Market Analysis: Master's in Advanced Regenerative Medicine

Prepared for Northeastern University

November 2019

In the following report, Hanover Research assesses the demand for master's degree programs in regenerative medicine, specifically highlighting demand trends within New England. This report includes an examination of student and labor market demand, as well as an analysis of potential competitor programs.

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Executive Summary

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Recommendations

Based on an analysis of degree completions, labor market demand, and potential competitors, Hanover Research recommends that Northeastern University (Northeastern):

1. **Launch its proposed master's in advanced regenerative medicine program.** Strong growth indicators for both student and labor demand in New England suggest that a new master's degree program in regenerative medicine will be viable. However, Northeastern should be cautious given the small cohort sizes of most existing programs (between five and 10 students). Thus, it will need to have a concrete recruitment plan in place to maintain enrollment.

2. **Make sure to include coursework in data science, business, and ethics, with a particular eye toward the commercialization of regenerative products.** Coursework in data science, business, and ethics will provide students with a well-rounded and marketable skillset for either doctoral studies or career entry. These types of courses are uncommon among competitor programs.

3. **Develop partnerships with local and national regenerative medicine organizations to assist in workforce development.** Regenerative medicine is a relatively new field with an emerging workforce. To ensure the professional development of its students, Northeastern should partner with local and national regenerative medicine organizations, such as professional societies, research institutes, and firms in the industry. This will give students hands-on experience working in the profession and should provide direct research-to-commercialization experience that is lacking in the market today.

Fast Facts

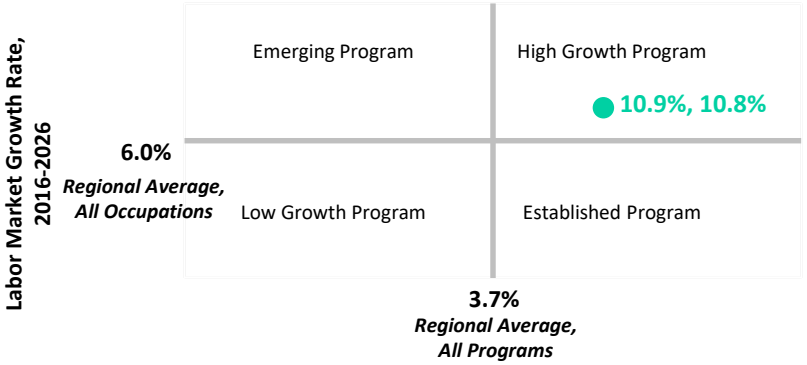
10.9% Regional compound annual growth rate of regenerative medicine-related master's degree programs between 2013 and 2017

8,101 Number of regenerative medicine-related job postings in New England over the past six months as of November 2019

8 Number of benchmarked master's degree programs in regenerative medicine, located nationwide

Regional Benchmark Analysis

Comparison of master's in regenerative medicine degree completions and relevant labor market to all completions and all occupations in New England



Key Findings and Program Demand Forecast

For master's in regenerative medicine programs in New England

Despite small completions volumes, programs related to regenerative medicine are experiencing strong growth at all geographic levels. Although regenerative medicine-related master's degree programs in New England had an average of only seven completions per program in 2017, programs in the field grew faster than average at all geographic levels between 2013 and 2017.

Bachelor's degree recipients can enter into most regenerative medicine-related occupations, but several regional job postings require a doctoral or professional degree. Excluding medical scientists, a bachelor's degree is sufficient for entry into all regenerative medicine-related occupations. However, many regional job postings in the field that emphasize medical research and development require applicants to possess an advanced degree, suggesting that Northeastern's proposed program will prepare graduates well for the local market.

There are few master's degree programs in regenerative medicine nationally, and there are no programs in the field in New England. Hanover benchmarked eight master's degree programs in regenerative medicine nationwide, four of which are offered as concentrations. Hanover was unable to identify a master's-level program in the field in New England.

Degree Completions Analysis

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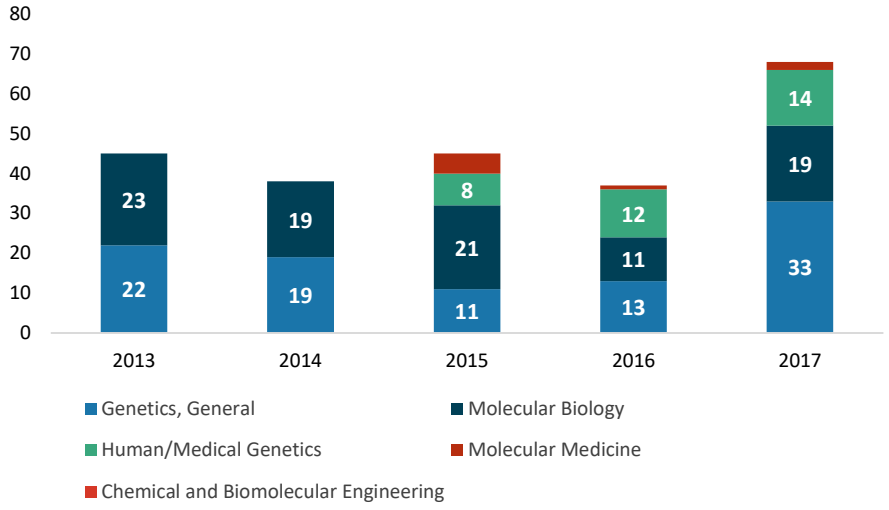
Regional Master's Degree Completions Volume

