THE GOOD FOOD INSTITUTE

Student Guide to Navigating the Alternative Protein Space

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Introduction

Wherever you are in the world, we're glad you've found us here.

We are at a unique point in history. By 2050, there will be nearly 10 billion people in the world to feed, and global meat demand is expected to grow by 70%. We don't have enough land on earth, fish in the sea, or *time* left to continue producing food the same way we do now. Conventional animal agriculture is simply too resource-intensive, poses too many threats to public health, and harms our planet and its animals in too grave a way for us to feed the world in a way we can stand by.

At GFI, we're hugely optimistic about the potential of alternative proteins to pave a brighter, more sustainable, and more compassionate future for humanity, but we also know its success isn't guaranteed. We need bright, passionate minds like yours to focus on solving some of the biggest challenges facing the alternative protein field - so that in 10 or 20 years, people around the world will be barbecuing up plant-based salmon filets or searing golden, cell-based steaks from their local meat brewery without hurting our planet.

You (yes, you!) get to be an integral part of deciding what the future of our planet looks like for centuries to come.

Though the alternative protein landscape has experienced near exponential growth in the last few years, the industry is still in its infancy. There are many opportunities to contribute to foundational research and to design novel applications for existing technology. It's not just that we can produce meat, eggs, and dairy in a better way: food science and cellular agriculture allow us to dream up new protein sources and to finetune the nutritional profiles of animal-based foods we already love to eat. If you're a creative thinker and dreamer who's excited to do your part in helping build a new paradigm for feeding the world and curious about how to make your mark, you're in the right place. We know meat doesn't sound as sexy as augmented reality or the cure for cancer, but its singular importance - its ability to determine the health of our planet and its people for generations to come - cannot be overstated.

We've assembled a set of educational resources that we hope you'll find helpful as you explore the many opportunities that await you in the alternative protein space. Thank you for being a part of this journey with us. We can't wait to see what invaluable contributions you make to the food system of the future!

Warmly,

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How to use this guide

People come to us at many stages of their careers. This collection of resources reflects the variety of questions and needs that newcomers to the alternative protein space might have. Here is a brief explanation of each section of this collection, and some general ideas about the target audience for each.

1. The basics summarizes our 101-level reading materials and directs you towards good starting places for familiarizing yourself with the alternative protein field.

Audience: Anyone who has not already explored GFI's resources (or anyone who wants a refresher); anyone just beginning their exploration of the alternative protein space.

2. Sparking interest on campus suggests ways that you can bring the alternative protein movement to your school, from bringing a GFI staff member to campus for a speaking engagement, to starting your own University Chapter focused on the future of food.

Audience: University members - from college freshmen to PhD candidates, from economics majors to agricultural science masters students to biomedical engineering postdocs - interested in building a community at their school.

3. Exploring unresolved questions goes into detail about some of the opportunities we have to solve new and exciting problems. Wondering about which plants should be used to make plant-based meat? How to structure cultivated cells so they grow into a steak? So are experts in the field! There are a wide range of questions that people from all manner of backgrounds might be suited to answer. Areas of study that may be helpful for each unresolved question are included. (We recommend that you familiarize yourself with the resources linked in The Basics before you tackle this section.)

Audience: A general interest audience curious about the scope of questions being asked in the alternative protein field; students curious to know which fields of study correspond to the questions they're beginning to ask; researchers and scholars looking for new white spaces in which to flex their academic muscles.

4. Choosing a major walks undecided students through some of the majors most common in existing plant-based and cultivated meat companies, and majors whose faculty members are more likely to contribute research related to the field. Included is a section on getting research experience, a must for any aspiring scientist.

Audience: Undergraduate students who have not yet picked a major or who are switching majors; recent grads considering applying to a graduate school program.

5. Starting an alternative protein company provides you with entrepreneurial resources such as GFI's Startup Manual and commercialization opportunities.

Audience: New or serial entrepreneurs ready to build their own food business.

6. Pursuing scientific research provides information about GFI's grant programs and GFI's SciTech communities.

Audience: Researchers and scholars curious about transitioning their academic focus towards alternative protein applications.

7. Finding research funding is a list of recommended grant programs that have funded or may fund a project related to alternative protein.

Audience: Researchers, scholars, or administrators seeking funding sources for scientific research.

8. Finding a job walks you through some of the potential alternative protein careers available to people with different educational backgrounds and interests. Includes links to websites that help you think more critically about your job-related aspirations, as well as tips for writing a cover letter if you choose to apply to an alternative protein company.

Audience: Soon-to-be and recent graduates looking to launch their careers in the alternative protein space; more experienced professionals thinking about transitioning towards a new career in plant-based and cultivated meat.

