Since my move to biotech 3 years ago, after >20 years as an academic faculty member, probably the most asked question was Why? However, underlying that question was really an absence of knowledge regarding the careers available in the biotechnology industry. This perspective will provide information about those career paths and will compare and contrast careers in academia versus careers in biotech and industry. The advice in this article is from my perspective as a senior leader working in a large and established biotech company. Therefore, it may not completely apply to jobs in small or early startup biotech companies or large pharmaceutical companies that do not have a substantial early discovery research program. For another perspective on timing of a move to biotech, readers may be interested in this article in ASBMBToday.¹

The opportunity to move to Genentech came at a time in my career when I was searching for new leadership positions which would support my passion for the development of scientists and physician-scientists, as well as provide the resources to use new technologies to drive innovation. At Genentech, my responsibilities are primarily administrative and my department provides pathology expertise and tissue-based analysis to support basic scientific discoveries, development of drug targets, and biomarkers using both human tissues and animal models. These activities are enabled by pathology core laboratories, including necropsy, clinical pathology, histology, immunohistochemistry / in situ hybridization, a human tissue biorepository, advanced light microscopy, electron microscopy, digital pathology, and novel tissue technologies.

1 | WHY WORK IN THE BIOTECHNOLOGY INDUSTRY?

One of the key advantages to work in biotech is easy access to current technological and scientific advances which make now an optimal time to translate basic
science knowledge into therapeutics addressing unmet medical needs. The feeling that your work can actually impact patients is one of the most common reasons employees in biotech love their jobs. This mission-driven approach was captured by this quote from a Business Insider article “The work is fascinating — and potentially lifesaving.” For scientists in biotech, there is often more time available to focus on the actual science and innovation. Why? Because resources are made available for prioritized projects, which means less time is spent on writing grants or other administrative duties. These resources not only consist of money, but also access to extensive and cutting-edge core facilities. These resources can accelerate the work by generating animal models, organoid cultures, performing complex multiplex immunohistochemistry, and spatial transcriptomics, as well as single cell flow and genomic analysis. Access to innovative new technologies can provide novel insights to scientific questions which may be difficult to achieve in academic laboratories with smaller budgets. For some people working in biotech, another frequent plus is the ease of getting access to human patient samples. These samples allow both clinical translational and basic science research where we can “learn” from patients in a true bedside-to-bench translation.

Nevertheless, there are some potential negatives to working in biotech. The first, especially if you are a physician-scientist, is that there are minimal direct patient interactions. Some biotech companies will allow their physician-scientists to have adjunct faculty appointments at nearby academic institutions and even continue a low level of clinical activity (clinic days, in-patient attending weeks, etc.). This is usually done on a volunteer basis, but does allow physicians to continue to understand key challenges of current patient care and unmet medical needs. The second potential negative is less interaction with trainees and students. For scientists and physician-scientists who value mentoring and teaching, this can be a major shift in their work responsibilities. Scientists and physician-scientists who enjoy working with trainees might want to look for a company that has programs for undergraduate and college interns, postdocs, and/or residents and fellows. Adjunct faculty appointments can also include some teaching and mentoring responsibilities, which would increase trainee interactions. This potential negative about biotech was one of my major concerns as I considered a move to biotech, as a significant portion of my former position was to develop the future careers of physician-scientist trainees. However, I have found that my passion for interacting and advising trainees has been met through expanded opportunities to develop members of my team at Genentech, volunteering at a local high school, and continued interactions with both my former mentees and national groups focused on physician-scientist career development.

Finally, there is a perception that biotech jobs are less secure, since companies do not have an equivalent of tenure. However, the current academic job market is also not perfect, as it has not kept pace with the supply of STEM PhD graduates. Only 23% of life and health sciences PhDs hold a tenured or tenure-track academic position. Although it is true that biotech jobs undergo annual review based on performance, an individual’s performance is evaluated based on their predetermined assigned work goals and consequently, as long as goals are met, there is reasonable job security. Of course, if a biotech company decides to stop an entire area of research, then there is a risk of job loss; but with the growing biotech industry there are often many other job opportunities available.

A recent study has reported that while fewer women in STEM choose industrial employment, the gender pay gap between men and women is smaller in industry and biotech than in academia. It should also be acknowledged that the ethnic and gender diversity and number of tenured faculty positions are significantly less than the diversity and number of STEM PhDs awarded. This lack of diverse representation in leadership is something that many large and established biotech companies are actively focused on changing, which makes for exciting opportunities for many who have felt that leadership opportunities were not options for their careers.

