

## 國立臺灣大學生命科學院 新開課程課程大綱

※課程名稱	中文	冷凍電子顯微術: 理論 與 實作一		
	英文	Cryo-Electron Microscopy: theory and practice (I)		
※開課學期	第一學期			
※開課系所	生化所	※課號/課程識別碼		
※學分(數)	2	※必/選修	選修	
※授課教師				
※全/半年	半年	英語授課	是： <input checked="" type="checkbox"/> 否： <input type="checkbox"/>	
修課人數上限	10	選課方式	<input type="checkbox"/> 第1類 <input type="checkbox"/> 第2類 <input type="checkbox"/> 第3類 (類別說明請參校網頁)	
※課程概述 (至少 50 字)	<p>基於最近顯微鏡技術突破，冷凍電顯成為結構生物學主流。本課程將複習 x 光結晶學，及冷凍電顯沿革。</p> <p>Due to the breakthrough in the technologies of cryo-EM, atomic models of many macromolecules are now available from their better than 4 Å cryo-EM maps. To respond to this revolution, we offer this course that covers the review on X-ray crystallography, the historical development of cryo-EM, the theory of EM image formation and analysis, current breakthrough including the hardware of direct electron camera and the software that can disentangle solution conformations. Finally, we will engage students with hands on practice on making EM specimen, plunger-freezing, and image processing using RELION and other software.</p>			
※課程目標	<p>使學生能認識及使用冷凍電解，解決非晶態巨分子結構。</p> <p>The objective of this course is to prepare a new generation of students that can use the revolutionized cryo-EM towards obtaining atomic-resolution description of his or her targeted biological molecules in a non-crystalline state, which is critical for establishing true structure-and-function in the context of physiological relevance.</p>			
課程要求 或 預修課程	Pre-requisite: General Physics(required), General Chemistry II (required), Fourier analysis or Fourier Optics (recommended), Signal Processing (recommended)			

