory aids

Medieval pilgrimage routes

- Port of Jaffa/ Joppa
- Mt Nebo





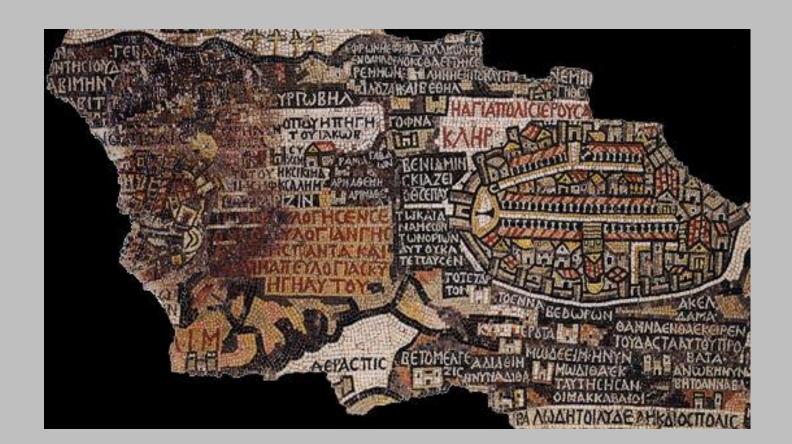


Memorising and understanding: Group quiz

 1. Medieval pilgrims regarded Mount Sinai as the site where □ Christ delivered the Sermon on the Mount □ Moses received the Ten Commandments □ Moses died 	 □ the second century □ the fourth century □ the sixth century
2. Moses died on ☐ Mount Sinai ☐ Mount Nebo ☐ the Temple Mount	6. The Temple Mount was regarded by the Jews as ☐ the site of Abraham's sacrifice ☐ the site of the Temple ☐ both of the above
3. Egeria's description of the holy land and Jerusalem dates to ☐ the second century ☐ the third century ☐ the fourth century	7. The First Temple in Jerusalem was built by ☐ King David ☐ King Solomon ☐ King Herod the Great
 4. The Madaba map represents □ a Roman road system □ a map of the Roman Empire □ a map of the Holy Land 	8. The Second Temple was built following the Babylonian captivity the Roman capture of Jerusalem the Egyptian looting of Jerusalem

Teaching skills: Source studies

- Professional and personal skills
- Skills of a historian (historical interpretation, source analysis and evaluation)
- Awareness of variety of sources: visual sources and textual sources (slow reading)
- Soft skills: communication and collaboration
- Variety of expression: individual and group work, quizzes, discussion, individual presentation, essay, exam



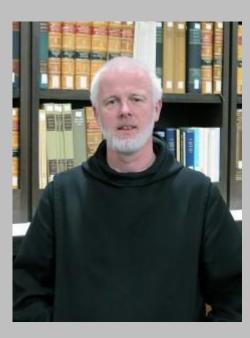
Different voices and different perspectives: Collaboration



The School of History, UCC

Jerusalem is one of the most contested, shared sacred spaces in the world. Yesterday, Dr Amanullah De Sondy gave a guest lecture on medieval Islamic Jerusalem to History's First Year optional module, HI 1005 Pilgrims and Crusaders. Dr De Sondy is Senior Lecturer in Contemporary Islam at UCC's Study of Religions Department. He discussed Jerusalem's role in Islamic culture and history, and focussed on the importance of the Dome of the Rock and its interaction with related Jewish and Christian holy places and traditions. Pilgrims and Crusaders is taught by History's Dr Malgorzata D'Aughton and Dr Diarmuid Scully. The module introduces students to the texts, images, objects and places that help us to understand early encounters between Christianity, Islam and Judaism, and the role of pilgrimage and holy war in medieval society, including Ireland.





The School of History, UCC added 4 new photos. History February 20 · @

Last Friday, 17 February, our MA in Medieval History students went to Dublin as part of their Skills-based module coordinated by Dr Malgorzata Krasnodebska-D'Aughton. The visits to the Book of Kells and the National Museum aimed not only at viewing historic artefacts but were conducted with the students' forthcoming online exhibition in mind. The masterclass in the Discovery Programme based on the Monastic Ireland project, www.monastic.ie, and led by the Monastic Ireland team created a forum for postgraduate students and researchers from various academic institutions and disciplines to exchange ideas on the topic of monasticism.