Distribution of master's degree completions in New England from 2013 to 2017



Total Master's Degree Completions

Aggregate degree completions by geographic level (2017)

	Massachusetts	New England*	National
Genetics, General	0	33	89
Molecular Biology	0	19	197
Human/Medical Genetics	9	14	157
Molecular Medicine	0	2	22
Chemical and Biomolecular Engineering	0	0	20
Total	**9**	**68**	**485**
Growth Rate	**73.2%**	**10.9%**	**3.5%**
Total Master's Growth	***2.4%***	***3.7%***	***1.6%***

Source: IPEDS

*In this report, New England includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.

Analysis of Findings

Master's degree completions in fields related to regenerative medicine are growing faster than average at all geographic levels.

Between 2013 and 2017, master's degree completions in fields related to regenerative medicine increased at an average annualized rate of 10.9 percent in New England, which is faster than the 3.7 percent average growth for all master's degree programs in the region. Regional growth is consistent with national trends, as master's degree completions in fields related to regenerative medicine nationwide increased at an average rate of 3.5 percent between 2013 and 2017, compared to 1.6 percent growth for all master's degree programs. While state growth rate is high, only one institution reported related conferrals (Brandeis University) and growth is measured against a very low volume (one to nine degrees between 2013 and 2017). This points to a high-growing, but very niche field that may struggle to attract a large cohort of students.

Indeed, completion volumes for master's degree programs related to regenerative medicine are small.

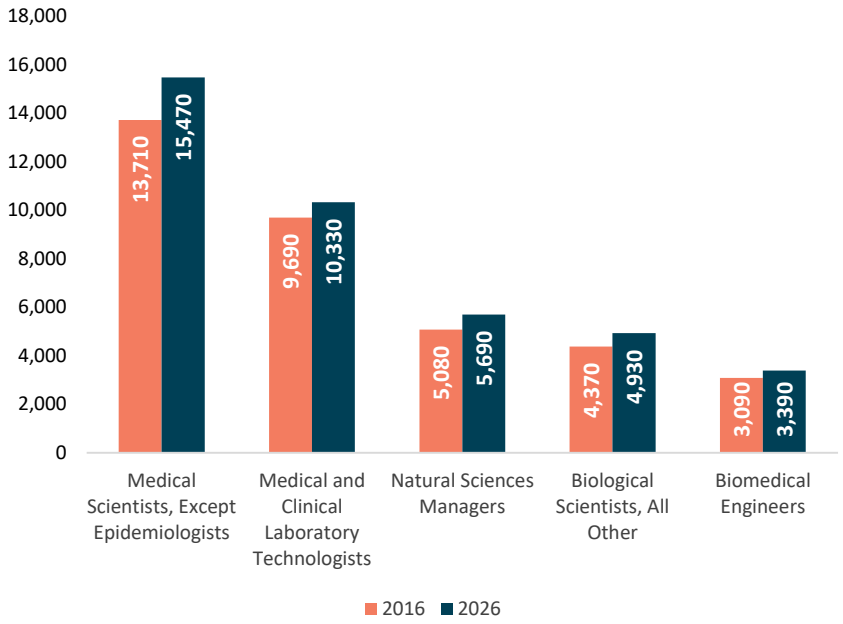
On average, institutions at all geographic levels reported between five and seven completions for their regenerative medicine-related programs in 2017. Of all national institutions with master's degree programs in regenerative medicine and related fields, Johns Hopkins University (MS in Biotechnology with concentration in Regenerative and Stem Cell Technologies) had the highest completions volume, with 28 reported completions in 2017. These data suggest that even though completions for programs in regenerative medicine are increasing, completions volumes remain small.

Advancements in research and new applications of existing technologies may continue to fuel demand for these degrees.

The National Institutes of Health estimate that approximately 500,000 Americans benefit from a transplant each year, with over 100,000 on the wait list. As new technologies emerge, regenerative medicine professionals will be needed to use and produce the new tools and methods. Applications such as insulin-producing pancreatic islets, tissue-engineered heart muscles, and "smart" biomaterials should continue to drive the need for research in this field.

Regional Current and Projected Job Availability

Regenerative medicine-related positions in New England as of 2016 and 2026 (projected)



Total Labor Market

Aggregate regenerative medicine-related job availability by geographic level

	Massachusetts	New England	National
2016	26,870	35,940	408,100
2026	30,120	39,810	454,200
Growth Rate	**12.1%**	**10.8%**	**11.3%**
Total Annual Openings	**2,510**	**3,220**	**35,500**
Aggregate Employment Growth	**7.4%**	**6.0%**	**7.4%**

Source: Projections Central

Analysis of Findings

Employment for regenerative medicine-related occupations is growing faster than average at all geographic levels.