<p>主要 參考書目</p>	<p>(例如: 書名、年份、作者、出版商/或代理商/或本校圖書館有/或網址/或其他方式)</p> <p>(1) Tony Crowther, The Resolution Revolution: Recent Advances In cryoEM (Methods in Enzymology) 1st Edition</p> <p>(2) Joachim Frank, Three-Dimensional Electron Microscopy of Macromolecular Assemblies: Visualization of Biological Molecules in Their Native State 2nd Edition</p>																																						
<p>※ 課程進行方式 與 週次單元主題</p>	<p>課程進行方式： 週次單元主題：</p> <table border="1" data-bbox="368 533 1331 1637"> <thead> <tr> <th data-bbox="368 533 512 591">週次</th> <th data-bbox="512 533 1331 591">單元主題</th> </tr> </thead> <tbody> <tr> <td data-bbox="368 591 512 649">第 1 週</td> <td data-bbox="512 591 1331 649">Review on structure-and-function relationship</td> </tr> <tr> <td data-bbox="368 649 512 707">第 2 週</td> <td data-bbox="512 649 1331 707">Review on how structure research has impacted life sciences</td> </tr> <tr> <td data-bbox="368 707 512 766">第 3 週</td> <td data-bbox="512 707 1331 766">The field in biology that are being revolutionized by structures</td> </tr> <tr> <td data-bbox="368 766 512 824">第 4 週</td> <td data-bbox="512 766 1331 824">Taking picture of a macromolecule: image or diffraction</td> </tr> <tr> <td data-bbox="368 824 512 882">第 5 週</td> <td data-bbox="512 824 1331 882">Do we always need a crystal for X-ray diffraction?</td> </tr> <tr> <td data-bbox="368 882 512 940">第 6 週</td> <td data-bbox="512 882 1331 940">The advantage of electrons over X-ray and the bad side</td> </tr> <tr> <td data-bbox="368 940 512 999">第 7 週</td> <td data-bbox="512 940 1331 999">The radiation damage issue and the birth of cryo-EM</td> </tr> <tr> <td data-bbox="368 999 512 1057">第 8 週</td> <td data-bbox="512 999 1331 1057">The milestones of cryo-EM over last 30 years</td> </tr> <tr> <td data-bbox="368 1057 512 1115">第 9 週</td> <td data-bbox="512 1057 1331 1115">The phase contrast image formation and contrast transfer</td> </tr> <tr> <td data-bbox="368 1115 512 1173">第 10 週</td> <td data-bbox="512 1115 1331 1173">Midterm</td> </tr> <tr> <td data-bbox="368 1173 512 1232">第 11 週</td> <td data-bbox="512 1173 1331 1232">The reduction of contrast: charge-induced motion hypothesis</td> </tr> <tr> <td data-bbox="368 1232 512 1290">第 12 週</td> <td data-bbox="512 1232 1331 1290">Direct electron camera: motion correction</td> </tr> <tr> <td data-bbox="368 1290 512 1348">第 13 週</td> <td data-bbox="512 1290 1331 1348">Direct electron camera: DQE and Poisson noise</td> </tr> <tr> <td data-bbox="368 1348 512 1406">第 14 週</td> <td data-bbox="512 1348 1331 1406">Harvesting information from noisy single particle images</td> </tr> <tr> <td data-bbox="368 1406 512 1464">第 15 週</td> <td data-bbox="512 1406 1331 1464">Towards 3D reconstruction: Fourier-slice theorem</td> </tr> <tr> <td data-bbox="368 1464 512 1523">第 16 週</td> <td data-bbox="512 1464 1331 1523">Image alignment, model bias, and maximum likelihood</td> </tr> <tr> <td data-bbox="368 1523 512 1581">第 17 週</td> <td data-bbox="512 1523 1331 1581">What if there are multiple conformations?</td> </tr> <tr> <td data-bbox="368 1581 512 1637">第 18 週</td> <td data-bbox="512 1581 1331 1637">Final exam</td> </tr> </tbody> </table>	週次	單元主題	第 1 週	Review on structure-and-function relationship	第 2 週	Review on how structure research has impacted life sciences	第 3 週	The field in biology that are being revolutionized by structures	第 4 週	Taking picture of a macromolecule: image or diffraction	第 5 週	Do we always need a crystal for X-ray diffraction?	第 6 週	The advantage of electrons over X-ray and the bad side	第 7 週	The radiation damage issue and the birth of cryo-EM	第 8 週	The milestones of cryo-EM over last 30 years	第 9 週	The phase contrast image formation and contrast transfer	第 10 週	Midterm	第 11 週	The reduction of contrast: charge-induced motion hypothesis	第 12 週	Direct electron camera: motion correction	第 13 週	Direct electron camera: DQE and Poisson noise	第 14 週	Harvesting information from noisy single particle images	第 15 週	Towards 3D reconstruction: Fourier-slice theorem	第 16 週	Image alignment, model bias, and maximum likelihood	第 17 週	What if there are multiple conformations?	第 18 週	Final exam
週次	單元主題																																						
第 1 週	Review on structure-and-function relationship																																						
第 2 週	Review on how structure research has impacted life sciences																																						
第 3 週	The field in biology that are being revolutionized by structures																																						
第 4 週	Taking picture of a macromolecule: image or diffraction																																						
第 5 週	Do we always need a crystal for X-ray diffraction?																																						
第 6 週	The advantage of electrons over X-ray and the bad side																																						
第 7 週	The radiation damage issue and the birth of cryo-EM																																						
第 8 週	The milestones of cryo-EM over last 30 years																																						
第 9 週	The phase contrast image formation and contrast transfer																																						
第 10 週	Midterm																																						
第 11 週	The reduction of contrast: charge-induced motion hypothesis																																						
第 12 週	Direct electron camera: motion correction																																						
第 13 週	Direct electron camera: DQE and Poisson noise																																						
第 14 週	Harvesting information from noisy single particle images																																						
第 15 週	Towards 3D reconstruction: Fourier-slice theorem																																						
第 16 週	Image alignment, model bias, and maximum likelihood																																						
第 17 週	What if there are multiple conformations?																																						
第 18 週	Final exam																																						
<p>評量方式</p>	<p><input checked="" type="checkbox"/>考試 <input checked="" type="checkbox"/>作業 <input checked="" type="checkbox"/>出席 <input checked="" type="checkbox"/>平時參與 <input type="checkbox"/>其他</p>																																						
<p>※課程新開 或 課程異動 說明事項</p>	<p>本校有無開設類似的相關課程？</p> <p><input type="checkbox"/>有 <input checked="" type="checkbox"/>無</p> <p>(<input type="checkbox"/>授課教師確認、<input type="checkbox"/>系所辦學程單位辦公室人員確認無誤)</p> <p>說明：</p>																																						

備註	This is a first cryo-EM course in Taiwan
----	--

(2014/9/18 更新)