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SUMMARY

By reading this profile we hope that you can build a better understanding of whether seeking to develop technical research expertise for animal product alternatives seems like one of the best ways for you to use your time in order to help animals.

HOW DOES THIS WORK HELP ANIMALS
Developing and scaling up the production of high-quality animal product alternatives will reduce the number of animals that are bred and killed for food.

WHO IS THIS WORK A GOOD FIT FOR
People with academic backgrounds in any of a wide variety of sciences, including disciplines relating to biology, chemistry, food science, and engineering. There are opportunities in both academia and industry.

HOW MUCH DO WE NEED MORE EXPERTISE IN THIS AREA
There are hundreds if not thousands of possible roles in this space. Some more specific types of expertise are more urgently needed than others.

WHAT OPTIONS WOULD YOU HAVE IF YOU WERE TO LEAVE THIS PATH
There are opportunities for switching between roles relating to technical research for animal product alternatives, but few obvious other backup options that would help animals.

HOW TO PREPARE FOR THESE ROLES
Get a relevant bachelor’s degree and probably also relevant graduate training. If needed, you can build experience through internships and volunteering, entry-level roles in industry, or in areas of academic research that overlap with animal product alternatives research.
INTRODUCTION

2013 saw the first public tasting of a cultivated meat hamburger — a burger grown from animal cells, without requiring the slaughter of an animal. Though the texture was described as “perfect” and the taste was “close to meat,” it was apparently “not that juicy” and the burger cost over $300,000 to produce.¹ But progress has been made rapidly. By February 2016, Memphis Meats claimed to have reduced the price of cultivated meat 18-fold.²

This profile discusses new animal product alternatives, such as cultivated meat (that is, products grown from animal cells without requiring the slaughter of any animals, variously referred to as “cultured meat,” “clean meat,” “cell-based meat,” “in-vitro meat,” “cellular agriculture” and so on³) and new plant-based foods that accurately mimic animal products. We focus on technical research roles relating to these foods, including everything from food science to molecular biology to mechanical engineering to computational science.

We will share some insights with you from the experiences of people working on these foods (via 6 interviews), plus the findings of our research into companies in the space. You can read more about our methodology here.
HOW DOES THIS WORK HELP ANIMALS?

IF YOU'RE INTERESTED IN HELPING ANIMALS EFFECTIVELY THROUGH YOUR CAREER, YOU SHOULD PRIORITISE WORK THAT HAS HIGH POTENTIAL FOR IMPACT.

At any one point, many billions of animals are trapped in factory farmed conditions, experiencing terrible lives. Advocates have been pushing for decades to help them through welfare reforms or by encouraging people to change their diets; progress has been made, but meat production is still growing.

Imagine if we could give people alternative foods that were so good and so well-integrated into their existing habits that there was no reason for them to eat conventional animal products? This would save animals from being bred into factory farming and being slaughtered for food, since people would now be buying and producing other types of food. This is the goal of creating new and better cultivated meat, highly meat-like plant-based foods, and other alternatives to animal products. For example, if plant-based foods continue to grow at around 20% per year until 2030, Kieran Grieg of Farmed Animal Funders notes that this would bring these foods to 10% of the global meat and seafood market.

The long-term effects of these new food technologies seem positive. Eating animal products makes people invested in (and biased towards) the oppression of animals. Attitudes often adjust to behaviours, which suggests that removing conventional animal products from diets would push attitudes towards animals in a positive direction. Long-term, indirect effects are difficult to predict, so there is at least some risk that they won’t be as positive as we expect, or perhaps even negative overall. Nevertheless, given how hard it is to change society’s values or behaviour on a massive scale, we expect these alternative foods to play a vitally important part of efforts to end animal farming.

Ian the chicken sitting comfortably while staff at Just eat chicken nuggets made from cells harvested from one of Ian’s feathers (video here).
The Good Food Institute (GFI) wrote in 2019 that, to commercialize cultivated meat, “four critical technology areas require further innovation: cell-line development, cell culture media, bioreactors and bioprocessing, and scaffold biomaterials.” So technical work on any of these technology areas could help to bring these products to market.

GFI is also optimistic that a shift in focus towards “large-scale production” will facilitate further price reductions for plant-based meat. Plant-based food companies themselves seem to agree that there’s still a lot of work to be done improving products and scaling up the technology.¹⁰

A lot of this work relates to scaling up the technologies that have been developed so far, but there are other opportunities for technical research that can help animals. For example, in plant-based foods, there are opportunities for trialling out the use of a variety of plant-based proteins in new contexts.¹¹ And in cultivated meat, there are opportunities to test the findings from work on some animal cell types with other animal cell types.¹²

The range of opportunities is summarised nicely by GFI’s mind maps on plant-based meat, cultivated meat, and fermented foods. Here’s the first of those three, as an example:
CULTIVATED VS. PLANT-BASED

From the perspective of movement-wide strategy, concerns about the estimates of when — if ever — cultivated meat will become cost-competitive with conventional animal products leads some individuals to prioritise plant-based products over cultivated meat.13

Open Philanthropy Project concluded in 2015 that “developing cost-competitive cultured meat products” seemed “extremely challenging” and they were “unable to find any concrete paths forward that seem likely to achieve that goal.” Slightly more optimistically, Animal Charity Evaluators made the following probability estimates in August 2017:

<table>
<thead>
<tr>
<th>Animal product category</th>
<th>5 years time</th>
<th>10 years time</th>
<th>20 years time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acellular</td>
<td>15%</td>
<td>40%</td>
<td>75%</td>
</tr>
<tr>
<td>Ground Meat</td>
<td>7.5%</td>
<td>20%</td>
<td>55%</td>
</tr>
<tr>
<td>Whole Pieces of Muscle Tissue</td>
<td>1%</td>
<td>5%</td>
<td>30%</td>
</tr>
</tbody>
</table>

More recently, Claire Yip predicted that we can expect “dairy and egg products from acellular agriculture” and “processed animal products from cellular agriculture” to be “highly similar cost-competitive alternatives to animal products” by “2030-40.” For “whole tissue meat from cellular agriculture,” Yip predicted “2050-70,” but noted that “fish, chicken, and invertebrates might be earlier.”

