

## 《农业生物技术》课程教学大纲（2021 版）

| 课程基本信息 (Course Information)       |  |                          |    |                  |   |
|-----------------------------------|--|--------------------------|----|------------------|---|
| 课程代码<br>(Course Code)             | AB028  | *学时<br>(Credit Hours)    | 32 | *学分<br>(Credits) | 2 |
| *课程名称<br>(Course Name)            | 农业生物技术<br>Agricultural Biotechnologies   |                          |    |                  |   |
| 课程类型<br>(Course Type)             | 选修课<br>Elective course   |                          |    |                  |   |
| 授课对象<br>(Target Audience)         | 上海交通大学在校生（特别是植科系高年级学生）<br>Open to any SJTU student interested in subject area (specifically Juniors and Seniors majoring in Plant Science)   |                          |    |                  |   |
| 授课语言<br>(Language of Instruction) | 英语/English   |                          |    |                  |   |
| *开课院系<br>(School)                 | 农业与生物学院/School of Agriculture and Biology  |                          |    |                  |   |
| 先修课程<br>(Prerequisite)            | General biology and first year college mathematics   | 后续课程<br>(post)           | 无  |                  |   |
| *课程负责人<br>(Instructor)            | Dan Luo 教授：<br>美国康奈尔大学生物与环境工程学院的教授，纳米生物技术中心、康奈尔材料研究中心、生物医学工程与新生命科学计划的成员之一  | 课程网址<br>(Course Webpage) |    |                  |   |
| *课程简介 (中文)<br>(Description)       | 本门课程的主要教学内容将包括：纳米生物技术的基本概念以及构建模块,介绍纳米技术与生物技术的相关概念，包括 DNA, RNA,TNA,PNA 等；电子光刻法以及 DNA 计算和 DNA 结构纳米生物技术，从全新的角度认识 DNA；纳米生物技术的运用；植物生物学在现实与未来的需求及其在 21 世纪面临的挑战；植物基因组学、蛋白质组学和代谢组学的进步；植物生物学，基因改造与社会，从社会角度探讨生物新技术的应用及发展；食品的未来：基因型分析与分子育种，植物转化与基因组编辑技术。  |                          |    |                  |   |
| *课程简介 (英文)<br>(Description)       | <b>Basic concepts and building blocks.</b> Nanobiotechnology strides at the interface between nanotechnology and biotechnology. We will introduce the “nano” concept related to nanotechnology and biotechnology, from scales to sizes to energy. We will also cover nanoscale building blocks of life, in particular nucleic acids (including DNA, RNA, TNA, PNA, etc.). We will learn the concepts |                          |    |                  |   |

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|   | <p>of polymers, hierarchy assemblies and self-assemblies.</p> <p><b>Technologies</b> We will learn photolithography (including microfluidics), which is one of the fundamental tools to realize nanotechnology. We will also learn DNA from an entirely new perspective: as programmable molecules. Examples including DNA computing and DNA structural nanotechnology (e.g., DNA origami).</p> <p><b>Applications of nanobiotechnology I:</b> DNA as nanoscale organizers to assemble nanoparticles and as nanoscale scaffolds for novel biosensing and diagnosis.</p> <p><b>Applications of nanobiotechnology II:</b> DNA as both generic and generic nanoscale building blocks for the creation of novel materials.</p> <p><b>Plant biotechnology:</b> current and future needs and the challenges of the 21st century. Society is facing growing challenges associated with feeding the rapidly expanding global population, while dealing with factors that limit food production, such as climate instability and loss of agricultural land. We will discuss those challenges and identify issues that will limit future food security.</p> <p><b>Advances in plant genomics, proteomics and metabolomics.</b> The last decade has seen an explosion in the development of new technologies to study living organisms, and particularly those related to the study of their genomes. This lecture will provide an overview of cutting edge technologies that are used to study plants, crop production and plant genetic diversity.</p> <p><b>Plant biotechnology, genetic modification and society.</b> The application of biotechnology to agricultural crop production, and particularly the use of genetic modification technologies is a politically sensitive issue that can be difficult for the general public to understand. This lecture and discussion section will focus on the related issues of new technologies, food, communication and the sensitivities of society to the nature of the food supply.</p> <p><b>The future of food:</b> genotyping and molecular breeding, plant transformation and genome editing technologies.</p> <p>Feeding a human population that will likely reach 10 billion over the next few decades will require the development of new types of crops and cropping systems. This lecture will examine current technologies that are being used to create new generations of crops.</p> |
| <b>课程目标与内容 (Course objectives and contents)</b> |   |
| <p>*课程目标<br/>(Course Object)</p>                | <ol style="list-style-type: none"> <li>1. The student will be able to identify, evaluate and discuss major factors that will limit global crop production over the coming decades.(A4, A5, B4)</li> <li>2. The student will be able to identify and evaluate ‘omics’ technologies that are being used to study plant biological processes and diversity.(B2, B4)</li> <li>3. The student will be able to identify and evaluate arguments that are used both for and against the use of genetically modified crops and their application to enhance food security.(B2,C3,C4)</li> </ol>  |

4. The student will be able to identify and evaluate biotechnologies and strategies that are being used to develop new crops and plant products that benefit society.(A2, A5, B3, B5)