Alignment of differing approaches to gradual development of students as independent learners and researchers

Hi2105 Case Studies in Research Skills

Teaching research skills: Medieval preaching

Careers of famous Franciscan preachers in Ireland

- Annals of Ulster, **U1454.6**/ Tadgh O'Donoghue
- Annals of Ulster, **U1486.17**/ Donal O'Fallon
- Annals of Ulster, **U1492.28**/ Angus MacNulty
- Annals of Ulster, **U1505.13**/ Patrick O'Feidhil

- http://www.ucc.ie/celt/published/T100001C/index.html
- CELT/ Corpus of Electronic Texts
- Ireland's first and longest running Humanities computing project
- 5% of hits for UCC websites

- Annals of Ulster, **U1454.6**: A sermon was preached this year on the Cloch-cuir in Fir-Manach by Tadhg Ua Donnchadha (Tadgh O'Donoghue), namely, on the feast-day of St. Lawrence.
- Annals of Ulster, **U1486.17:** A general Synod was held in Droiched-atha by the archbishop of Ard-Macha, namely, Octavian the Italian and the bishops and clergy of the North of Ireland, on the (5th of the Ides) 11th of July. Domnall Ua Fallamhain (Donal O'Fallon), namely, Friar Minor of Stricter Observance and the preacher that did most service to Irishmen since Patrick was in Ireland, was at that Synod, endeavouring to release his Letters for the bishopric of Derry, which had been granted to him that time from Rome.
- Donal O'Fallon: vicar provincial, 1472-75, bp of Derry, 1485-1500.
- Annals of Ulster, **U1492.28:** Aengus Mac-an-Ulltaigh (Angus MacNulty), namely, a Friar Minor of Stricter Observance and good, reputable preacher, died in Autumn.
- Annals of Ulster, 1505 **U1505.13:** Patrick O'Feidhil, namely, a Friar Minor of Stricter Observance and a <u>distinguished, honoured preacher in Ireland and in Scotland, died.</u> And he died in the monastery of Tech-Molaigi and was buried in it.
- http://www.ucc.ie/celt/published/T100001C/index.html

Collaboration: History programmes and library



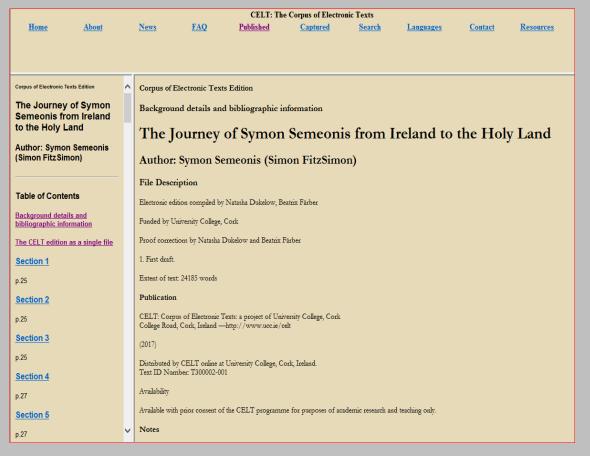
Training students as historians and professionals

Hi6091 Skills for Medieval Historians, MA in Medieval History

Becoming a historian: Hi6091 Skills for Medieval Historians

- MA in Medieval History: three taught modules in medieval history, a module in applied history, a Latin module and a dissertation
- Collaborative online exhibition
- Field trip
- Work placements







HI6091: Work Placement in Special Collections

Posted on September 21, 2017 by Elaine Harrington

The River-side welcomes this guest post from Kate O'Brien and Donncdha Carroll, students on the 2016/2017 MA in Medieval History in UCC, that includes the HI6091: Skills in Medieval History module. HI6091 is taught by Dr Malgorzata Krasnodębska-D'Aughton, recently selected for a President's Award for Excellence in Teaching 2016/2017 and Elaine Harrington. The module featured in the Award application as an illustration of the teaching approach that combines traditional skills of a historian with a creative use of technology. Part of the HI6091 module, Dr D'Aughton designed, includes a specifically tailored work placement that focuses on public outputs. Donncdha Carroll and Kate O'Brien spent six weeks in Special Collections providing collection care on St Fin Barre's Cathedral Library Collection and creating a finding aid for an uncatalogued collection of Photostats. Kate and Donncdha had previously written posts for The Riverside as part of The Book of Kells student exhibition hosted on The Riverside.

Recent Posts

- HI6091: Work Placement in Special Collections
- A Printed Pilgrimage
- Curating 'Journeys of Belief and Belonging: Modern Irish Pilgrimage'
- The Book of Kells: Image and Text / The Carpet Page
- The Book of Kells: Image and Text / The Temptation of Christ

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← The Book of Kells: Image and Text / The Chi Rho Page The Book of Kells: Image and Text / The Carpet Page →

The Book of Kells: Image and Text / The Temptation of Christ

Posted on June 2, 2017 by Elaine Harrington

Student Exhibition, MA in Medieval History

The Temptation of Christ

The temptations of Christ are described in the Gospels of Mathew (4:1-11), Mark (1:12-13) and Luke (4:1-13). Following forty days of fasting in the desert, Christ is tempted by the devil three times. The final temptation takes place at the Temple in Jerusalem and aims to test Christ's divinity by asking him to throw himself from the Temple to verify whether the angels would protect him. The Kells scene described as the Temptation of Christ is set within Luke's Gospel (folio 202v). It shows Christ on top of the box-like structure flanked by two angels above, with a black winged figure of the devil possibly holding a lasso placed to the right. The illustration contains curious features that raise a number of questions. Why is Christ's unusually large body emerging from the Temple? Who is the small figure in the door and who are the other human figures? What is the meaning of the angels and the devil?