Even though all occupations in New England are projected to grow by 6.0 percent between 2016 and 2026, jobs related to regenerative medicine are expected to grow by 10.8 percent over the next decade. A similar trend exists within Massachusetts and nationally.

However, a bachelor's degree is sufficient for entry into most regenerative medicine-related occupations except for medical scientists.

According to the Bureau of Labor Statistics (BLS), most workers aged 25 years and older working in occupations related to regenerative medicine have a bachelor's degree and no higher degree. An exception is medical scientists, as 23.6 percent of workers in the profession have a master's degree, and 50.3 percent have a doctoral or professional degree. The BLS notes that most medical scientists have a PhD in their field of practice, although some have a medical degree. Note that this likely underestimates the need for advanced degrees in the field of regenerative medicine, given that many workers in these jobs are likely not to pursue regenerative-specific work outside of medical science.

An aging population and the development of new medical technologies are driving demand for workers in occupations related to regenerative medicine.

The BLS observes that as the population lives longer, more workers will be needed to develop medical technologies to address its health problems. Stem cells play a crucial role in the development of new medical technologies and treatments. The stem cell and regenerative medicine market in the United States will experience an estimated compound annual growth of 4.9 percent between 2017 and 2024, and the AABB estimates that nearly one-in-three Americans would benefit from regenerative medicine.

In particular, estimates indicate that Dermatology, Bone Graft Substitutes, and Osteoarticular Diseases commanded the largest market share of global regenerative medicine revenue as of 2018. These could be viable areas to highlight as part of Northeastern's prospective program.

Real-Time Job Postings Intelligence

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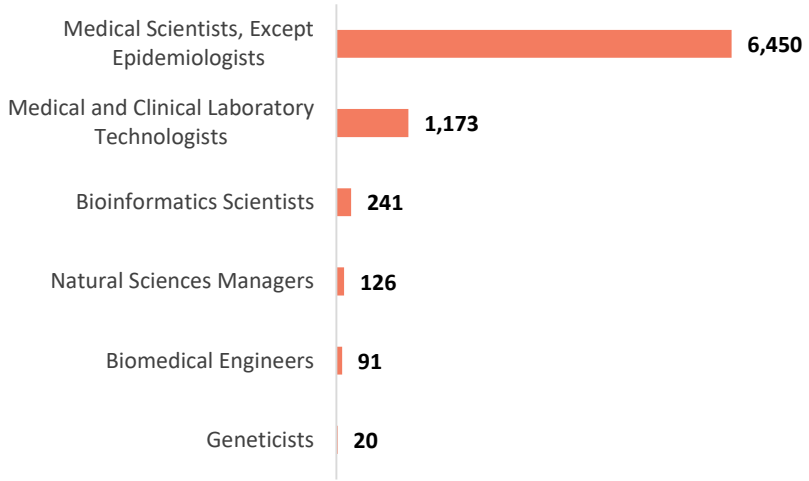
Regional Job Postings Analysis

Regenerative medicine-related job postings by occupational group during the past 180 days as of October 2019



Regional Employment Facts

Regional regenerative medicine-related positions by occupational group

Occupation	Average Salary		Unemployment Rate	
	New England	*U.S.*	*New England*	*U.S.*
Medical Scientists, Except Epidemiologists	$96,200	$96,400	1.5%	1.7%
Medical and Clinical Laboratory Technologists	$61,100	$53,900	2.3%	2.6%
Natural Sciences Managers	$170,900	$139,700	1.1%	1.2%
Biomedical Engineers	$101,700	$95,100	1.6%	1.8%
Biological Scientists, All Other	$82,900	$83,600	1.5%	1.7%

Source: JobsEQ and BLS

Analysis of Findings

Employers in the New England advertised 8,101 regenerative medicine-related positions over the past six months.

The vast majority of the job postings were for medical scientist positions, whereas there were fewer than 100 postings each for biomedical engineers and geneticists. Of the 6,594 job postings that specified a minimum educational level, 822 postings required applicants to hold a master's degree, whereas 1,905 postings specified that applicants should hold a doctoral or professional degree. The greater Boston area, notably Cambridge, is the top market for regenerative medicine-related positions in New England.

Salaries for workers in regenerative medicine-related occupations in New England are above national averages.

Alongside above-average employment growth, workers in occupations related to regenerative medicine in New England also earn higher salaries relative to national averages. In addition to higher salaries, workers in regenerative medicine-related occupations in New England also experience slightly below-average unemployment rates compared to national averages.

