Liberal education is a philosophy of education that empowers individuals, liberates the mind from ignorance, and cultivates social responsibility. Characterized by challenging encounters with important issues, and more a way of studying than a specific course or field of study, liberal education can be achieved at all types of colleges and universities. “General Education” and an expectation of in-depth study in at least one field normally comprise liberal education.

From AAC&U, 1998

### LEAP Essential Learning Outcomes

<table>
<thead>
<tr>
<th>Knowledge of Human Cultures and the Physical and Natural World</th>
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<tbody>
<tr>
<td>study in the sciences and mathematics, social sciences, humanities, histories, languages, and the arts</td>
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<table>
<thead>
<tr>
<th>Intellectual and Practical Skills</th>
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<tbody>
<tr>
<td>Inquiry and analysis</td>
</tr>
<tr>
<td>Critical and creative thinking</td>
</tr>
<tr>
<td>Written and oral communication</td>
</tr>
<tr>
<td>Quantitative literacy</td>
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<tr>
<td>Information literacy</td>
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<tr>
<td>Teamwork and problem solving</td>
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<table>
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<tr>
<th>Personal and Social Responsibility</th>
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<tbody>
<tr>
<td>Civic knowledge and engagement</td>
</tr>
<tr>
<td>Local and global</td>
</tr>
<tr>
<td>Intercultural knowledge and competence</td>
</tr>
<tr>
<td>Ethical reasoning and action</td>
</tr>
<tr>
<td>Foundations and skills for lifelong learning</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Integrative Learning</th>
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<tbody>
<tr>
<td>Synthesis and advanced accomplishment across general and specialized studies</td>
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</tbody>
</table>

The Essential Learning Outcomes Provide:

- A Common Framework for Learning Within and Across Disciplinary Boundaries
- A Common Point of Departure for Professional Fields AND the Liberal Arts and Sciences
- Transparent Connections Between General Education and Majors
- Guidance for Students Navigating Multiple Fields of Study and Institutions
• “Departmental goals still often poorly aligned with those
of the college or university.”

• “Departments often fail to specify how the requirements
of the major contribute to students’ intellectual and
personal growth.”

Bob Connor, “What’s happened to the major in liberal education?”
Liberal Education 95: 2-3.

The Major Plays the
Decisive Role in:

• Developing intellectual and practical skills

• Educating citizens for civic, intercultural and
ethical responsibility

• Teaching students to integrate and apply their
learning

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Skills that biochemistry and molecular biology students should
obtain by the time they have finished their undergraduate program:

• Understanding of the fundamentals of chemistry and biology and the key principles of
biochemistry and molecular biology.
• Awareness of the major issues at the forefront of the discipline.
• Ability to assess primary papers critically.
• Ability to dissect a problem into its key features.
• Ability to design experiments and understand the limitations of the experimental approach.
• Ability to interpret experimental data and identify consistent and inconsistent components.
• Ability to think in an integrated manner and look at problems from different perspectives.
• Awareness of the ethical issues in the molecular life sciences.
• Ability to work safely and effectively in a laboratory.
• Awareness of the available resources and how to use them.
• Ability to use computers as an information and research tool.
• Ability to collaborate with other researchers.
• Ability to use oral, written, and visual presentations to present their work to both a science literate
and a science non-literate audience.
• Ability to think in an integrated manner and look at problems from different perspectives.
• Awareness of the ethical issues in the molecular life sciences.

For a B.A., students take ~1/2 of courses in
the major.

For a B.S., students take many more
courses in the major.

Where can the goals of a liberal
education be met in not in the major?
Comparisons of Liberal Education goals and ASBMB guidelines

Grant from Teagle Foundation to ASBMB on “Liberal Education and the Disciplines”

Questions:
- How are the skills and competencies of recommended curriculum incorporated? In which courses, at what level?
- Are these viewed as integral to the major?
- How can we incorporate broader goals: citizenship, diversity, character?
- What is the evidence for the value of liberal education to graduate/professional schools and employers?
- What does BMB contribute to liberal education for the non-major?