9. Staying connected points you towards GFI-hosted communities and social media accounts that will keep you in the loop as this nascent industry evolves.

Audience: Anyone who wants to stay in the loop!

10. Digging deeper lists extensive further resources for you to peruse at your leisure.

Audience: Did you get to the end of this document and find yourself wanting more? Then Digging Deeper is for you!

1. The basics

If you're learning about the plant-based and cell-based meat industry for the first time, welcome! We recommend that you orient yourself by watching TED: The Next Global Agricultural Revolution, with GFI Executive Director Bruce Friedrich. You might also want to check out Plant-based Meat 101, with GFI Director of Science and Technology David Welch, and Cultivated Meat 101, with GFI Associate Director of Science and Technology Liz Specht, for an exciting introduction to the science behind alternative protein. We think you'll also enjoy An Ocean of Opportunity, which covers the opportunities in our new sustainable seafood initiative. Is the Future of Meat Animal-Free? and Formulating With Animal-Free Ingredients are two additional articles we'd recommend.

If you're ready to dive more deeply into this field, we recommend signing up for our free, introductory online course - through which you can learn about the science behind plant-based and cell-based meat at your own pace.

Impact spotlight

In 2016, Sri Artham, the now-founder of plant-based bacon company, Hooray Foods, knew little about plant-based and cultivated meat, beyond that it was a space he deeply believed could help change the world for the better. Shortly thereafter, Sri took our free online course and was inspired to start experimenting with plant-based bacon formulations in his home kitchen. Less than a year later, he developed a plant-based bacon that was selling successfully at several restaurants and closed his first fundraising round led by one of the most active funds in plant-based foods. Key takeaway? Take our course! You could be the next Sri!

2. Sparking interest on campus

For students who are interested in building on-campus communities around the alternative protein movement

If you're reading this guide and you're on a university campus, chances are you've sometimes felt isolated, like you're the only person you know who's excited about alternative protein. Maybe you're an undergraduate student who wishes there were more opportunities to learn about plant-based and cultivated meat. Maybe you're a graduate-level researcher who wants to change your lab's agenda, but you don't know how. Perhaps you're a postdoc ready to become an industry scientist and would like to form connections with startups in the field.

Whoever you are, you will almost certainly benefit from a campus-based community of people who are similarly enthusiastic about alternative protein!

If you're excited about building the alternative protein movement at your university and are able to commit to spending 10-15 hours a week helping to establish a good food community on campus, fill out this form to enter the GFI Student Database, and make sure to check the box indicating your interest in starting a university chapter. You'll be signed up to receive GFI's University Chapter Guide, which is scheduled to be released in December. This guide will lead you through the process of founding multidisciplinary clubs with members at every stage of their academic career, and it will include suggestions for how to generate engagement among students and faculty through discussion groups and larger, campus-wide activities like symposiums.

Beyond starting a university chapter, you can also generate buzz on campus by inviting us to speak for your class or department. In the past, we've spoken at some of the top business, engineering, law, and agricultural programs in the world. We're excited to continue bringing the good food conversation to schools around the world. If you think your peers and colleagues would benefit from guest lectures or larger speaking events from GFI staff members, industry scientists, or other stakeholders like entrepreneurs and policymakers, you can invite us to your campus by filling out this speaker request form.

3. Exploring unresolved questions

For those curious about the biggest questions in the alternative protein space and the disciplines best suited to answer them

Whether you're a tissue engineering postdoc or an undergraduate studying economics, we are delighted that you've found us! While the plant-based and cultivated meat field has made impressive gains in the last couple of years, there is still a critical shortage of students from science and engineering disciplines focused on solving key technical bottlenecks. There are dozens of questions that remain unanswered in the plant-based and cultivated meat space - ranging from basic, foundational questions like how to use plant biology to increase high-protein crop yields to dreaming up innovative methodologies for how to make affordable, serum-free cell-culture media commercially available.

Elsewhere in this document, we'll link you to funding opportunities, papers about alternative protein, and communities of inquisitive people who want to move the industry forward. But what are some of the unresolved questions that we need to overcome? And how can you position yourself to help solve for them?

We've chosen a series of questions meant to illustrate the scope of opportunity associated with the alternative protein field. This list is merely a starting point with a few examples of problems whose solutions could potentially jumpstart innovation and transformation in our food system. Some solutions might be low-hanging fruit just waiting for an observant newcomer pick them.

Others might only reveal themselves to a team of dedicated, inquisitive minds. Either way, the rewards to pursuing the questions posed in this new industry are limitless.