Some experts are much more optimistic. For example, Elliot Swartz from GFI also expects cost-competitive products within the next 5 to 10 years. And even if you accept the more pessimistic estimates and forecasts, you might think of cultivated meat as offering a higher-risk, higher-return strategy.14

Of course, other factors might affect your overall strategic view, including:

- The quality of existing products and the tractability of further technical improvements,15
- Which products will be most widely accepted once they reach parity with conventional products in terms of price, taste, and distribution,16
- The ability to fundraise for further research and development from investors who aren’t usually animal advocates.17
Given the many uncertainties involved, we need to continue to invest substantial resources into both approaches. Work in the fermentation field of animal product alternatives also seems promising. So, for many individuals, career strategy considerations such as personal fit (discussed below) will be more important than these overarching movement-wide considerations.

MEAT VS. OTHER ANIMAL PRODUCTS

There is a lot more suffering and death involved in producing fish, seafood, meat from chickens, and eggs than in producing meat or dairy from cows, at least in the US. Despite this, beef alternatives make up a large proportion of meat alternatives and the plant-based dairy industry is more established than the plant-based meat industry. These sorts of comparisons suggest that working on research that focuses on alternatives to fish, seafood, meat from chickens, or eggs is more important than working on alternatives to dairy or beef. Given that a focus on seafood and chicken products seems to have been neglected by plant-based food companies, there are likely some opportunities for easy wins in developing better alternatives to these animal products.

However, in the long-term, if we want to replace animal agriculture entirely, we need a thriving research field and industry that tackles all of these problems. You might also think that there are good strategic reasons for focusing on other product types. So, if you’re very flexible and highly focused on maximising your positive impact for animals, you might want to look for opportunities to focus on fish, seafood, meat from chickens, or eggs. But other career strategy considerations, like your personal fit with different types of research (discussed below), might matter more than differences in the direct impact potential by product type.

Impossible Foods and Beyond Meat are often compared to one another. Both make highly meat-like plant-based burgers, among other products, and both have been gaining lots of attention and investment.
FOR-PROFIT VS. ACADEMIC

It's helpful for animals if research related to animal product alternatives is open-access, via academic institutions, rather than kept solely for use by individual companies and protected by intellectual property laws. This way, multiple companies are able to build off of the same shared knowledge base. For example, open-access research from the 1990s seems to have played a role in later advancements in plant-based meats from companies like Beyond Meat and Impossible Foods. It also means that even if there's some sort of investment winter following industry failures, where some of the research progress in the for-profit sector is lost or wasted, the field won't be damaged too much. On the other hand, there is a risk that academic work will simply duplicate some of the work that companies have already completed or focus on less urgent research questions. We'd encourage people to strongly consider academic opportunities, but we're optimistic about work in both settings, so your decision might depend on practical factors and questions of personal fit (discussed below).

SOCIAL CHANGE VS. FOOD TECHNOLOGY

Technical research to develop animal product alternatives is only helpful if we expect that consumers are likely to actually consume the products once they are comparable in price, taste, and convenience to conventional animal products.

Gallup found in January 2020 that 41% of Americans have already eaten plant-based meats and that the market for highly meat-like plant-based meats is growing. Studies have found that between 19% and 66% of respondents were willing to try cultivated meat, depending on the question wording and specifics of the study. These findings provide evidence that, even without additional advocacy work, high-quality

Birgit Dekkers has a foot in both academia and the for-profit world, as a researcher at Wageningen University and co-founder of Rival Foods.
alternative foods might capture a substantial proportion of the market for conventional animal products.

But should impact-focused animal advocates focus on social change, such as activism and marketing of new products, or on developing better animal product alternatives, such as through mechanical and tissue engineering? Sentience Institute summarise the relevant considerations and evidence on either side of this debate but note that “many resources of the animal advocacy movement, such as a dedicated college graduate with a degree in tissue engineering, are clearly better suited for one strategy or the other.” Both technical research on animal product alternatives and social advocacy could be impactful uses of your time; unless you have a particularly strong view on the social vs. technical tradeoff, general career strategy considerations like personal fit are likely to be more important for your career planning than your views on the optimal distribution of resources in the animal advocacy and animal-free food movements.

EARN AND DONATE

Where salaries for technical research roles in for-profit companies are advertised publicly, they seem substantial. So you might be able to contribute directly to technical research while earning enough money to donate large amounts to effective animal advocacy nonprofits. This could even help animals more than the direct technical work that you do.28
WILL YOU HAVE A GOOD PERSONAL FIT WITH TECHNICAL RESEARCH ROLES?

THE INFORMATION IN THIS SECTION IS INTENDED TO HELP YOU ASSESS WHETHER YOU WILL HAVE GOOD PERSONAL FIT WITH PPL ROLES. YOUR “PERSONAL FIT” WITH A ROLE OR CAREER PATH IS HOW WELL-SUITED YOU ARE TO IT AND YOUR CHANCES OF REALLY EXCELLENTING AT IT. WE THINK THIS IS ONE OF THE MOST IMPORTANT FACTORS IN IMPACT-FOCUSED CAREER STRATEGY.