Methods:
- Surveys (Chairs and Instructors)
- Interviews

Chairs’ survey (n=94)

<table>
<thead>
<tr>
<th>Take account of ASBMB guidelines</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>46%</td>
</tr>
<tr>
<td>No, unaware of guidelines</td>
<td>23%</td>
</tr>
<tr>
<td>No, aware but dismissive</td>
<td>21%</td>
</tr>
</tbody>
</table>

Preliminary findings from survey

<table>
<thead>
<tr>
<th>Degree granted</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.A.</td>
<td>22%</td>
</tr>
<tr>
<td>B.S.</td>
<td>56%</td>
</tr>
<tr>
<td>B.A. and B.S.</td>
<td>20%</td>
</tr>
</tbody>
</table>

How have your major requirements changed since the first ASBMB guidelines were published (1990)?

- No change: 25% 
- We have added more specific courses: 29% 
- We have added more skill-based requirements: 16% 
- We require/encourage more undergraduate research: 23% 
- Our methods of pedagogy have moved away from lecture: 41% 
- We do more assessment of student learning: 23% 
- We have decreased the number of courses required: 22% 
- Use of technology has increased: 16% 
- Major created since the new guidelines (2003): 7%
Do you explicitly teach the following skills in courses required for the major?

- Oral communication: [ ] No, [ ] Advanced Courses, [ ] Only Introductory Courses, [ ] At all levels
- Statistics: [ ] No, [ ] Advanced Courses, [ ] Only Introductory Courses, [ ] At all levels
- Scientific writing: [ ] No, [ ] Advanced Courses, [ ] Only Introductory Courses, [ ] At all levels
- Reading primary literature: [ ] No, [ ] Advanced Courses, [ ] Only Introductory Courses, [ ] At all levels

Are students expected to carry out a lab project in which they have input into the experimental design for any courses meeting requirements for the major?

- No: 15
- Advanced Courses: 42
- Introductory and Advanced Courses: 31

Number of Courses surveyed by Level:

- Instructor survey:
  - Beginning: 25
  - Intermediate: 91
  - Advanced: 87

Level of BMB Skills Taught in Advanced Courses:

- [ ] Introduced
- [ ] Reinforced & Built Upon
- [ ] Assumed

Skills include:
- Presentation of Work
- Collaboration
- Quantitative Skills
- Integration of Thinks
- Design Follow-Up
- Awareness of Issues
Lab exercise that is laid out for students and outcome known

Course Level

- Beginning (18)
  - Advanced (70)
  - Intermediate (74)
  - Beginning (19)

- Course Level

- Intermediate (74)
  - Advanced (70)
  - Intermediate (74)
  - Beginning (20)

- Course Level

- Advanced (70)
  - Beginning (20)
  - Intermediate (74)
  - Advanced (70)

Open-ended problems

Course Level

- Beginning (25)
  - Advanced (69)
  - Intermediate (74)
  - Beginning (20)

- Course Level

- Intermediate (74)
  - Advanced (69)
  - Intermediate (74)
  - Beginning (20)

- Course Level

- Advanced (69)
  - Beginning (20)
  - Intermediate (74)
  - Advanced (69)

Read Primary Literature

Course Level

- Beginning (36)
  - Advanced (70)
  - Intermediate (74)
  - Beginning (20)

- Course Level

- Intermediate (74)
  - Advanced (70)
  - Intermediate (74)
  - Beginning (20)

- Course Level

- Advanced (70)
  - Beginning (20)
  - Intermediate (74)
  - Advanced (70)

Pedagogical Methods Used in Advanced Courses

- Projects
  - Student design
  - Write research proposal
  - Lab analysis/interpretation
  - Critique other student's work
  - Computer modeling
  - Lab notebooks
  - Project student's learning
  - Lab student's analysis
  - Case studies
  - Pre & Post Test Assessments
  - Problem sets
  - Open-ended problems
  - Work in small groups
  - Read primary literature
Conclusions of the Report

- About half of institutions follow ASBMB’s recommended curriculum
- Major strong on intellectual and practical skills
- Major lacking in skills for personal and social responsibility
- Integrative and critical thinking is valued but only appears at advanced level
- Pedagogy not reflective of research on student learning
- Sustained undergraduate research most valued for grad school and employment
- Most attention given to students going on in BMB
- Deep divide between those who view themselves as primarily researchers and those who view themselves primarily as teachers
- ASBMB limited by lack of accrediting power.