As you read through these questions, keep one overarching question in mind: what parameters do we need to consider at every step of the food production process? From taste to nutritional content, myofiber width to bioreactor temperature, there is always something to change and to measure. What parameters might we be overlooking at any given step of the production process? What parameters could we be measuring more meaningfully? By following this line of thought, you may be able to conduct a white space mapping exercise of your own!

Plant-based meat

By 2035, the global plant-based meat market is projected to be worth somewhere between $100B and $370B. But to achieve success of that kind, we'll need to show that we can optimize raw materials and scale up the supply chains that contribute to plant-based products.

Think about plants as raw materials. How can we grow better raw materials for plant-based meat?

Genetic engineering | Mycology | Plant science

Throughout human history, plants have been selectively grown to fulfill different uses as effectively as possible. Plants like corn and cotton went through centuries of change before they became the crops we recognize today. Plant-based meat is a new kind of food, and it's therefore a new application for the crops we grow.

There is huge potential to optimize the plants we're familiar with to become excellent ingredients for plant-based meat. Could potatoes be bred to have more protein? Will different growing environments be better for plants intended to be meat than for plants intended to be eaten directly? Have we even identified all the parameters that we could change in a given crop? The possibilities are countless! Working on crops with this end-use in mind could make plant-based meat products tastier and cheaper - and therefore more widely adopted.

How do we build a model that can predict what the right plants are?

Computational science | Data science | Genetic engineering | Food science | Plant biology

We've only scratched the surface in terms of our understanding of plant life: by some estimates, we've only explored 8% of Earth's flora. That means there are millions of species out there that could have an application in plant-based meat--even plants that we might not eat directly.

Currently, we experiment with new plant-based meat ingredients in a lab. We have to go through the steps of isolating part of a plant and processing it before we can know for sure whether it will work in a given application. That's time-consuming and expensive. How can we

identify plants we don't currently grow for food, but that might contribute to a better plant-based meat product?

How can we take a plant and turn it into optimally functional ingredients for plant-based meat?

Food science | Molecular biology | Biochemistry | Plant biology

Currently, many plant-based meats are made primarily from protein isolates from plants. Fats and starch are added in separately. But that's only because we have not thoroughly explored plant fractionation (breaking plants down to their component parts) and how it could be applied to plant-based meat. There are almost certainly more effective ways to derive ingredients from plants.

How can we change the way we approach the question of fractionation? Could we derive a protein-fat compound as a unified ingredient--as opposed to deriving protein and fat separately and then recombining them? Are there ways to derive ingredients that cook more consistently, or that react more predictably with different flavoring compounds?

Taste and mouthfeel are paramount in determining whether or not someone will *crave* a given food product. Working to make ingredients more functional can have an immensely positive impact on the popularity of plant-based meat.

Let's dig deeper into processing. How can we achieve an optimal texture and mouthfeel from our ingredients?

Chemical engineering | Biochemistry | Mechanical engineering | Food science

Extrusion - pushing ingredients through extremely small holes to create a new texture - is the most common method for plant-based meat production. But while we've spent decades mastering extrusion for products like pasta or cheerios, we're only just beginning to understand how to apply the art of extrusion to plant-based meat products that satisfy the palates of meat consumers. Furthermore, there may be a number of other technologies and mechanisms that produce even more meaty textures - we just haven't hit on the right application or set of parameters yet.

The way we process plant-based meat not only affects the texture in our mouths, it also affects how easy plant-based meat is to cook. Work within this white space can help make ethical food tastier *and* more accessible.

Cultivated Meat

The first cultivated meat prototype debuted in 2013. While cultivated meat science has evolved in the past six years, more focus has been on optimizing and scaling up cell proliferation than cell differentiation. The field needs to develop robust, scalable processes for muscle and fat cell differentiation in an animal cell culture production environment. A fantastic blog post by

GFI Senior Scientist Elliot Swartz discusses the four critical, interconnected technology areas where scientists can make a huge impact and help meet the needs of the cultivated meat industry: cell line development, cell culture medium, bioreactors and bioprocessing, and scaffolding biomaterials. If you'd like to take a deep-dive, follow Elliot's 301 cultivated meat series - the most comprehensive resource on the science behind cultivated meat that we're aware of. Below, we dive into a few key, unresolved questions that scholars like you can help us answer.

How can we establish immortal cell lines?

Genetic engineering | Molecular biology | Cell biology

The foundational raw material in cultivated meat is the stem cell. Cells can be acquired from an animal by means of a painless biopsy, at which point they are isolated and put in an environment where they proliferate through cell division until there are enough of them to start triggering their transition from stem cell to target cell (muscle cell, blood cell, etc).