WHAT DO TECHNICAL RESEARCHERS DO?

We asked our interviewees about what the work is like in this area and took a look at job postings.

Basic research tasks include:
- Preparation and maintenance of the bioreactors, cell cultures, food samples, or whatever equipment and products that you work with,
- Ordering and monitoring equipment,
- Carrying out tasks to run the experiments,
- Monitoring and recording of results,
- Data analysis,
- Planning future experiments.

But your day-to-day might look quite different, depending on your specific role and the research field that you’re working in.

It also depends on your level of seniority:
- Researchers involved in a company’s upper management, like a Chief Technical Officer, might focus more on overarching strategy.
- Senior scientists and heads of research subdivisions might need to figure out what sorts of experiments and equipment are needed, and manage others to achieve this, with some direct involvement in the research. The same might be true of academics with PhD students or postdoctoral researchers.
- More junior scientists, engineers, researchers, technicians, and PhD students will focus more on manual execution and implementation of research, such as maintaining cell cultures or bioreactors for cultivated meat. Some of this work may be quite repetitive. These roles may include administrative tasks, too.

Zhong-qing Jiang, Co-Founder and Chief Scientist at Gold & Green Foods Ltd, a plant-based meat company, has a PhD in cereal technology from Helsinki University.
There are also some parts of the job that differ between academia and startups:

- Researchers in for-profit companies may have more “flexibility in terms of the techniques you can use, the equipment that you require, and the team that you can build.”
- There might be more bureaucracy in academic roles, whereas the startup environment can be fast-paced.
- Researchers in academia might also work on side projects less directly related to animal product alternatives.
- Researchers in academia also have to look out for, attend, network at, and give presentations at relevant conferences and meetings.
- Researchers in academia need to write manuscripts for publication in peer-reviewed journals.
- In academia you may also have teaching responsibilities.
- Academic lecturers need to write grant applications.

WHAT MAKES GREAT TECHNICAL RESEARCHERS?

Our interviewees believed that great technical researchers:

- Have relevant technical experience,
- Are motivated and passionate about the mission,
- Are willing to work hard,
- Are good communicators,
- Think outside the box and have a problem-solving mindset,
- Are detail-oriented.

Skills that might become more important as you become more senior include:

- The ability to ask good research questions and design experiments to test them,
- An overview understanding of how technology develops,
- Management and leadership capability.
ARE THERE ANY OTHER REASONS YOU MIGHT OR MIGHT NOT BE A GOOD FIT?

Of course, research on animal product alternatives is very mission-driven, seeking to have a positive impact. Excitement about this mission and optimism about the possibility for technology to achieve this impact is common among researchers in the field; the work could be more rewarding than roles in other scientific fields. Many researchers also enjoy the collaborative aspects of the work, including involvement in various conferences.

Securing permanent employment in academia is very competitive. It’s presumably even harder if you’re hoping to focus on a relatively new research area with low prestige and funding, such as research related to animal product alternatives.

Some research tasks can be very repetitive. For example, Petra Hanga of Aston University noted that it takes six hours of continuous work to harvest a bioreactor and Jeremiah Johnston of New Harvest commented jokingly that 90% of lab work is “washing dishes.” We know of at least one person who gave up on a planned career in technical research for animal product alternatives because, during graduate study, they realised that they didn’t enjoy lab work enough to stay motivated.

Some roles might involve quite long hours. For example, we saw at least one job ad that asked for “flexibility to work on weekends as needed” and Christie Lagally of Rebellyous Foods commented several times that working at a startup producing animal product alternatives is a “24/7 job.”

If you work on cultivated meat, you’re working on an area of research that not everyone respects and that many people find weird. That could be demotivating. On the other hand, many people are excited about cultivated meat.

The work is not always well-defined, though this might be less of an issue in engineering or other roles oriented more towards processes and maintenance.

When deciding between whole categories of animal product alternatives, like cultivated vs. plant-based meat, mostly, you can think of your personal fit in terms of particular scientific disciplines that are more or less relevant to each field. Of the 18 different areas of expertise that GFI lists as being relevant to the development of plant-based or cultivated meat in its student guide, only 4 — genetic engineering, computational science, molecular biology, and mechanical engineering — are listed for both areas (see “What sort of academic training is relevant” below). For scientists who have already developed particular skills, your expertise may be obviously more directly applicable to one area or another. But you may notice other differences between the fields. For example, although there is lots of room for technical work to make commercially viable cultivated meat products, there may actually be more room for scientific innovation in improving plant-based foods.

The animal product alternatives industries, especially for cultivated meat, are relatively small, new, and dynamic. This may be exciting. But it also makes it difficult to predict the future needs of the industry, which makes this a riskier career path than some others that help animals. Seeking to slowly develop highly specialised technical expertise (e.g. through a PhD) could backfire if the needs of the industry change.
HOW CAN YOU ASSESS YOUR PERSONAL FIT?