The Book of Kells, TCD MS 58, folio 202v© Trini tyCollege Dublin



Two angelic figures flanking the head of Christ, The Book of Kells, TCD MS 58, folio 202v (detail) @ Trinity College Dublin

The permanent Temple built by Solomon in Jerusalem replaced the portable Tabernacle carried by the Israelites for forty years in the desert, as the place of the meeting between God and his people (Exodus 7:16). The holiest area of the Tabernacle contained the Ark of Covenant with the tablets of the Ten Commandments and could only be attended by Aaron, the high priest and his descendants (Exodus 25–31 and 35–40). According to St Paul, the Church was the new Tabernacle 'set up by the Lord, not by man' with Christ becoming the new high priest (Hebrews &2, 4:14). Two angelic figures featured above Christ's head may further link the Kells image to the Tabernacle. Their number and position allude to the cherubim placed on top of the Ark of the Covenant from where God's voice was to be heard (Exodus 25:22). They may also allude to Luke 4:10-11 where the devil tempts Christ and states that the angels should come to his aid if he leaps from the Temple. The framed figure in the doorway may depict the priestly figure of Aaron in the Tabernacle, King Solomon, the builder of the Temple or Christ himself.



The Book of Kells, TCD MS 58, folio 202 v (detail) © Trini ty

- Professional skills, such as writing about public history, editing, dealing with copyright issues and plagiarism, working to deadlines, marketing and publicity;
- Soft skills of communication, collaboration, team work.





Scholarly Resources About Monastic Ireland Contact



Order: Augustinian, Arroasian rule Founded some time after 1140



Clontuskert Augustinian Priory

Add to favorites

Founded by the O'Kellys of Hy Many Also known as Priory of St Mary Cluain Tuaiscirt O Maine; Clontuskert-Omanny; The priory of the Virgin Mary

Site plan



Click map to start the tour















The Place

What happened?

121g: Melaghlin, the son of Conor Mainmoy, was slain by Manus, the son of Turlough O'Connor, who had taken his house at Clontuskert.

137g: Nicholas O'Ouinaeych, Augustinian canon of St Mary's was granted a dispensation in order to become prior of Clontuskert. The same year, a prior of Clontuskert was given jurisdiction over the Augustinian community at Aughrim and a papal indulgence was granted to those who visit and help to repair the priory.

1404: The monastery of Cluain Tuaisgirt Ua Maine was destroyed by fire after being struck by

1444: Death in battle of Prior Breasal, son of Eoghan O'Kelly.

1471: Restoration of the priory concludes with the erection of the western portal.

1551: Donat O Kelle, chaplain, confirmed by King Edward VI.

1567: Priory with its possessions leased to Redmond Burke, son of Ulick Burke (d.1544), 1st earl of Clanricarde.

1570: Priory is granted to Richard Burke (d.1582), 2nd earl of Clanricarde.

1595/6: Sons of Redmond Burke partake in rebellion that results in destruction of the priory.

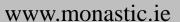
1610: Priory is regranted to Richard Burke (d.1635), 4th earl of Clanricarde.

1637: Partial restoration of the site, the chancel is roofed and a gable wall erected by Augustinian

1716: Clonrickard lands including Clontuskert are leased to the Rev. William Fitzgerald, Bishop of

Entry by Anne O'Mahony







As chairman of the UCC Historical Society, he directed and performed in an anniversary dramatic reproduction of the 1921-22 Dáil debates on the Anglo-Irish Treaty, which saw two successful runs in 2012. As chairman of the UCC International Relations Society, he was twice Secretary-General of the Irish National Model United Nations. After completing an MPhil in Medieval History on national identity, imperialism and providential history in twelfth-century English chronicles at Corpus Christi College, University of Cambridge, Jesse is currently pursuing a doctorate there thanks to support from the Arts and Humanities Research Council and the

Undergraduate Award Winner in 2012

University: University College Cork
Course: Historical Studies & Archaeology

National University of Ireland.



Embedding research in curriculum

- Jesse Harrington, Undergraduate Awards 2012 winner, essay submitted for the Hi3122 module
- Natasha Dukelow and Martha Ewence, joint winners of Jennifer O'Reilly Memorial Prize awarded by the School of History for the best BA degree project in Medieval History, dissertations submitted for the third-year seminar, February 2017.

Closing remarks based on observation and student feedback



- Students enjoy learning that involves creativity and collaboration
- Students like to see how teaching relates to their intellectual needs
- Students enjoy practical aspects of learning
- Students like being involved
- Students enjoy working things out
- Students work well in groups
- Importance of keeping the sense of fun in teaching
- Importance of teaching the discipline