However, there is a limit to how many times cells can divide. Overcoming this limit, and even creating a "cell bank" of different cell lines, could go a long way towards making research on cultivated meat less expensive, and towards making entry into the commercial cultivated meat space more accessible to more mission-aligned entrepreneurs.

How can we ensure that cells differentiate into the desired tissue types at scale?

Bioengineering | Tissue engineering | Molecular biology | Cell biology | Computational science

One of the challenges cultivated meat producers face is differentiation at scale: how to get stem cells to transform into the desired cell type (blood, fat, muscle, etc.) when the volume is much larger than what you'd typically see in a lab setting. There are a few different ways to do this. One is to grow different types of cells separately, so that, for instance, every stem cell in one bioreactor becomes a fat cell. Another is to co-culture stem cells and try to trigger differentiation for multiple types of cell within the same bioreactor.

To overcome this challenge, we need to optimize cell culture media and the growth factors it contains. Cell culture media formulation is a fascinating process: what nutrients do cells need to grow optimally? What growth factors are required to trigger the desired differentiation? How can we produce media sustainably and cost-effectively (Last year, GFI Associate Director of Science and Technology Dr. Liz Specht released a cost analysis highlighting hypothetical scenarios to dramatically lower the cost of cell culture medium)? Can we recycle components of media to keep costs down? Are there models we can use to predict whether a formulation would work, so that we don't have to gather expensive materials to test new media?

These are some of the most pressing questions facing cultivated meat researchers and entrepreneurs. Solving them will revolutionize the way we think about this industry.

What are the different methods we can use to improve the structure of cultivated meat products?

Tissue engineering | Materials engineering | Meat science

Most cultivated meat products to date have not had a complex structure. Early stage companies have made ground beef into hamburgers, or unstructured shrimp into dumplings. But the question nearly everyone is grappling with is how to make a complex cut of meat like a T-bone steak or a bluefin tuna fillet.

There are several reasons that structural complexity remains a challenge. One is that knowledge about the makeup of certain cuts of meat often gets siloed in the conventional animal agriculture industry. What is the best way to achieve marbling in a cut of meat, and how should fat and muscle interact to create that marbling? That's a question that needs to be solved in cooperation with members of the existing meat industry.

Another reason we haven't cracked the complex meat code yet is the scaffolding problem. To create thick cuts of meat, cells need to grow on a scaffold that allows cell culture media to permeate layers of cells and that might allow for targeted differentiation. A host of mechanical and biocompatibility properties all affect the effectiveness of the scaffolds we might end up using. Insight into these issues could rapidly launch cultivated meat production into true competition with existing meat products.

How can we design sensors and facilities to ensure quality and efficiency for large-scale cultivated meat production?

Mechanical engineering | Chemical engineering | Electrical engineering | Computational science | Design

Think about all the conditions we need to understand in order to produce high-quality and safe cultivated meat: bioreactor temperature, cell differentiation progress, growth factor density, and waste levels, to name just a few. The larger a bioreactor is--the more meat it can produce--the more interesting a challenge monitoring all these conditions becomes.

Cultivated meat is a wide open frontier, and there is ample room for creativity and invention.There are a host of existing technologies for testing conventional animal product safety that might be adapted for use in a cultivated meat context. Electric testing for cell death in recently-caught fish, for instance, is a new tool that holds promise for a bioreactor application. And of course, inventive minds should think boldly about new ways to monitor cells and meat at different stages of production.

Both consumers and producers care about food safety. And inventing new tools that keep us safer is an excellent way to move the cultivated meat industry forward.

Fermentation of microorganisms

Mycology | Industrial biotechnology | Microbiology

According to the National Academy of Sciences, 99.999% of microorganisms have yet to be discovered. While plant-based and cultivated meat are the best known forms of alternative protein today, both would benefit from the addition of animal proteins created through recombinant technology or from ingredients made from algae, fungi, and other single-cell microbial sources. Algae, fungi, or bacteria may provide efficient protein biomass for alternative meat products. Additionally, these ingredients can contribute essential sensory characteristics like taste or color, or provide important functional properties such as scaffolding support or nutritional value. For these ingredients to benefit the plant-based and cultivated meat industries, they must be characterized, optimized, and produced through low-cost, large-scale manufacturing processes. Read more about opportunities to apply fermentation methods to cellular agriculture here. Many of the questions we highlight in our plant-based meat section are also applicable to the fermentation of microorganisms--solving challenges for either application can help with both kinds of production!

Non-technical opportunities

Creating a tasty, cravable, and inexpensive plant-based or cultivated meat product is only part of the solution to the problems associated with conventional meat. We also need to ensure that we create a clear, open culture of free-flowing information in which people will want to try these products. We need people from a panoply of non-technical backgrounds to assist in the creation of a fair playing field for new food products. Here are some of the non-technical questions we need to answer.