- Look honestly at your previous success in related work that uses the skills described above and the academic disciplines described below. Introspection on your preferences and personality could also be helpful.
- Read relevant technical academic papers, and perhaps write up your thoughts, synthesis, and analysis in a public blog or academic review article. We recommend using your personal connections and GFI’s database of academic labs as starting points. GFI can help connect you to individuals in the space, as can national organisations like Cellular Agriculture UK, Cellular Agriculture Canada, Agriculture Cellulaire France. You can join relevant directories that help connect individuals, such as GFI’s Talent Database, GFI India’s Talent Database, GFI’s student database, the effective animal advocacy community directory, and the Effective Altruism Hub. See also 80,000 Hours’ recommended “email scripts for cold-emailing.”
- Seek out opportunities to volunteer in an academic lab doing relevant work; these opportunities might not always be advertised. You could also look for internships or other lab opportunities at companies working on animal product alternatives.
- If you already work in a job doing some kind of lab research, is it possible to seek out opportunities more directly relevant to the sorts of work you would be doing if you worked on animal product alternatives?
- Although a much more time-intensive method of testing your fit, it might be possible to get a role as a junior scientist (or a less technical role) at a relevant company in between your undergraduate and graduate degrees — it might also help you work out whether doing a graduate degree is worthwhile for you.
- Creating a student group or professional networking group focused on animal product alternatives might be a good way to start building connections and knowledge. Alternatively, you might be able to start organising events and a sub-community within existing animal advocacy, vegan, or effective altruism groups.

Cellular Agriculture Society’s “vision for meat production in 2040” as part of their “Project CMF”
WHAT DOES TECHNICAL RESEARCH FOR ANIMAL PRODUCT ALTERNATIVES LOOK LIKE IN PRACTICE?

A BETTER UNDERSTANDING OF THE LANDSCAPE OF THE ANIMAL ADVOCACY MOVEMENT MIGHT HELP YOU UNDERSTAND SOME PRACTICAL CONSIDERATIONS OF WHETHER YOU ARE WELL-SUITED TO WORK IN THIS AREA.

It’s also important for understanding how your strengths compare to other members of the animal advocacy movement who might plausibly do similar roles. This determines your comparative advantage — the job or path that is highest-impact for you, taking into account the possibility of coordination with others in the animal advocacy movement. This is something we can talk through with you if you apply for a one-to-one careers advice call with us.
HOW MUCH DOES THE MOVEMENT NEED MORE EXPERTISE IN THIS AREA?

The success of animal product alternatives will presumably depend on continued excellent technical research. We don’t have much reason to believe that companies struggle to hire and retain technical researchers in general any more or less than they do for other role types, but these roles are important. Our “spot-check” found that these roles make up a large proportion of the current roles at companies producing animal product alternatives:

<table>
<thead>
<tr>
<th>Area of expertise the role seems to focus on</th>
<th>% of roles at cultivated meat companies</th>
<th>% of roles at plant-based food companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical product-focused research</td>
<td>53%</td>
<td>16%</td>
</tr>
<tr>
<td>Engineering, manufacturing, and processing</td>
<td>15%</td>
<td>3%</td>
</tr>
</tbody>
</table>

This represents hundreds of jobs. And there are additional relevant research roles in academia and in companies that only partly focus on animal product alternatives.

Within technical research on cultivated meat, several interviewees highlighted engineering skills as being especially needed at the moment. There was also evidence in our spot-check that cultivated meat companies struggle to hire or retain people in these roles. We don’t have evidence to believe this is also the case for plant-based food companies though. As the cultivated meat industry is relatively young and is growing rapidly, these needs may also change, so you probably shouldn’t seek to retrain to engineering from other relevant technical skillsets if this will take a long time or if you don’t have good personal fit with those sorts of roles.

A couple of interviewees commented that, while more entry level research roles may not be particularly difficult to fill in cultivated meat companies, there is more of a struggle to fill technical research roles that also have management and leadership responsibilities. But we actually found contrary evidence to this in our spot-check. If existing institutions aren’t constrained by a lack of talented researchers, one option is to create a new startup yourself. Even if business skills and entrepreneurship don’t seem like your forte, you could take leadership of the technical aspects and seek a co-founder or hire with business expertise.

Petra Hanga is a Lecturer in Biological Engineering at Aston University in the UK. She works on scaling up the production of cultivated meat.
IS FUNDING AVAILABLE?

There is substantial investment in private companies, meaning that there are lots of technical research jobs available at companies working on animal product alternatives. The amount of funding is also growing.

The investments in animal product alternatives seem impressive, but are arguably low compared to other scientific research programmes with ambitious goals. New Harvest believes that academic research funding is difficult to come by because “cellular agriculture lies at the intersection of medical research and food science” and because there is “a catch-22 that exists for all novel research,” where “you need data to apply for grant money, but you need money to get that initial data.” Funding for academic research is available from a variety of places (see the “useful resources” below), but there is still not enough. Our impression is that academic research for cultivated meat still relies substantially on GFI and New Harvest.

WHICH COUNTRIES ARE TECHNICAL RESEARCH ROLES BASED IN?

In our spot-check of roles at companies producing animal product alternatives, companies were identified in 29 different countries. A lot of roles are based in the US:

<table>
<thead>
<tr>
<th>Country</th>
<th>Companies making animal product alternatives in general</th>
<th>Cultivated meat companies specifically</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>53%</td>
<td>42%</td>
</tr>
<tr>
<td>Belgium</td>
<td>10%</td>
<td>2%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>7%</td>
<td>5%</td>
</tr>
<tr>
<td>Sweden</td>
<td>7%</td>
<td>0%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>5%</td>
<td>14%</td>
</tr>
<tr>
<td>Canada</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>Chile</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Israel</td>
<td>2%</td>
<td>15%</td>
</tr>
</tbody>
</table>

Of the staff working for companies based in the US, 74% worked for companies based in California. Elliot Swartz’ website also shows that most funding for cultivated meat is currently focused on companies based in California.