Top Hard Skills in New England

- Molecular Biology (1,264)
- Chemistry (1,253)
- Cell Culture (1,118)
- Data Analysis (915)
- Enzyme-Linked Immunosorbent Assay (806)

Top Employers in New England

- Brigham & Women's Hospital (471)
- Massachusetts General Hospital (194)
- Ivy Exec (164)
- Novartis (162)
- Broad Institute (152)

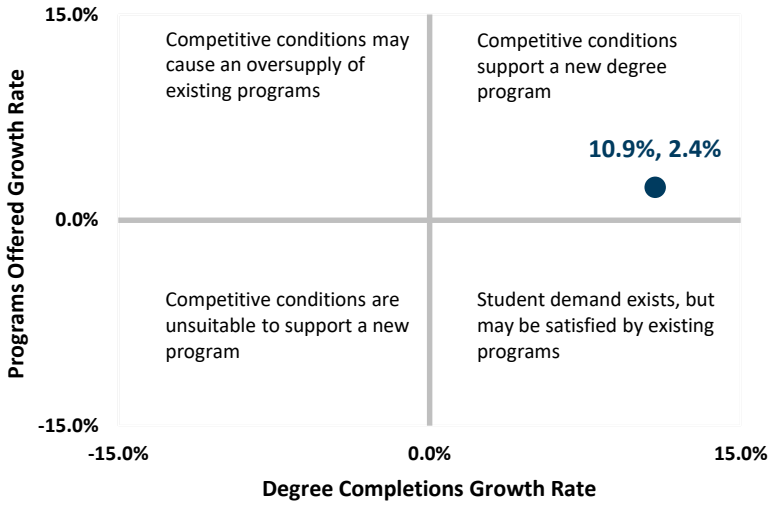
Competitor Analysis

There are few institutions nationwide that offer master's degree programs in regenerative medicine, and there are no such programs in New England.

Hanover identified and benchmarked four national institutions that offer master's degree programs dedicated to the study of regenerative medicine or related fields: California Polytechnic State University, Case Western Reserve University, the University of Minnesota, and the University of Southern California. Additionally, Hanover found four national institutions with concentrations in regenerative medicine and related fields offered as part of a separate degree program: Duke University, Johns Hopkins University, the University of Washington, and Wake Forest University. Hanover was unable to identify any master's degree programs in regenerative medicine offered by institutions in New England, indicating a regional market gap for a program in the field.

Regional Market Saturation (2013-2017)

Within New England, do competitive conditions support an additional master's degree program in regenerative medicine program?



Benchmarked Competitor Programs

Institution	Location	Program
Dedicated Regenerative Medicine Master's Degree Programs		
California Polytechnic State University	San Luis Obispo, CA	MS in Regenerative Medicine
Case Western Reserve University	Cleveland, OH	MS in Regenerative Medicine & Entrepreneurship
University of Minnesota	Minneapolis, MN	MS in Stem Cell Biology
University of Southern California	Los Angeles, CA	MS in Stem Cell Biology and Regenerative Medicine
Regenerative Medicine Concentrations in Other Master's Degree Programs		
Duke University	Durham, NC	MS in Biomedical Engineering, Tissue Engineering and Regenerative Medicine Concentration
Johns Hopkins University	Rockville, MD	MS in Biotechnology, Regenerative and Stem Cell Technologies Concentration
University of Washington	Seattle, WA	MS in Applied Bioengineering, Regenerative Medicine and Biomaterials Concentration
Wake Forest University	Winston-Salem, NC	MS in Biomedical Engineering, Regenerative Medicine Concentration

Competitor Analysis: Program Trends

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Marketing Messaging

Competitors' marketing messaging focuses on the unique and interdisciplinary nature of regenerative medicine, as well as the outlook of the field. An analysis of program webpages found that six benchmarked competitor programs highlight the unique and interdisciplinary nature of regenerative medicine, as exemplified below in an excerpt from Case Western Reserve University's program webpage. Johns Hopkins University explicitly lists the disciplines involved in regenerative medicine on its program webpage, mentioning "cell therapy, gene therapy, tissue engineering and more."

Additionally, three competitors highlight the outlook of regenerative medicine. California Polytechnic State University, the University of Southern California, and the University of Washington refer to the field as "the future of medicine" or "the medicine of the future." Although competitors provide a general narrative on the field's outlook on their program webpages, no competitors include hard data on regenerative medicine's industry outlook, such as salaries or employment growth.

Case Western Reserve University	*"This **unique, interdisciplinary program** will provide a rigorous educational pathway targeting individuals seeking the advanced skills and training required to excel in the **unique workforce** necessary to support the exponential growth an application of the field of regenerative medicine."*
Johns Hopkins University	*"This concentration within the Biotechnology degree program **uniquely prepares graduates** with a valuable hands-on and theoretical skillset that translates across the areas of regenerative medicine, cell therapy, gene therapy, tissue engineering and more."*
University of Southern California	*"The Master of Science degree program invites you to chart the course for **the medicine of the future**—regenerative medicine."*

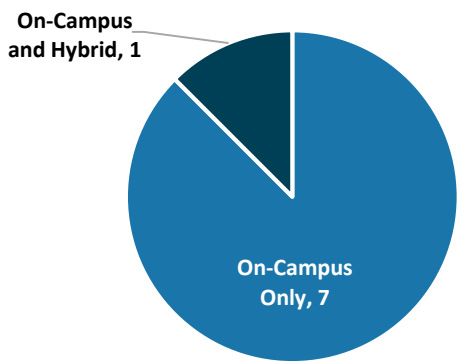
Source: Institutional websites

Top Marketing Themes

- **Skill Development** – *medicine, biology, engineering, chemistry, and business skills*
- **Experiential Learning Opportunities** – *laboratory experiences, internships, research projects, thesis options*
- **Educational and Career Outlook** – *preparation for PhD programs, employment in clinical and business settings*
- **Program Resources and Networks** – *on-campus research institutes, community and national partnerships*

Delivery Methods

Most benchmarked competitor institutions exclusively deliver their regenerative medicine programs on-campus. Johns Hopkins University is the only identified competitor at which some online coursework for its regenerative medicine program is offered. However, Johns Hopkins' program is hybrid rather than fully-online, as students must take one required course, Stem Cell Culture Laboratory Methods, on-site at the institution's Montgomery County campus.