2 WHAT ARE THE MAJOR DIFFERENCES BETWEEN ACADEMIA AND INDUSTRY?

After my move to a biotechnology company, there were several aspects of this new environment that immediately demonstrated some different approaches to scientific work (Table 1). First, in academia a significant amount of time is spent formulating a hypothesis, generating preliminary data to support that hypothesis, using that data to write a grant to obtain funding for more in-depth research, and then sending that grant proposal off to an anonymous set of peer-reviewers and council(s) to decide if your project is worth their support. As many in academia can attest, grant review can often be a frustrating process, as there is no immediate mechanism for answering reviewer’s questions or clarifying any misunderstandings. Although the grant cycle can take months to years, it does allow for investigator-driven ideas and a focus on individual interests. Research projects based on grant support can be contrasted with the approach in many biotechnology companies, where project teams present their ideas
should be realized that most companies only hire scientists who fit with their thematic areas and subsequently search projects in biotech is a requirement for alignment with the company’s area of focus. While true, it is the extreme diversity of scientific expertise which makes science in industry extremely rewarding, fun to be involved in, and able to move extremely quickly. My own department at Genentech, Research Pathology, is a good example of unique, but diverse, expertise that is a component of our project teams. All of our investigators have pathologists assigned to their teams. These pathologists help interpret animal models of disease and biomarkers in human tissue and our core laboratories provide support for development and performance of tissue and fluid-based assays.

### TABLE 1 Major differences between academia and industry

|                      | Academia                                                                 | Industry                                                                 |
|----------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------|
| **Preliminary data** | Use to support grant applications                                       | Use to secure funds and expert resources to continue projects and drug development |
| **Funding/data review** | Anonymous peer review                                                   | Company committees make decisions after face-to-face presentations       |
| **Motivation**       | Discovery to generate new knowledge; Long-term goals more associated with individual interests | Discovery to meet “unmet medical needs” (which often does generate new knowledge) |
| **Collaboration and teamwork** | More focused on small teams (within labs or schools)                   | Approval of a drug can involve a team of >1000 people                    |
| **Performance and advancement** | Publications, funded grants                                              | Achievement of assigned work and shared goals, Publications (some companies) |
| **External recognition** | Publications, talks                                                     | Publications & talks (some companies), but key contributors may not be externally associated with the final product |

(again supported by current literature and preliminary data) in a face-to-face interaction with key decision makers. Although the amount of preparation is probably the same, this type of interaction does allow for a more satisfying “discussion” of the research ideas and usually results in a faster funding decision (sometimes within weeks). One potential negative regarding research projects in biotech is a requirement for alignment with the company’s area of focus. While true, it should be realized that most companies only hire scientists who fit with their thematic areas and subsequently those scientists are given a large amount of research latitude. Probably the main difference is the research questions asked are always driven by determining if the research results will fulfill an unmet medical need, as the company will only prosper if some of the science actually leads to newly developed drugs. Biotech companies need to make profits (e.g., quarterly earnings, shareholder value) in order to continue their research and development activities. In order to take a research project from the early stages of hypothesis generation and preliminary data through to a therapeutic drug ready for clinical trials, an extremely large team is often involved. While this might not be surprising, it is the extreme diversity of scientific expertise which makes science in industry extremely rewarding, fun to be involved in, and able to move extremely quickly. My own department at Genentech, Research Pathology, is a good example of unique, but diverse, expertise that is a component of our project teams. All of our investigators have pathologists assigned to their teams. These pathologists help interpret animal models of disease and biomarkers in human tissue and our core laboratories provide support for development and performance of tissue and fluid-based assays.

### 3 WHAT TYPES OF JOBS ARE AVAILABLE FOR SCIENTISTS AND PHYSICIAN-SCIENTISTS IN BIOTECH?

The NIH Biomedical Workforce Working Group Report\textsuperscript{13} reported that 18% of the biomedical workforce was doing “Industrial Research,” while 43% were employed in Academic Research/Teaching. A recent survey of changing career interests in PhD students found that over the course of their training all students generally expressed an increased interest in careers outside of academia, and one more recent report demonstrated even higher percentages of STEM doctoral recipients employed in industry (37% in 2018).\textsuperscript{14,15} Many of these biotech careers are very similar to positions in academic institutions, including research postdoctoral fellows, scientific researchers (similar to staff scientists in academia/government), lab/scientific managers, and scientific investigators leading research teams. Biotech scientists can be involved in research at multiple stages in the drug discovery process.\textsuperscript{16} This includes discovery/early stage research, which is very similar to hypothesis-based research undertaken in the majority of academic laboratories. However, it also includes later stage investigations to determine appropriate biomarkers of disease, drug design, and reverse translation efforts. Scientists are also involved in patent law, project management, safety and regulatory interactions, business development, and various leadership positions (such as the global head of disease focus areas, chief scientific officers, or vice presidents). These leaders are responsible for both evaluating and overseeing research collaborations and for setting priorities and the overall scientific direction of the company.
A focus on biotech and industry jobs for physician-scientists shows fewer of these trainees end up in biotech careers, with only ~5% indicating current positions in “Industrial Research,” while 63%–66% have full-time academic positions.17 Physician-scientists can be hired into all of the jobs listed above, but also have additional opportunities to utilize their clinical training. Specific job functions could include overseeing clinical studies from target assessment to Phase II clinical trials, as well as providing leadership and direction of the clinical development pipeline.