When we checked, GFI’s database of academic labs working on animal product alternatives included 24 labs in the United States, 7 in Israel, 6 in Canada, 4 in the Netherlands, 3 in China, 3 in the United Kingdom, and one in each of Australia, Belgium, Brazil, Estonia, Finland, Germany, Japan, Norway, Portugal, Serbia, Singapore, and Switzerland.
WHAT OPTIONS WOULD YOU HAVE IF YOU WERE TO LEAVE THIS PATH?

Much of the career capital built up through technical research for cultivated meat might be applicable to the scientific disciplines that this technology interacts with, such as tissue engineering for regenerative medicine. Bruce Friedrich of GFI was less optimistic that food scientist expertise, specialised to plant-based foods, would be applicable outside of the area of plant-based foods.

Of course, there are opportunities for changes within the overall category of technical research for animal product alternatives. Our interviewees believed that there was a lot of overlap in the required skills in academia and startups. Anecdotally, it seems more common to transition from academia to industry than the other way round and, in general, it seems hard to re-enter academia. You could certainly apply for roles at nonprofits like the Good Food Institute and New Harvest if you have developed technical research experience. These roles are far less numerous, but the organisations may struggle more to secure high quality applicants, partly because the salaries are lower. And relevant academic, startup, or nonprofit backgrounds could all provide useful preparation if you decided to start your own company developing animal product alternatives.

But beyond these opportunities to stay within the broad area of technical research, it’s not obvious to us that there are great backup options that would also be top options for helping animals. Potentially you might apply your expertise to lobbying roles focused on animal product alternatives, though a research-intensive route probably wouldn’t be the best preparation for that. If you can use your technical research or startup experience to subsequently find well-paid work in other sectors, then you might be able to switch your focus towards “earning to give” and donating lots of money to effective animal advocacy nonprofits. Again, though, technical research roles seem unlikely to be the most efficient way to prepare yourself to earn lots of money.

There may be some opportunities specific to particular research disciplines. For example, tissue engineering work related to cultivated meat might be partly transferable to technological efforts to provide high quality alternatives to animal experimentation in clinical research. It’s possible that some of your career capital (for some disciplines and types of work) could transfer to other ways of doing good in the world that don’t relate specifically to animals, like reducing global catastrophic biological risks.

INTERESTED IN TECHNICAL RESEARCH ROLES TO HELP ANIMALS?

If you need to do some career planning, 80,000 Hours’ “Tips on making career plans” will likely be helpful.

If you’re considering whether you’d like to focus on developing technical research expertise for animal product alternatives, or bringing your existing expertise to support the animal-free food movement, we might be able to help you talk through your options. You can apply for a one-to-one careers advice call with us here.
HOW TO PREPARE FOR TECHNICAL RESEARCH ROLES FOR ANIMAL PRODUCT ALTERNATIVES

SO FAR, THIS PROFILE HAS FOCUSED ON INFORMATION TO HELP YOU DECIDE WHETHER SEEKING TO DEVELOP TECHNICAL RESEARCH EXPERTISE FOR DEVELOPING ANIMAL PRODUCT ALTERNATIVES WOULD BE A HIGH-IMPACT USE OF YOUR TIME. THE INFORMATION BELOW IS MORE FOCUSED ON HELPING YOU DECIDE WHAT YOU COULD DO NEXT IF YOU DECIDE THAT YOU DO WANT TO FOCUS ON THIS.

WHAT ARE THE ENTRY REQUIREMENTS?

Our spot-check found that the majority of advertised opportunities in “technical product-focused research” and “engineering, manufacturing, and processing” roles in for-profit companies explicitly required a bachelor’s (undergraduate) degree. Most of those roles also explicitly required some sort of biology, chemistry, or life sciences focus in your educational qualifications, though this wasn’t always the case for engineering roles (e.g. pure mechanical engineering might be fine). So, priority number one, is: get a relevant degree.

The question of whether you should seek a relevant master’s degree or PhD in addition to your bachelor’s has a less obvious answer. About half of relevant job postings in our spot-check asked explicitly for this; this was less frequently a requirement for engineering than product-focused roles and for plant-based than cultivated roles. Indeed, Birgit Dekkers of...
Rival Foods and Wageningen University confirmed that graduate qualifications were not always needed for research roles for plant-based foods.

Several technical research roles asked for PhDs or master’s degrees — but if asking for a master's, they often also asked for additional years of industry experience. Pursuing a PhD seems like a safer bet if you hope to enter this field, but if you’ve already got a master’s, there may be other entry routes. And if you’re hoping to test your fit in the space before applying for graduate programmes, then seeking out relevant full-time work that only requires a bachelor’s degree could be a good option for a few years.

Of course, you’ll need a PhD if you want to work in academic settings rather than for-profit settings. Given our optimism about open-access, academic research in this space, we’d encourage most people who are keen to pursue careers in technical research for animal product alternatives to get a PhD and at least seriously explore the academic pathway.

The vast majority of roles at for-profit companies in our spot-check also asked explicitly for one or more years of relevant experience beyond those provided by your education.

<table>
<thead>
<tr>
<th>Area of expertise the role seems to focus on</th>
<th>Cultivated meat companies, average years of experience required</th>
<th>Plant-based food companies, average years of experience required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical product-focused research</td>
<td>2.6</td>
<td>2.6</td>
</tr>
<tr>
<td>Engineering, manufacturing, and processing</td>
<td>3.5</td>
<td>4.6</td>
</tr>
</tbody>
</table>

Often, those roles asked specifically for relevant industry experience, so doing postdoctoral research positions at academic labs might not be best if you’re hoping to work in for-profit companies.