Competitor Analysis: Program Trends

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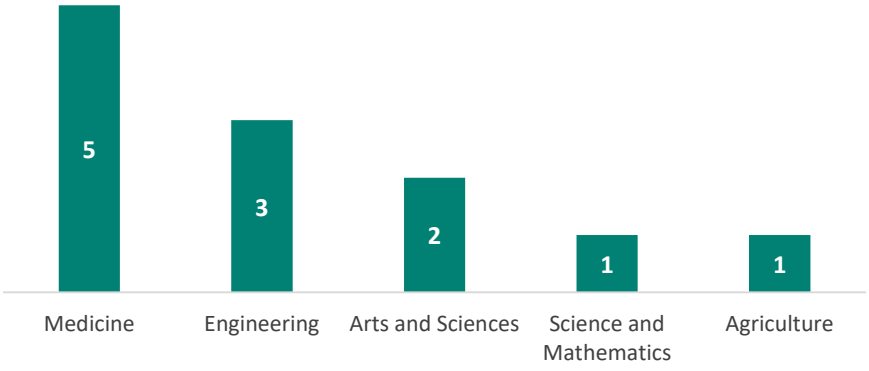
Credit Requirements

Most benchmarked regenerative medicine programs require 30 credits of coursework. Five benchmarked competitors require 30 credits of coursework for program completion. Credit requirements range from a minimum of 27 at the University of Southern California to a maximum of 40 at Johns Hopkins University.

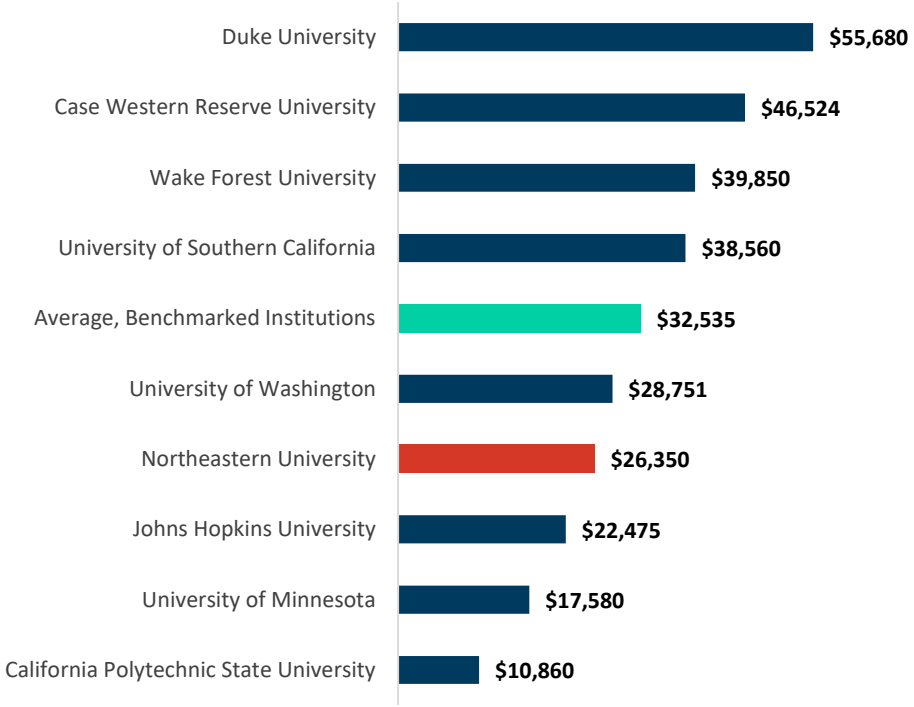
Associated Academic Units

Benchmarked programs are most often associated with schools of medicine. Five benchmarked regenerative medicine programs are affiliated with their institution's medical school. It should be noted that all benchmarked institutions except for California Polytechnic State University have a school of medicine. Other academic units associated with benchmarked programs include schools of engineering, arts and sciences, science and mathematics, and agriculture. Four benchmarked programs are part of two or more academic units, highlighting the interdisciplinary focus of these degrees.



Annual Tuition

Northeastern's current tuition rate for its biotechnology program is lower than the rates charged by most benchmarked private institutions. Northeastern's current $26,350 annual tuition rate for its master's degree program in biotechnology – assuming two-year program completion – is $6,185 less than the average tuition rate charged by benchmarked institutions. Only one benchmarked private institution, Johns Hopkins University, charges a lower tuition rate than Northeastern. Additionally, Northeastern's tuition is $2,401 below the University of Washington's in-state tuition rate. These findings indicate that Northeastern could charge a higher tuition rate for its proposed master's in advanced regenerative medicine program and remain competitive with similar institutions.