4 | WHAT DO PATHOLOGISTS DO IN BIOTECH?

To provide some illustrative examples of physician-scientist careers at a large and established biotech company, I will define the roles played by pathologists. At Genentech, there are two pathology departments (Research Pathology and Safety Assessment Pathology) who are involved during the early phases of drug development (prior to Investigational New Drug (IND) stage). These pathologists are either MD or DVM graduates who have completed pathology residencies. In addition, many have completed clinical fellowships and/or PhDs and they utilize both their clinical training, as well as their scientific expertise, as they contribute to scientific and disease-focused teams (Table 2). Key responsibilities for our pathologists include interpretation of histological and immunostained images, and then using this information to advise scientific teams on next steps in their projects. This analysis involves human or animal tissues from multiple experimental models, organoids, procured tissue, or biopsies.

Pathologists are often key drivers for biomarker development and are extensively involved in method development for assays to detect molecular targets in tissues and design of clinical studies utilizing those biomarkers. Safety Assessment pathologists additionally help to evaluate potential therapeutic drugs for evidence of tissue and cellular toxicity.

5 | WHAT CAN INDUSTRY TEACH ACADEMIA?

During my biotech career, I have discovered several things that biotech companies and industry seem to do extremely well. The first is the value placed on interdisciplinary perspectives and the skills to optimally work within a diverse team.12 These interdisciplinary teams provide unique opportunities to approach projects and questions from multiple perspectives and can really amplify innovation. However, to be successful in this type of environment, a scientist or physician-scientist needs to be a good communicator, open to alternative ideas, successful in interpersonal relationships, and welcome healthy conflict and critiques of ideas and plans. These soft skills are not always “taught” in training programs, so taking a course or participating in a project that can develop these skills is one way to optimize a resume for success in biotech and industry.18–20 Because one individual may provide expertise to multiple different project teams, it is also useful to have multi-tasking, project management, and organizational skills. Many large and established biotech companies also prioritize career development for all employees. Every person writes both short-term and long-term goals each year. These include both project and research goals, as well as goals to further an employee’s own growth and development beyond their current role. Because these goals are discussed with direct managers, there is help and guidance for achievement of

| Drug development stage |       |
|------------------------|-------|
| Early stage research   |       |
| ▪ Help evaluate animal and human-models of disease |
| ▪ Define spatial location and expression levels of potential targets |
| ▪ Develop tissue and fluid-based assays and novel technology for research use |
| Late stage research    |       |
| ▪ Define and develop assays for biomarkers of disease |
| ▪ Evaluate potential therapeutic leads for preclinical effects in animal and human-models |
| ▪ Evaluate safety studies |
| Early development      |       |
| ▪ Define and develop diagnostic biomarkers for precision treatment |
| ▪ Optimize biomarkers predictive of treatment response |
| ▪ Evaluate tissue specificity of treatment targets to help define safety concerns |

TABLE 2 Pathologist roles in biotech and industry
the next stage of a biotech career. Lastly, my new position in biotech has provided me with a more optimal integration of work and life outside of work. Of course, it could be because my new position is in California, where the weather encourages an active, outdoor life for everyone, but I believe it is more than just the location. My company strongly believes that you can only optimally contribute at work if you also have time to recharge outside of work. This leadership perspective, added to the often higher salaries that are paid in biotech and industry, is one potential reason to consider a career in biotech.21

6 | FINAL THOUGHTS

Now that I have had experience in both academia and biotech, it is clear that both environments value good science and investigators who keep up with cutting-edge information and use this knowledge to ask innovative and creative questions. There is also a focus on data and results which have been generated by rigorous scientific methods and are reproducible. This is critical so that biotech and industry can translate research information into therapeutics for human use.22 Second, in order to succeed in both settings, scientists and physician-scientists need to develop and practice their networking skills and surround themselves with both mentors and sponsors.23,24 Finally, remember that most scientists and physician-scientists did not initially plan for what became their eventual career trajectory. Everyone should be open to opportunities and measure new options against a list of the things they enjoy.25

CONFLICT OF INTEREST

R.G.L. is a current employee of Genentech, a member of the Roche group, and may hold Roche stock or stock options.

AUTHOR CONTRIBUTIONS

R.G.L wrote and edited the paper.

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How to cite this article: Lorenz RG. Perspective on careers in a large biotechnology company focused on research and development. FASEB BioAdvances. 2022;4:157–161. doi:10.1096/fba.2021-00102