How do we craft a compelling narrative around plant-based and cultivated meat?

Communications | Media studies | Journalism

Just because a new technology is excellent does not mean that people will automatically flock to it. (Ask your technophile Gen X cousin about LaserDiscs to learn more!) We need clear, compelling, and honest stories about alternative protein that will appeal to a wide range of consumers. Those stories need to be told through a number of outlets and by numerous voices.

What concerns do consumers have about new food technology, and how can we assuage them honestly and simply? How can we make an unassailable ethical case for plant-based and cultivated meat? What transformative stories can we tell about the companies in this space and products they make? How can we encourage food science literacy among the general public? People with a knack for storytelling and strong insights into the human need for narrative

should get creative in answering these questions. It's not enough to have good products--we need a good story, too!

How do we create a level regulatory playing field for the alternative protein industry?

Political science | Communications | Public policy

Keeping consumers safe is one of the most important roles that many government agencies play worldwide. But it's all too easy for regulatory bodies to favor existing actors - the status quo - when they are faced with new technologies, especially in the culturally fraught world of food. Traditional animal agriculture lobbying groups are working hard in many countries to assure favorable regulatory conditions for their products, and unfavorable conditions for alternative proteins.

We need a savvy strategy to make sure that regulators treat all food products fairly. When we talk to policymakers, we need clear language that demystifies the tech behind plant-based and cultivated meat. And we need people who can fight for the regulatory rights of alternative protein at many levels, from local to federal, across many different countries.

What strides can we make towards optimizing the nutrition of alternative proteins?

Public health | Dietetics | Nutrition

Keeping in mind that what's nutritious for one person can vary, there are a number of rules of thumb by which we deem some foods more nutritious than others. We are constantly discovering more about how to make foods more healthy. Relatively recently--only about a hundred years ago--we learned how to improve the nutritional profile of staple grains through fortification, thereby vastly decreasing the prevalence of certain micronutrient deficiencies in almost every part of the world. We have every reason to believe that through the development of alternative proteins, we can make meat healthier, too.

Much of the work to make plant-based and cultivated meat healthier than conventional meat will be done by food scientists, engineers, and chemists, and they will need to be in consistent communication with nutritionists and dieticians who have cutting-edge knowledge about what makes food truly healthy for most people. Solving nutrition challenges in food production must be an interdisciplinary undertaking if we're going to be successful! And if we can make a new kind of meat that outperforms conventional meat not only in taste and price but also in nutrition, then we'll have created an unstoppable force for good.

4. Choosing a major

For unspecialized or early-in-career students who are interested in learning how best to position themselves to solve for key questions

The best major for you will be an area of study where you have a deep interest and desire to learn. Some of the most commonly applied majors are bioengineering, chemical engineering,

biology, food science, agriculture, business, ecology, environmental engineering, medicine or pre-medicine, and variations. As you've seen above, some universities also split their biology majors into human biology, molecular biology, and organismal biology, or may split environmental or plant biology from animal biology. Building up the requisite experience may require you to take classes outside of your major, or tie together multiple areas of focus into a double major or specialized degree program. If you're not inclined toward science, but would like to make a difference by changing policy around clean and plant-based meat regulation, a law degree or background in public policy, government, and international relations will be helpful, particularly if you can focus on food science and policy on biological materials.