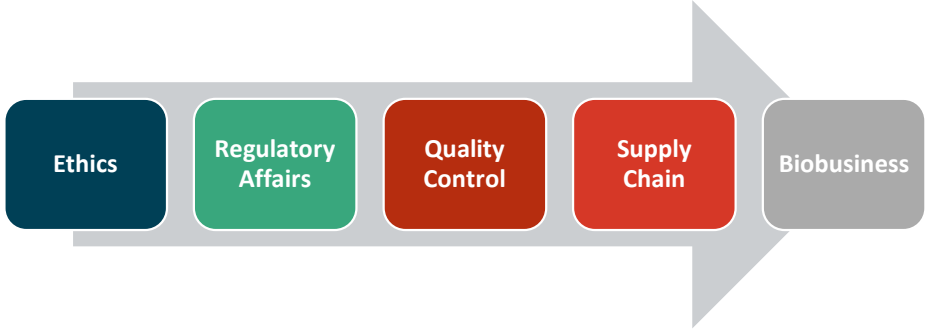


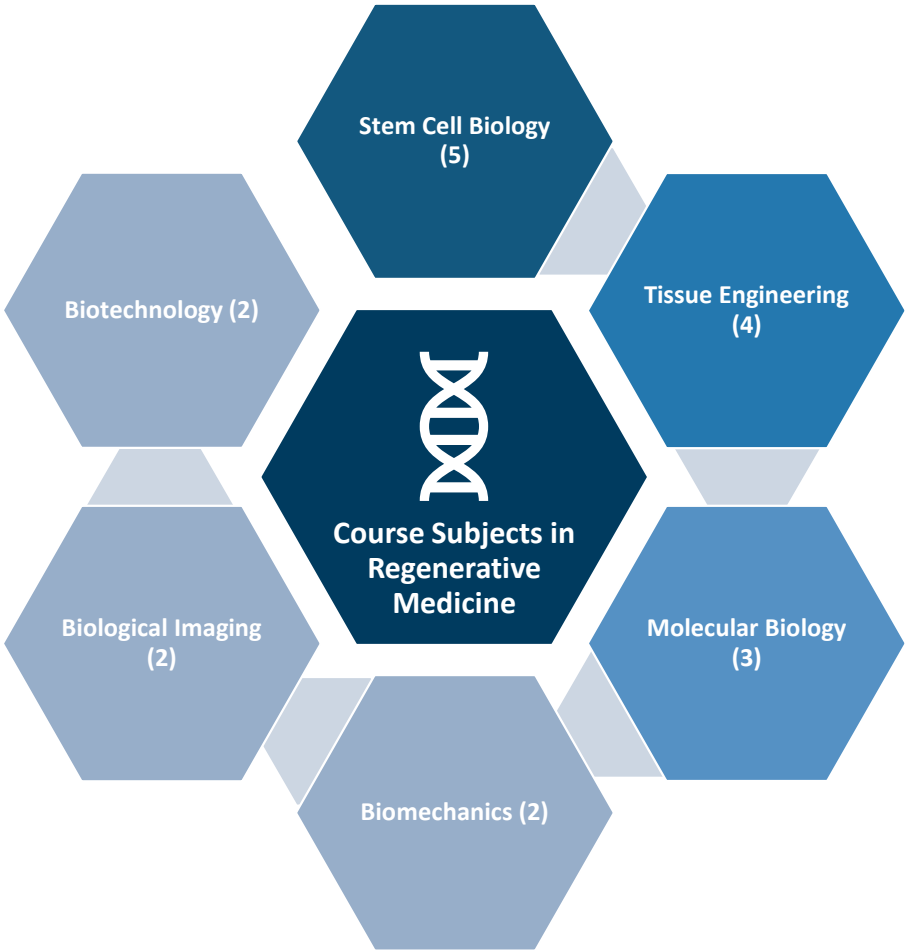
Note: To approximate the tuition rate for Northeastern's proposed program, Hanover took the per credit tuition rate of Northeastern's master's in biotechnology program, multiplied that rate by the number of credits required (34), and divided the resulting figure by two, assuming two-year program completion.

Curricular Components

Stem cell biology is the most common subject covered in the curricula of benchmarked competitor programs. Five benchmarked competitors offer coursework in stem cell biology as part of their programs in regenerative medicine; two competitors, the University of Minnesota and the University of Southern California, include "stem cell biology" in their program titles. The University of Southern California's MS in Stem Cell Biology and Regenerative Medicine offers the most extensive coursework in the subject, with nine courses dedicated to the study of stem cells. Other common topics featured in competitor programs' curricula include tissue engineering, molecular biology, biomechanics, biological imaging, and biotechnology.

Effective coursework in regenerative medicine should cover ethics, regulatory affairs, quality control, supply chain, and biobusiness. A 2019 project primarily run by practitioners at the Mayo Clinic recommended that regenerative medicine curricula incorporate the study of ethics, regulatory affairs, quality control, supply chain, and biobusiness. The project found that studying these subjects ensures success by enabling students "to adopt and deliver validated regenerative medicine solutions." Although the project focused on curricula at medical schools, the broad nature of the curriculum outlined by the project allows it to be generalizable to all programs in regenerative medicine. Northeastern could differentiate its program's curriculum by offering coursework in the subjects recommended by the Mayo Clinic's project, as few competitor programs have coursework in ethics or business-related topics.





