Improving skill competence and research outcomes in China through BIOS, an authentic research experience

Justin Fendos, Liang Cai
Fudan University
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BIOS is not the firmware to boot the computer, but stands for

The Biology Intensive Orientation Summer

BIOS is designed primarily for 1st and 2nd year science majors through the School of Life Sciences, Fudan University.
Challenges in teaching (instructors).

• Huge social demands
  One Belt One Road – Talents with global vision
  Made in China 2025 – Creative talents
  Hsue-Shen Tsien’s Quest – Talents could lead to original discoveries
• Decreased students' enrollment intention
• Desire to have high quality graduate students
  Grad-students, not postdoc, are the main force of research
  Undergraduates tend to have their Ph.D. aboard
Challenges in teaching (students).

• The growing material and cultural needs
  Research is hard
  Scientists are poor

• Biological research has no challenge
  False impression due to high school teaching, we cannot change

• Lack confidence and competence to do research
  Minimal prior authentic research experience
  No direct contact with research group leaders
Goals for the BIOS program.

• Curriculum geared specifically towards biology research

• Create a significant learning experience

• Empower the students with skills to apply for research group intern positions

• Be collaborative
The structure of BIOS.

3 days

Basic training

Topical modules

15 days

Biochemistry

Cell biology

Fish genetics

Mouse genetics

Plant biology

15 days

Biochemistry

Cell biology

Fish genetics

Fly genetics

Plant biology
The structure of BIOS.

3 days

Basic training

- Biochemistry
- Cell biology
- Fish genetics
- Mouse genetics
- Plant biology

15 days

- Biochemistry
- Cell biology
- Fish genetics
- Fly genetics
- Plant biology

15 days

Authentic research experience.
The structure of BIOS.

Basic training

- Biochemistry
- Cell biology
- Fish genetics
- Mouse genetics
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15 days

- Biochemistry
- Cell biology
- Fish genetics
- Fly genetics
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15 days

Authenticate research experience.
The structure of a module (biochemistry).

<table>
<thead>
<tr>
<th>Time</th>
<th>Monday</th>
<th>Tuesday</th>
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<th>Thursday</th>
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<td>Proposal</td>
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Assessing skills is different from assessing knowledge.
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What is the capital of Georgia?

a) Athens
b) Atlanta
c) Columbus
d) Savannah
Assessing skills is different from assessing knowledge.

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How to assess competence in growing bacteria?
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1. Preparing growth media
2. Inoculating media with cells, without contamination
3. Growing under appropriate conditions, again without contamination
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1. Preparing growth media
2. Inoculating media with cells, without contamination
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1. Correctly calculate media components. Mix them together in the right way. Sterilize the solution. Handle the solution aseptically.
How to assess competence in growing bacteria?

1. Preparing growth media
   1. Correctly calculate media components. Mix them together in the right way. Sterilize the solution. Handle the solution aseptically.

2. Inoculating media with cells, without contamination

3. Growing under appropriate conditions, again without contamination

<table>
<thead>
<tr>
<th>4a: Work in the clean bench</th>
<th>Yes(1)</th>
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<tbody>
<tr>
<td>4b: UV pretreatment of the clean bench</td>
<td>Yes(1)</td>
</tr>
<tr>
<td>4c: Operate close to the alcohol burner</td>
<td>Yes(1)</td>
</tr>
<tr>
<td>4d: Wearing gloves during operation</td>
<td>Yes(1)</td>
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<tr>
<td>4e: Calculate the volume of the needed reagent accurately</td>
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<td>4f: Choose the proper pipettor and set to the right scale before using</td>
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<td>4g: Change tips when necessary</td>
<td>Yes(1)</td>
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<tr>
<td>4h: Tip contaminated</td>
<td>No(1)</td>
</tr>
<tr>
<td>4i: Keep tubes closed when not using</td>
<td>Yes(1)</td>
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How to assess competence in growing bacteria?

**Assessment results**

- **% students with full points**
  - Red: 4a) Pick the right bench
  - Green: 4b) UV pre-treat
  - Blue: 4c) Alcohol burner use

<table>
<thead>
<tr>
<th>Experiment #</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
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</thead>
<tbody>
<tr>
<td>4a) Pick the right bench</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>4b) UV pre-treat</td>
<td>100</td>
<td>100</td>
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<td>100</td>
<td>100</td>
<td>100</td>
</tr>
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**Assessment Criteria**

- **4a:** Work in the clean bench
  - Yes (1)
- **4b:** UV pretreatment of the clean bench
  - Yes (1)
- **4c:** Operate close to the alcohol burner
  - Yes (1)
- **4d:** Wearing gloves during operation
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- **4e:** Calculate the volume of the needed reagent accurately
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- **4h:** Tip contaminated
  - No (1)
- **4i:** Keep tubes closed when not using
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How to assess competence in growing bacteria?

### Assessment results

- **4a**: Pick the right bench
- **4b**: UV pre-treat
- **4c**: Alcohol burner use

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<tbody>
<tr>
<td>1st</td>
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<tr>
<td>2nd</td>
<td>20</td>
</tr>
<tr>
<td>3rd</td>
<td>80</td>
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#### Evolving, self-regulated process.

<table>
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Non-science topics work too!
Assessing skills is different from assessing knowledge.
Thank you!

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http://bio-elite.fudan.edu.cn