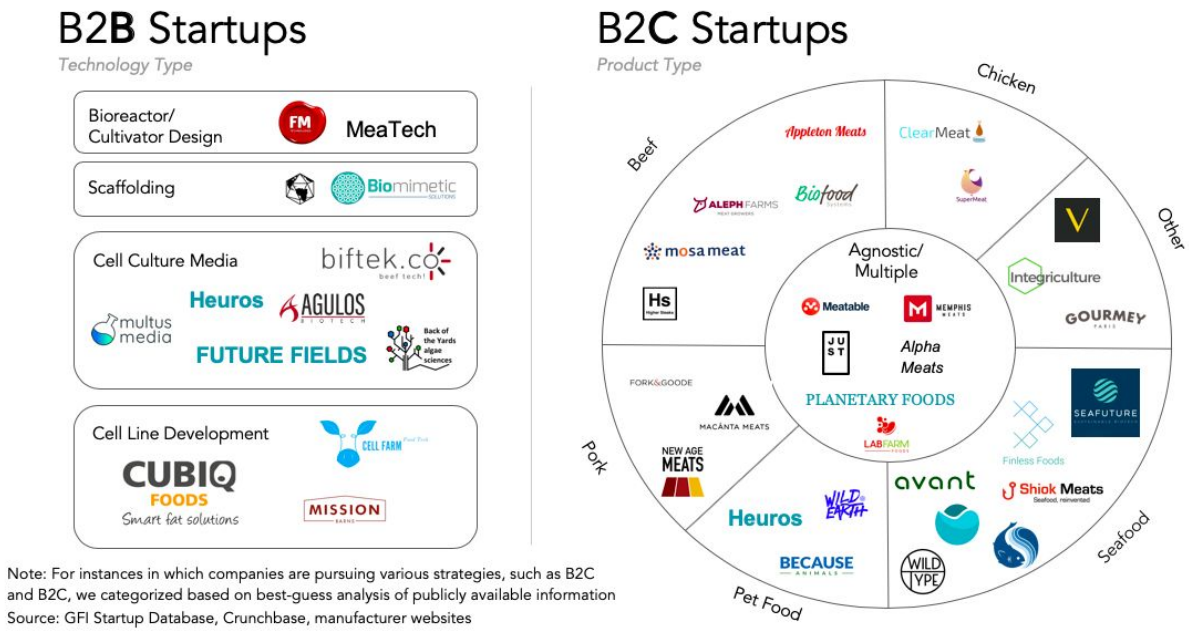
Here are a set of videos by MajorPrep we found helpful in articulating the unique characteristics of a few disciplines commonly associated with the alternative protein field:
What is biochemistry?
What is biomedical engineering?
What is chemical engineering?
What is mechanical engineering?
What is industrial engineering?

We're also seeing a growing need for those with computational backgrounds to contribute to the cultivated meat sector. Visit the Cultivated Meat Modeling Consortium to learn more.

Gaining research experience

If you're studying at a research university, you can reach out to professors working on related topics - like stem cell biology, protein engineering, food science, environmental engineering, and plant biology - directly, or contact the department administrator for a relevant department to ask for suggestions on which professors might be working on the most similar projects. There may be an undergraduate research program already established in which you'll be able to get paid or receive course credit for doing research. Even if you're a high-school student, if you live near a university, feel free to reach out; many labs will take all of the extra labor they can get!

If there's no relevant research going on at your school, consider a summer internship - either at a company working in this space, like one of the cultivated meat companies in the graphic below, or with a research group at another university. For a comprehensive list of alternative protein companies (save for those that are in stealth mode), check out GFI's Company Database.



Note: For instances in which companies are pursuing various strategies, such as B2C and B2C, we categorized based on best-guess analysis of publicly available information
Source: GFI Startup Database, Crunchbase, manufacturer websites

Doing an internship at one of these companies would be a great way to get a sense of what techniques and skills are most valuable for you to learn, as well as what it's like to work at a company. Doing research in an academic lab vs. in industry are very different experiences in terms of incentives, access to external resources, and pace or time pressure of research. Funding for summer research at a university may be available through GFI's own grant program, New Harvest, or through programs designed to bring underrepresented students and students at smaller schools into research, like the Amgen Scholars Program. A variety of the top universities across the US host their own programs, which can be found here.

5. Starting an alternative protein company

For entrepreneurs ready to build their own food businesses

At GFI, we have a team of folks dedicated to assisting entrepreneurs as they formulate ideas and plan their business. The best place to start is the Startup Manual which is a step-by-step guide to planning, launching, and growing a food business. Though it may seem like the ever-growing new protein landscape has everything covered, there is white space abounds for entrepreneurs to make their mark. GFI's list of Commercialization Opportunities can give you a sense of the many, untapped business ideas in the plant-based and cell-based

meat industry, and our map of incubators and accelerators can help get you connected to early-stage resources for good food entrepreneurs. If you are ready to start a business, join the GFIdeas Community, a space to help entrepreneurs connect with each other, learn from guest speakers, and find support within the industry. To keep up-to-date on the good food market and consumer behaviors, you can also sign up to receive our state of the industry reports.

6. Pursuing scientific research

For scientists and engineers wanting to learn more about alternative protein research

Due to the support of our generous donors, GFI plans to give away a few million dollars each year to fund projects focused on improving the organoleptic (sensory) qualities, cost, and scale-up of plant-based and cultivated meat through our competitive research grant program. Though the application cycle for this year has just passed, we highly encourage you to review our RFP to get an idea of which kinds of projects we hope to mobilize. Occasionally, we also accept off-cycle research proposals through our rolling submission process. You're always encouraged to email research_grants@gfi.org with a 1-pager if you'd like some feedback.