Source: npj Regenerative Medicine.

Partnerships and Workforce Development

All benchmarked regenerative medicine programs advertise their partnerships with medical centers, organizations in the industry, or other academic institutions. All eight benchmarked competitors have at least one partnership with an industry organization or another academic institution; no competitors promote their partnerships with professional organizations. Several competitors, including Case Western Reserve University and the University of Minnesota, also partner with local medical centers. Benchmarked programs, including California Polytechnic State University's MS in Regenerative Medicine, leverage their partnerships to secure internships for their regenerative medicine students.

The gap between research and commercialization is one of the main barriers to workforce development in the field of regenerative medicine. A discussion at the 2017 Forum on Regenerative Medicine highlighted the finding that despite significant advances in regenerative medicine, a gap exists between research and the commercialization of regenerative medical technologies. Through its plan to include the study of business themes, Northeastern's proposed regenerative medicine program can address this gap by preparing students to link the process of researching and developing regenerative medical products with the commercialization of such products.

Industry members are collaborating to improve workforce development by establishing standardized processes for manufacturing regenerative medical technologies. The lack of standardized manufacturing processes for regenerative medical technologies represents an additional barrier to workforce development in the field. The Regenerative Medicine Manufacturing Society (RMMS), launched in early 2018, has the goal of "[promoting] the scale-up of regenerative medicine manufacturing processes to facilitate the smooth and quick transition of new therapies to market for the benefit of patients." Society members consist of representatives from industry organizations, regulatory agencies, and academic institutions, including benchmarked competitors such as Wake Forest University.

Experiential Learning Opportunities

Six benchmarked competitors require their regenerative medicine students to engage in research, either through the completion of a research project or participation in a research laboratory.

Two competitors, California Polytechnic State University and Case Western Reserve University, require their regenerative medicine students to pursue an internship, often through a community partner.

Wake Forest University requires its regenerative medicine students to write and defend a thesis, and the University of Minnesota offers an optional thesis.

The University of Washington requires its regenerative medicine students to undergo a clinical practicum in which students shadow clinicians and faculty members at the institution's medical school.

Program Outcomes

Benchmarked programs equip students for both doctoral study and career entry. Graduates of master's degree programs in regenerative medicine are equally prepared for doctoral study and career entry. Four benchmarked institutions – California Polytechnic State University, Duke University, the University of Minnesota, and the University of Southern California – highlight their programs' alumni outcomes on their webpages. Program alumni from the four institutions pursue doctoral study, primarily in PhD programs but also in medical programs, and begin careers in industries including biotechnology, healthcare, pharmaceuticals, and consulting.

Competitor Analysis: Institutional Spotlights

Market Analysis: Master's in Advanced Regenerative Medicine

Case Western Reserve University

MS in Regenerative Medicine & Entrepreneurship

Location	Cleveland, OH
Sector	Private not-for-profit
Annual Tuition, 2019-20	$46,524
Delivery	On-campus
Associated Academic Units	School of Medicine School of Graduate Studies
Credits Required	30
Length to Completion	Two years

Curriculum

Core Courses

- RGME 535: Foundations in Regenerative Medicine (3)
- RGME 545: Stem Cell Biology and Therapeutics
- RGME 560: Independent Study – Research Project (3)
- RGME 565: Independent Study – Internship (3)
- BIOL 491: Contemporary Biology and Biotechnology for Innovation (3)
- BIOL 492: Contemporary Biology and Biotechnology for Innovation (3)

Electives

- 6 credits of science electives
- 6 credits of business development electives (3 credits strongly recommended to be GENE 467: Commercialization and Intellectual Property Management)

Partnerships

- University Hospitals Cleveland Medical Center
- Cleveland Clinic
- Athersys
- The Ohio State University

Johns Hopkins University

MS in Biotechnology, Regenerative and Stem Cell Technologies Concentration

Location	Rockville, MD
Sector	Private not-for-profit
Annual Tuition, 2019-20	$22,475
Delivery	On-campus and online
Associated Academic Units	Krieger School of Arts & Sciences
Credits Required	40
Length to Completion	Up to five years

Curriculum

Core Courses

- 410.601: Biochemistry (4)
- 410.602: Molecular Biology (4)
- 410.603: Advanced Cellular Biology I (4)
- 410.604: Advanced Cellular Biology II (4)

Concentration Courses

- 410.630: Gene Therapy (4)
- 410.653: Regenerative Medicine: Bench to Bedside (4)
- 410.753: Stem Cell Biology (4)
- 410.780: Stem Cell Culture Laboratory Methods (4)

Electives

- 8 credits of courses in the Biotechnology curriculum

Partnerships

- Peking University
- Biotechnology firms
- Governmental organizations
- Other schools within the Johns Hopkins University system

Source: Institutional websites.

Master's in Advanced Regenerative Medicine Competitor Benchmarking

Benchmarked programs are offered by institutions located in the United States, offering master's degree programs in regenerative medicine, either as a dedicated degree program or as a concentration.