Your technical research experience may need to be very close to the research focus of the company or lab that you intend to work at. Robert Yaman of Mission Barns commented that, for roles there, mammalian cell culture was especially needed. Job postings in technical research roles for cultivated meat sometimes explicitly mentioned this sort of specific experience requirement. However, other job ads do not mention this or explicitly note that it is preferred but not required. Consider, by comparison, that a
description for a “Senior Scientist - Extrusion Applications” role at Impossible Foods noted that a “background in extrusion and food texturization” is “desirable but not necessary; any bright and driven scientist will be considered.” Robert also commented that if you have experience in an adjacent but not completely relevant field or lack technical experience generally, then it should be a high priority to seek out the right kind of lab experience.\textsuperscript{82}

Note that sometimes formal entry requirements are \textit{not as “required”} as the job advert implies. Of course, beyond the formal entry requirements, you'll also want to ensure that you have good personal fit (see the relevant section above).

\section*{WHAT SORTS OF EXPERIENCE ARE MOST USEFUL FOR DEVELOPING TECHNICAL RESEARCH EXPERTISE?}

Of course, relevant technical research experience is very helpful, if not required. The more closely related your experience to the positions you're considering, the better.\textsuperscript{83} However, there is still a lot of overlap between technical research focused on animal product alternatives and other fields of research (such as those mentioned in the section on academic training below),\textsuperscript{84} so working in one of these fields seems a good temporary option for skill-building if you can't immediately land your ideal technical research role. Take, for example, Marie Gibbons, who began doing cultivated meat research at Harvard, despite her background being in veterinary medicine.\textsuperscript{85}

Another option is to work in entry-level roles in the industry, such as being a lab assistant or technician, that might not require as much relevant technical experience.\textsuperscript{86} This might be a good option straight after your undergraduate degree.

If you have sufficient expertise to secure a role at the Good Food Institute or New Harvest, then this may provide you with a great overview of the needs of the research field, which you can later apply to work in industry.\textsuperscript{87} On the other hand, you likely wouldn't be gaining technical research experience in these roles.
WHAT SORTS OF ACADEMIC TRAINING IS RELEVANT?

GFI’s student guide lists the following academic pathways as relevant for particular types of technical research to improve plant-based foods technology:

**Plant-based meat**

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

- Genetic engineering
- Mycology
- Plant science

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

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

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

- Food science
- Molecular biology
- Biochemistry
- Plant biology

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

And for cultivated meat:

**Cultivated Meat**

How can we establish immortal cell lines?

- Genetic engineering
- Molecular biology
- Cell biology

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

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

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

- Tissue engineering
- Materials engineering
- Meat science

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

The guide also lists mycology, industrial biotechnology, and microbiology as relevant for working on the fermentation of microorganisms.

Our impression from our interviews and research is that GFI’s list is pretty comprehensive for the most directly applicable academic disciplines. Across the different types of animal product alternatives, they note that “some of the most commonly applied majors” (i.e. degree focuses) are “bioengineering, chemical engineering, biology, food science, agriculture, business, ecology, environmental engineering, medicine or pre-medicine, and variations.”

But an alternative option is to just try to get really good at a less obviously relevant scientific field that you are especially well-suited to and then apply your expertise to technical research for animal product alternatives. We’ve heard mixed advice on whether
this is worthwhile though—of course, it’s much riskier because you may never succeed in applying your expertise to animal product alternatives.

When choosing your academic institution, applying to the most prestigious and highly ranked universities you have a realistic shot at securing a place in is probably a good strategy. But you’ll also want to try to look for courses that have the best training and experiences of specific relevance to animal product alternatives. Be aware that graduate programmes in some institutions might not provide much hands-on experience in the lab or with relevant machinery. Varun Desphande of GFI India noted, for example, that the easiest way to get such experience in India was to work in industry or do your graduate training outside of the country. Birgit Dekkers of Rival Foods and Wageningen University also commented that, in Europe there are options for four-year applied degrees, which are more vocational and less academic, that could actually be better from a startup’s point of view than more academic graduate degrees.

**USEFUL RESOURCES**

- The interview findings spreadsheet for this profile.
- One-to-one careers advice calls with us.
- GFI’s quarterly careers conversations call.
- 80,000 Hours’ advice on “**how to get a job.**”

Recommended resources for reading more on the technical details of cultivated meat include:

- [Meeting the needs of the cell-based meat industry](...) (short).
- [Opportunities in clean meat mindmap](...) (short).
- [The bottlenecks to the scale-up of cultured meat and plant-based meat](...) (medium).
- [Technical, socio-political, and regulatory challenges in cellular agriculture](...) (medium).
- GFI’s online course (medium).
- [How it’s made: the science behind cultivated meat](...) (detailed).
- [An analysis of culture medium costs and production volumes for cultivated meat](...) (detailed).
- [Cultured Abundance](...) a blog with various summaries and analyses of patents (medium).

Recommended resources for reading more on the technical details of plant-based foods include:

- Plant-based meat mind map (short).
- GFI’s online course (medium).
If you're looking for stories, interviews, and inspiration from scientists and entrepreneurs who already work in animal product alternatives, resources include:

- GFI's "Pioneers of the Future of Food" profiles.
- Some of the interviews on each of the Feeding 10 Billion, Sentience Institute, Brave New Meat, Business For Good, Cultured Meat and Future Food, and Plant-Based Business podcasts.
- GFIdeas and GFIdeas India
- A few books partly cover this, such as Clean Meat, The End of Animal Farming, and Gene-trepreneur.