If you're curious about what a career as a scientist or engineer in the alternative protein space could look like, check out this set of career profiles, featuring pioneers in the future food movement. If you have additional questions and want to meet others working in the space, apply to join our monthly SciTech Team Office Hours. You can also follow our SciTech team on Twitter at @GoodFoodScience, if you're interested in staying up to date on science and innovation in the alternative protein space. In the future, we hope to launch an *Alternative Protein Research Collaborative*, a resource to help researchers take stock of who is working on what, find opportunities to collaborate, connect with potential industry partners, and help funding agencies understand the growing demand for research funding. In the future, we also hope to launch a monthly seminar series and a companion online discussion forum - a space for academic and industry scientists to connect about their research, exchange ideas, and propose opportunities for collaboration. If you haven't already, please be sure to join our GFI Student Database - the resource we use to keep this community of students informed and engaged - so that you can be the first to know when these resources are launched.

7. Finding research funding

For scholars wanting to learn more about funding opportunities for alternative protein research

In the year, we hope to launch an alternative protein funding database to more easily connect students and researchers like you to funding. However, while that's in the works, we recommend that you check out the following grant opportunities that are either specialized grants for alternative protein research or open-ended grants that we believe are well-suited for alternative protein projects. To stay up to date on the latest grants and fellowships available, we recommend that you check grants.gov, NIFA, and FFAR. If you need guidance on applying for open-ended funding, feel free to email GFI Research Funding Coordinator James Dale at jamesd@gfi.org or attend SciTech Team Office Hours.

Funding sources	*=Funding opportunity is not exclusively for alternative protein research			
Organization	Program	Topic	Funding	Submission date
New Harvest	Postdoctoral fellowship	Cellular agriculture	Up to $55K per year	November 15, April 15
	Graduate fellowship	Cellular agriculture	Up to $40K per year	November 15, April 15
	Seed grant	Cellular agriculture	$5K	November 15, April 15
CU Boulder	Environmental Studies P.h.D. fellowship	Food system technologies (inc. cellular agriculture)	--	December 1, 2019
NIFA*	Agriculture and food research initiative	Agricultural innovation, plant health & production, food safety, & more	Up to $1M	December 18, 2019
NSF*	Graduate fellowship	Fairly open	Up to $138K	October 19, 2020
FFAR*	Ph.D. fellowship	Next-generation crops, urban food systems, health-agriculture nexus	Up to $50K per year	February 17, 2020
Purple Orange	Entrepreneurial scientist fellowship	Plant-based and cultivated meat, eggs, and dairy	Up to €120K	Rolling basis

8. Finding a job

For students and recent grads looking for a job at an existing alt. protein company

Depending on whether you're interested in having your own start-up company, working for a company developing consumer-facing products or tools, equipment, and additives for other companies, working for a biotech company, doing your own research in academia, or working at a nonprofit like GFI, there are a wide range of jobs available, depending on your skills and interest. If you haven't already, check out this set of career profiles, featuring nine pioneering scientists and engineers of the alternative protein movement. PhDs are in greatest demand in academia, where you'll need a PhD to lead your own research and become a faculty member,

and in biotech and government labs, where PhDs are given more responsibility and more ability to direct their own research. Master's degrees and MBAs are great preparation for going into business, either with your own startup or at an existing company, and are good preparation for career tracks where you won't be working at a lab bench with a white coat on, but may be working on strategy, marketing, design, data analysis, business operations, sourcing, or fund-raising and development. Positions for graduates with bachelor's degrees will likely be as staff scientists working on a senior scientist's research agenda, or as a business analyst. These jobs can be good ways to figure out whether further education or graduate school is needed to fulfill your interests.

The best position in the field really depends on your interest - because you'll be more motivated to work in an area that interests you and because business management and bench science attract different personalities. It might be best to give both a try, either through taking a business class, or through observing what both types of jobs are like at internships. The 80,000 Hours podcast goes into more detail on what types of expertise are most needed in the field right now, though 5 years from now, or when you're ready to enter the field, that might be different. Working at nonprofits like GFI can be a great way to work directly on some of the most important problems in this field, and there are openings for candidates at all levels; previous experience, knowledge, and enthusiasm are just as important areas of preparation as degrees.

In the coming months, we will launch an extensive career portal for those seeking internships, jobs, and funding opportunities. In the meantime, there are several job boards that may be of interest to you:

- Job openings in the industry
- Jobs in cellular agriculture
- Food+Tech Connect Job Board
- ForceBrands' Job Board

Don't forget to join our Talent Database, a resource we share with startups looking to expand their teams.