Institution	Location	Program	Associated Academic Units	Credits Required	Annual Tuition, 2019-20	Delivery Method	Marketing Messaging	Notable Features
California Polytechnic State University	San Luis Obispo, CA	MS in Regenerative Medicine	• College of Engineering • College of Science and Mathematics • College of Agriculture, Food and Environmental Studies	30	$10,860	On-campus	"Apply now if you want to gain the skills that will allow you to make a direct contribution to bringing cell-based therapies into the clinic"	• Open-ended capstone project involving a written report and a poster presentation • Required nine-month internship with an industry or academic partner • Funding and support from the California Institute for Regenerative Medicine (CIRM)
Case Western Reserve University	Cleveland, OH	MS in Regenerative Medicine & Entrepreneurship	• School of Medicine • School of Graduate Studies	30	$46,524*	On-campus	"This unique, interdisciplinary program will provide a rigorous educational pathway targeting individuals seeking the advanced skills and training required to excel in the unique workforce"	• Program offered as part of the National Center for Regenerative Medicine (NCRM) • Independent research project involving a 20-page paper • Required internship culminating in a final paper • Variety of partnerships available through the NCRM
Duke University	Durham, NC	MS in Biomedical Engineering, Tissue Engineering and Regenerative Medicine Concentration	• Pratt School of Engineering	30	$55,680*	On-campus	"The Duke BME Master of Science (MS) degree provides a solid foundation of rigorous training and research experience to propel your career to developing new biomedical technologies"	• At least three courses, or nine credits, applied to the concentration • On-campus Center for Biomolecular and Tissue Engineering (CBTE) • Required research project culminating in a poster presentation

Source: Institutional websites (see embedded hyperlinks).
Note: California Polytechnic State University utilizes a quarter system. To convert quarter units to semester credit hours, Hanover multiplied the number of required quarter units by 0.667 and rounded to the nearest whole number.
*Annual tuition calculated by doubling the advertised semesterly rate.

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Johns Hopkins University	Rockville, MD	MS in Biotechnology, Regenerative and Stem Cell Technologies Concentration	• Kreiger School of Arts & Sciences	40	$22,475†	On-campus and hybrid	"This concentration within the Biotechnology degree program uniquely prepares graduates with a valuable hands-on and theoretical skillset that translates across the areas of regenerative medicine, cell therapy, gene therapy, tissue engineering and more"	• Designed for working professionals with weekend and evening courses • Partnerships with Peking University, biotechnology firms, governmental organizations, and other schools in the JHU system • Annual research symposium
University of Minnesota	Minneapolis, MN	MS in Stem Cell Biology	• Medical School	30	$17,580*	On-campus	"This program is an excellent preparation for work in academic and bioscience industry settings"	• Program offered as part of the Stem Cell Institute (SCI) • Thesis option involving one year of research in a faculty member's laboratory • Required research paper and presentation for non-thesis students
University of Southern California	Los Angeles, CA	MS in Stem Cell Biology and Regenerative Medicine	• Keck School of Medicine	27	$38,560	On-campus	"The Master of Science degree program invites you to chart the course for the medicine of the future—regenerative medicine"	• One-year program with an optional second year dedicated to research • On-campus Center for Regenerative Medicine and Stem Cell Research with more than 80 laboratory groups

Source: Institutional websites (see embedded hyperlinks).
*Annual tuition calculated by doubling the advertised semesterly rate.
†Annual tuition calculated by multiplying the advertised rate per course by the total number of courses required, then dividing that number by two, assuming two-year program completion.

Master's in Advanced Regenerative Medicine Competitor Benchmarking

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Institution	Location	Program	Associated Academic Units	Credits Required	Annual Tuition, 2019-20	Delivery Method	Marketing Messaging	Notable Features
University of Washington	Seattle, WA	MS in Applied Bioengineering, Regenerative Medicine and Biomaterials Concentration	• College of Engineering • UW Medicine	31	$28,751	On-campus	"Students collaborate with world-class faculty from UW and UW Medicine, and local industry partners to transform biomedical research into technologies for improving patient care"	• Five to six courses, or 10 credits, applied to the concentration • Required clinical practicum in which students shadow UW Medicine clinicians and faculty • On-campus Institute for Stem Cell & Regenerative Medicine (ISCRM)
Wake Forest University	Winston-Salem, NC	MS in Biomedical Engineering, Regenerative Medicine Concentration	• Graduate School of Arts & Sciences • School of Medicine	30	$39,850	On-campus	"The Regenerative Medicine concentration offers a unique educational and research experience for students pursuing a MS or PhD"	• Five courses, or 16 credits, applied to the concentration • Concentration also available to MS students in three other programs: Molecular and Cellular Bioscience, Integrative Physiology & Pharmacology, and Neuroscience • Required writing and defense of a thesis • Six credit hours of required research in the laboratory of a regenerative medicine faculty member

Source: Institutional websites (see embedded hyperlinks).
Note: The University of Washington utilizes a quarter system. To convert quarter units to semester credit hours, Hanover multiplied the number of required quarter units by 0.667 and rounded to the nearest whole number.

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