Recommendations

- Ensure solid foundation of coursework that allows for a meaningful research experience
- Better articulation of difference between BA and BS, role of each, and advising.
- Provide opportunities for undergrad and grad faculty; undergrad and med school faculty; undergrad and industrial scientists to meet and discuss preparation
- Publicize and support innovative, effective pedagogies
- Consider accreditation mechanism
- Provide assessment tools
- Update the recommended curriculum and skills for the major

Achieving the Goals of Liberal Education:

- Strengthening Intellectual and Practical Skills
  - Writing-Intensive Courses (across the major)
  - Skill-Intensive Courses (quantitative reasoning, oral communication, informative literacy, etc. across the major)
  - Collaborative Assignments and Projects
  - Undergraduate Research (at multiple levels)
  - Internships (supervised and evaluated)

- Deepening Personal and Social Responsibility
  - Common Intellectual Experiences (exploring “big questions” in relation to their field)
  - Service and Community-Based Learning
  - Internships
  - Capstone Projects and Culminating Experiences

- Practicing Integrative and Applied Learning
  - Learning Communities (multiple courses linked to a “big question” or topic)
  - Undergraduate Research
  - Service and Community-Based learning
  - Internships
  - Capstone Projects and Culminating Experiences

High Impact Practices:

- First-Year Seminars and Experiences
- Common Intellectual Experiences
- Learning Communities
- Writing-Intensive Courses
- Collaborative Assignments and Projects
- Undergraduate Research
- Diversity/Global Learning
- Service Learning, Community-Based Learning
- Internships
- Capstone Courses and Projects
Higher Levels of Participation in High Impact Practices (HiPs) Correlate with
- Higher Retention
- Higher Grade Point Average
- Higher Self-Reported Gains on Deep/Integrative Learning Scale

HiPs Offer "Compensatory Benefit" for Students from Less Advantaged Backgrounds and/or with Lower Entering Scores


Teaching Students to Integrate Their Learning:
- Learning Communities – Thematically-Linked Courses
- Supervised Internships
- Advanced Integrative Cross-Disciplinary Courses
- e-Portfolios and Capstone Projects

Education for Personal and Social Responsibility: Dimensions
- Striving for excellence
- Cultivating personal and academic integrity
- Contributing to a larger community
- Taking seriously the perspectives of others
- Developing competence in ethical and moral reasoning

How to integrate Personal and Social Responsibility into the major?
- Work within existing courses/structures in the major
- Use minors, certificates, tracks, etc.
- Include at entry, midpoint, culminating assignments/assessments
- Create new courses or sequences
- Make efforts transparent to students
- Coordinate and build on:
  - General education
  - Co-curriculum
  - Graduation requirements
Achieving the Goals of Liberal Education: Embedding High Impact/High Effort Practices within the Major

- **Strengthening Intellectual and Practical Skills** (wide spread acceptance)
  - Writing-Intensive Courses (across the major)
  - Skill-Intensive Courses (quantitative reasoning, oral communication, informative literacy, etc. across the major)
  - Collaborative Assignments and Projects
  - Undergraduate Research (at multiple levels)
  - Internships (supervised and evaluated)

- **Practicing Integrative and Applied Learning** (less common)
  - Learning Communities (multiple courses linked to a "big question" or topic)
  - Undergraduate Research
  - Service and Community-Based learning
  - Internships
  - Capstone Projects and Culminating Experiences

- **Deepening Personal and Social Responsibility** (still to come)
  - Common Intellectual Experiences (exploring "big questions" in relation to their field)
  - Diversity, Civic and Global Learning
  - Service and Community-Based Learning
  - Ethics-Intensive Courses
  - Collaborative Assignments and Projects