Tailoring your cover letter

In your cover letter, you should explain both what aspects of the work done by the company where you're applying are interesting (e.g. if applying to Beyond Meat, mention which of their products you'd be interested in improving, or if you'd be more interested in working on flavor, texture, extrusion processes, or protein texturization), and what lab skills you've learned already that would be applicable (e.g. types of microscopy, cell culture, protein purification, DNA synthesis). The primary purpose of the cover letter should be to convince the company how you would be helpful to them, and secondarily to convince them that you've read about their work and know what they do and where you might fit in. If you apply to multiple companies,

you should have a different cover letter to each, tailored to their products and the type of work they do.

In your resume, definitely include any publications you have - including a thesis (if you've written one), abstracts, and poster presentations. When you describe different research projects you've worked on, explain the types of techniques you use regularly - both for data analysis and wet lab work (e.g. R, Matlab, Python, and whichever bench techniques you apply frequently). A good guide with examples of resumes and cover letters specifically for researchers is Harvard's "Resumes and Cover Letters for PhD Students".

9. Staying connected

For those interested in staying engaged with the GFI community

If you haven't already, add your information to our GFI Student Database - the resource we use to keep this community of students informed and engaged. There are many great articles that get published every day as these industries attract more and more attention from the media and the general public. Stay up to date by following @GoodFoodInst on Twitter. You can also sign up for our monthly innovation newsletter to keep up with exciting new developments in the good food world. If you haven't already, make sure to join the GFIdeas Community (for entrepreneurs) and SciTech Team Office Hours (for scientists and engineers). If you have any more questions, comments, or ideas, email Amy Huang at amyh@gfi.org or Annie Osborn at annieo@gfi.org. We're here to make you feel supported on your alternative protein journey.

10. Digging deeper

For those wanting to read more about the science behind alternative protein

If you're interested in doing more reading on the plant-based and cultivated meat space, we've compiled the following foundational reading list to help guide your reading.

Plant-based meat:

Understanding differences in protein fractionation from conventional crops, and herbaceous and aquatic biomass - Consequences for industrial use by Tamayo Tenorio A, Kyriakopoulou KE, Suarez-Garcia E, van den Berg C, van der Goot AJ, *Trends Food Sci. Technol.*, 2018 — Journal Article

Replacement of meat by meat substitutes. A survey on person- and product-related factors in consumer acceptance by Hoek AC, Luning PA, Weijzen P, Engels W, Kok FJ, de Graaf C, *Appetite*, 2011 — Journal Article

Enhancing crop yield by optimizing plant developmental features by Mathan J, Bhattacharya J, Ranjan A, *Development*, 2016 — Journal Article

CRISPR/Cas Genome Editing and Precision Plant Breeding in Agriculture by Chen K, Wang Y, Zhang R, Zhang H, Gao C, *Annu. Rev. Plant Biol.*, 2019 — Journal Article

Platforms for Plant-Based Protein Production by Xu J, Towler M, Weathers PJ, *Bioprocessing of Plant In Vitro Systems*, 2016 — Book Chapter

Chapter 6 - Plant-Based Meat Analogues by Kyriakopoulou K, Dekkers B, van der Goot AJ, *Sustainable Meat Production and Processing*, 2019 — Book Chapter

Structuring processes for meat analogues by Dekkers BL, Boom RM, van der Goot AJ, *Trends Food Sci. Technol.*, 2018 — Journal Article

Cultivated meat:

The eco-friendly burger: Could cultured meat improve the environmental sustainability of meat products? by Tuomisto HL, *MBO Rep.*, 2018 — Journal Article

Consumer acceptance of cultured meat: A systematic review by Bryant C, Barnett J, *Meat Sci.*, 2018 — Journal Article

Opportunities for applying biomedical production and manufacturing methods to the development of the clean meat industry by Specht EA, Welch DR, Rees Clayton EM, Lagally CD, *Biochem. Eng. J.*, 2018 — Journal Article

Bringing cultured meat to market: Technical, socio-political, and regulatory challenges in cellular agriculture by Stephens N, Di Silvio L, Dunsford I, Ellis M, Glencross A, Sexton A, *Trends Food Sci. Technol.*, 2018 — Journal Article

Cultured meat from stem cells: challenges and prospects by Post MJ, *Meat Sci.*, 2012 — Journal Article

Making Sense of Making Meat: Key Moments in the First 20 Years of Tissue Engineering Muscle to Make Food by Stephens N, Sexton AE, Driessen C, *Frontiers in Sustainable Food Systems*, 2019 — Journal Article

How Will Cultured Meat and Meat Alternatives Disrupt the Agricultural and Food Industry? By Gerhardt, C., Suhlmann, G., Ziemben, F., Donnan, D., Warschun, M., Kuhnle, H, *AT Kearney*, 2019 — Report