There are a number of jobs boards relevant to animal product alternatives:

- GFI's industry job board
- Cell Agri's job board
- 80,000 Hours' job board
- Food+Tech Connect job board
- ForceBrands' job board

For academic labs currently working on animal product alternatives, see GFI's list.

Academic funding is available from a number of places, including:

- The Good Food Institute ("at least $3.15 million to promising plant-based and cultivated meat research projects" through the 2019 research grants)90
- New Harvest ($400,000 provided to date)91
- Various US governmental agencies and foundations
- The North Carolina Food Innovation Lab
- The Indian government
- The Dutch government
- The Government of Western Australia,
- The Israeli government,
- The EU’s Horizon 2020 R&D funding,
- Possibly also Canada’s protein industries supercluster or the EU’s protein2food and Smart Protein projects,
- Merck, a company based in Germany,
- Purple Orange Ventures, an impact seed fund based in Germany,
- Private donors, including in the past Google co-founder Sergey Brin,92
- For students, as well as GFI and New Harvest’s own funds, GFI notes that "programs designed to bring underrepresented students and students at smaller schools into research, like the Amgen Scholars Program" also offer funds. "A variety of the top universities across the US host their own programs, which can be found here."

If you’re interested in entrepreneurship:

- GFI has various resources on entrepreneurship in animal product alternatives, including a "Good Food Startup Manual."
- Counterfactual can help you with impact and market research, co-founder recruitment, and securing investment.

THANK YOU FOR YOUR INTEREST IN HELPING ANIMALS!

Thank you for reading this skills profile. We hope this has been helpful for shaping your future steps. We wish you the best of luck in your animal advocacy career planning.

If you've found this skills profile useful, you can support our work by donating to Animal Advocacy Careers. Your contributions will support us to help animals!
NOTES

1 This was calculated by multiplying the cost claimed by the BBC for the burger (£200,000) by the exchange rate at the time, resulting in €307,700.

2 Citing a podcast with Uma Valeti of Memphis Meats, Sentience Politics wrote: “The only private company making cultured beef as of June 2016 reports a production cost of about €36,200/kg, 27 representing an 18-fold price reduction compared with the €650,000/kg burger unveiled in 2013.” They add that Mark Post, a leading researcher in the initial unveiling of the burger in 2013, had “announced in late 2015 that, under ideal conditions, combining pharmaceutical bioreactor technology to existing tissue culture techniques can already reduce costs to €60/kg of cultured ground beef.”

Sentience Politics wrote that “proof of concept has existed in various forms only since the early 2000’s,” citing this article. There are several examples of work prior to the early 2000s, as shown by Wikipedia’s article on the “Timeline of cellular agriculture.” Nevertheless, the 2013 public tasting was an impressive achievement in itself, given the short history of the technology. For more on the history, see Chapter 6 in The End of Animal Farming and this podcast episode.

3 On the various terminologies used, see section 2 of this article. For testing and discussion of terminology, see here and here.

4 See, for example, the effects for animals discussed here. Meat consumption and production have stagnated or declined in some countries in the global North, though the extent to which this is due to animal advocacy is unclear.

5 Kieran excludes dairy from this rough model. Another assumption made is that “the rest of that market were to grow at 2% per year over that time period.” Organisations haven’t always published their quantitative estimates of the potential impact of the successful development and marketisation of cultivated meat.

6 For example, see the paragraph beginning “Recent psychological research…” here and the next few paragraphs.

7 For example, this article notes that it has been demonstrated that “that attitudes may be inferred from behavior in accordance with self-perception principles (Bem, 1972). These self-perception effects have also been shown in a variety of domains, e.g. environmental behavior (Chaiken & Baldwin, 1981), religious behavior (Salinick & Conway, 1975), and humor (Olson, 1992).”

Meat eaters experience cognitive dissonance relating their consumption of animal products and employ strategies to reduce this dissonance including “avoidance, dissociation, perceived behavioral change, denial of animal pain, denial of animal mind, pro-meat justifications, reducing perceived choice, and actual behavioral change.” Many of these strategies result in less consideration of animals, so removing meat eating would remove the need for individuals to engage in these dissonance-inducing strategies.

8 One concern is that alternative foods that accurately mimic conventional animal products might increase cultural attachment to animal products, perhaps perpetuating the association between “animals” and “food” longer than is necessary. Higher “meat attachment” has been linked to interest in buying cultivated meat, but this does not necessarily imply that the consumption of cultivated meat further reinforces meat attachment. Whether this concern is realised might depend substantially on the framing of advocacy that surrounds the transition of the food system towards alternative foods; if it is framed solely as a direct replacement for animal products, with little discussion of its ethical benefits, then this risk might be increased.

Sentience Institute’s online experiment suggests that awareness of animal product alternatives decreases people’s opposition to animal farming. But this could be for a number of different reasons and the situation could be different if these products successfully displaced the majority of conventional animal products.

If you are very optimistic about animal welfare and rights advocacy, you might think it’s likely that the end of animal farming will occur regardless of improvements in animal product alternatives. In that case, developing new animal product alternatives might be unnecessary.

9 See, for example, here and here.

10 See, for example, the answers by Chris Davis of Impossible Foods, Daniel Rauch and Rose Bechtel of Miyoko’s Kitchen, and Parendi Birdie of JUST here. See also Christie’s discussion (6:18).

11 GFI’s plant-based meat mind map notes that: “The vast majority of commercially available plant-based protein ingredients comes from only 2 percent of the 150 plant species on which today’s global food supply depends. A
significant pool of potential plant protein sources is thus available for exploration, and this does not even take into account the almost 250,000 additional plant species not used in agriculture today. Innovation opportunities in this area include expanding and diversifying our use of plant protein sources, determining which sources are best suited to particular plant-based meat products, and ensuring that the proteins from these novel sources are optimized specifically for plant-based meat rather than plant-based foods in general."