5. The students will understand the importance of sizes when down to the nanoscale; different sets of physical rules start to govern the behavior of objects. Students will also grasp the concept of movement at the nanoscale related to diffusion and energy.(B1, B2)

6. The students will learn the concept that DNA is not only a genetic biomaterial but also a generic nanomaterial. (B4,C3)

7. The students will gain knowledge of several fundamental tools related to nanobiotechnology. (B1, B5, D1)

8. The students will be exposed to real world applications of nanobiotechnology.(B4)

| *教学内容进度<br>安排及对应课<br>程目标 (Class<br>Schedule &<br>Requirements &<br>Course<br>Objectives) | 章节 | 教学内容 (要点)  | 学时 | 教学形式                             | 作业及考<br>核要求   | 课程思政<br>融入点  | 对应课程<br>目标 |
|--|----|--|----|----------------------------------|---|--|------------|
|  | 1  | Plant biotechnology:<br>current and future<br>needs and the<br>challenges of the 21st<br>century | 4  | Lectures<br>&<br>Discussio<br>ns | Reading<br>of<br>assigned<br>materials<br>and<br>participat<br>ion in<br>discussio<br>n | 引导学生<br>掌握科学<br>前沿理论<br>知识, 坚<br>定理想信<br>念, 养成<br>优良的思<br>想品德、<br>健康心理 | 课程目<br>标 1 |
|  | 2  | Advances in plant<br>genomics, proteomics<br>and metabolomics                                    | 4  | Lectures<br>&<br>Discussio<br>ns | Reading<br>of<br>assigned<br>materials<br>and<br>participat<br>ion in<br>discussio<br>n | 引导学生<br>掌握科学<br>前沿理论<br>知识, 激发<br>对专业的<br>兴趣                           | 课程目<br>标 3 |
|  | 3  | Plant biotechnology,<br>genetic modification<br>and society                                      | 4  | Lectures<br>&<br>Discussio<br>ns | Reading<br>of<br>assigned<br>materials<br>and<br>participat<br>ion in<br>discussio<br>n | 厚植家国<br>情怀, 引<br>导学生勤<br>于思考、<br>善于钻<br>研, 对推<br>陈出新怀<br>有浓厚兴<br>趣, 富有 | 课程目<br>标 2 |

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|   |   |   |                        |   |   | 探索精神, 并渴望解决社会实际问题。 |  |
| 4 | The future of food: genotyping and molecular breeding, plant transformation and genome editing technologies | 4 | Lectures & Discussions | Reading of assigned materials and participation in discussion | 通过学习增强对基础知识的专业兴趣, 培养及增强学生的专业意识              | 课程目标 4             |  |
| 5 | Basic concepts and building blocks.   | 4 | Lectures & Discussions | Reading of assigned materials and participation in discussion | 指导学生脚踏实地, 勤奋努力, 培养及增强学生的专业意识                | 课程目标 5             |  |
| 6 | Technologies  | 4 | Lectures & Discussions | Reading of assigned materials and participation in discussion |   | 课程目标 6             |  |
| 7 | Applications of nanobiotechnology I   | 4 | Lectures & Discussions | Reading of assigned materials and participation in discussion | 拓宽学生的国际化视野, 具有对多元文化的包容心态, 胸怀天下, 以增进全人类福祉为己任 | 课程目标 7             |  |
| 8 | Applications of nanobiotechnology II  | 4 | Lectures &             | Reading of  | 拓宽学生的国际化                                    | 课程目标 8             |  |

|  |  |  |  |             |  |                                     |  |
|--|--|--|--|-------------|--|-------------------------------------|--|
|  |  |  |  | Discussions | assigned materials and participation in discussion | 视野, 具有对多元文化的包容心态, 胸怀天下, 以增进全人类福祉为己任 |  |
| <p>注 1: 建议按照教学周学时编排。</p> <p>注 2: 相应章节的课程思政融入点根据实际情况填写。</p> |  |  |  |             |  |                                     |  |
| *考核方式 (Grading)  | <p>作业 (70%) + 考试 (30%)</p> <p>(Grade Constitution): Homework (70%) and Final Exam (30%)</p>  |  |  |             |  |                                     |  |
| *教材或参考资料 (Textbooks & Other Materials)                     | <p>参考资料:</p> <p>The following textbook may be used as a reference:<br/> "Plant Biotechnology and Agriculture- Prospects for the 21<sup>st</sup> Century" (2012, First Edition). Eds. Arie Altman and Paul Michael Hasegwa. Elsevier Publishing. ISBN 978-0-12-381466-1.</p> <p>However, students will not be required to purchase this books because specific course handouts will be provided to students from current and relevant sources from refereed publications accessible via the internet.</p> <p>Handouts related to nanobiotechnology will be provided; students will be required to read a number of published papers before and after the class.</p> |  |  |             |  |                                     |  |
| 其它 (More)  |  |  |  |             |  |                                     |  |
| 备注 (Notes)   |  |  |  |             |  |                                     |  |

备注说明:

1. 带\*内容为必填项。
2. 课程简介字数为 300-500 字; 课程大纲以表述清楚教学安排为宜, 字数不限。