Similarly, *The End of Animal Farming* notes that: “The key to Hampton Creek’s research has been the trial-and-error testing of a huge database of plants, and the success of that testing has come down to individual species with unique properties, like mung bean protein, which was found to coagulate with heat, making it a prime candidate for plant-based scrambled eggs... entrepreneurs or scientists seeing a neglected opportunity should go for it. Throw different strategies at the wall. See what sticks, then consolidate.”

12 For example, there has been more work on mammals than on fish, and more work on some types of fish than others. This was noted by Elliot Swartz and by Jennifer Tung of Finless Foods.

13 See, for example, the paragraph beginning “On the other hand...” [here](https://www.farmedanimalfunders.org/), written by Kieran Grieg of Farmed Animal Funders.

14 For generalised discussion of this kind of approach, see [this post](https://medium.com/p/659b01215aa9) focused on allocating funding.

15 For example, Kieran Grieg of Farmed Animal Funders [wrote](https://www.farmedanimalfunders.org/) that his impression was that “Plant-based options already seem to be: 1. (fairly) cost-competitive, though most still have significant room for progress 2. (fairly) taste-competitive, though most still have significant room for progress.”

16 For example, you might think that, given [strong attachments to meat and animal products](https://www.farmedanimalfunders.org/), all else equal, consumers would prefer products made from real animal cells. Alternatively, you might think that preferences for naturalness and other concerns about cultivated meat will prevent this technology from ever being as widely accepted.

17 From the perspective of founding new companies, Lisa Feria of the impact-investing firm Stray Dog Capital [believes](https://www.farmedanimalfunders.org/) that cultivated meat companies have been finding it easier to secure venture capital funding than plant-based food companies, because the former seems more patentable and has potentially higher margins. However, she sees there as being substantial untapped opportunities for high-impact animal product alternatives developments in plant-based products, especially those focusing on replacing chicken or seafood products.

18 Open Philanthropy Project [noted](https://www.openphilanthropy.org/) in 2019 that “beef alternatives currently make up about 60% of all meat alternatives... But 96% of vertebrate farmed animals are chickens and fish, and price-competitive alternatives to them remain further away; for instance, large eggs are 10X cheaper than Just Eggs, on a weight, servings, and protein basis.” Open Philanthropy [predicted](https://www.openphilanthropy.org/) that beef alternatives “may soon taste and cost the same as ground beef.” Lisa Feria of Stray Dog Capital also has the impression that work on products other than beef and dairy has been neglected so far (130.06). The distribution seems less uneven within cultivated meat significantly.

19 According to the Good Food Institute’s “2019 U.S. State of the Industry Report Plant-Based Meat, Eggs, and Dairy,” plant-based milk stands at 14% share in the total milk category in the US, compared to 1% for plant-based meat and 0.2% for eggs.

20 For example:

- Impossible Foods and Beyond Meat have shown that there’s a real demand for alternatives to beef products.
- Beef products might also be easier to make. It might make sense to do some products really well before worrying too much about trying to create more difficult products equally well.
- You might think that producing certain types of foods first will be more likely to win public approval and regulatory success. For example, people might object less to cultivated meat if they’ve been wearing leather made in a similar way for years already. And foie gras is both especially horrible to the animals and especially expensive to produce, so it might be easier to produce an alternative that’s better in every way.

21 For discussion of some patents in cellular agriculture, see [here](https://www.farmedanimalfunders.org/).

22 Certainly, plant-based companies seem to have used equipment such as extruders that were developed in previous decades (Christie shared Kieran’s impression (17:30)), although we are unsure about the extent to which these developments were made in industry or in open-access scientific research.

23 Kieran Grieg of Farmed Animal Funders considers this possibility [here](https://www.farmedanimalfunders.org/) — see the paragraph beginning “Now, I do wonder...” and following 4 paragraphs.

24 See the answers by Robert and Jeremiah’s response [in response to the question beginning “Overall, across all the different technical bottlenecks...”](https://www.farmedanimalfunders.org/). In a more positive light, Mark Post has commented (at a talk on May 20th 2020 entitled “How to get publishable research in academia”) that in academia you can work on “subjects that
are more kind of risky and not of immediate commercial value for [companies] but future commercial value for [companies]."

25 If you are expecting to focus on technical research and you have a realistic opportunity to conduct technical research that will be open access, we would encourage you to pursue it, especially if you are able to secure funding from governments, investors, or donors who don’t usually focus on research and development for animal product alternatives or animal advocacy. That money would probably otherwise be used in ways that are less helpful for animals than, say, funding granted by nonprofits such as GFI or New Harvest, who might otherwise use such funding for important capacity-building or legislative work.

26 Various market research firms predict high growth of plant-based foods. AT Kearney, though noting that, “qualitative forecasting is required as historical patterns cannot be applied,” predicts that by 2030, “novel vegan meat replacements” and cultured meat will equal or surpass conventional meat in all analyzed criteria, including scalability, consumer acceptance, and regulatory approval. They conclude that, “cultured meat will win in the long run. However, novel vegan meat replacements will be essential in the transition phase.” “The Great Protein Shake-up?” Jeffries (September 17, 2019) estimates that the meat industry “is set to reach $2.7tn by 2040. Alternative meat is still in an embryonic stage (our best case is $470bn of total meat market by 2040, worst case a mere $90bn).” Such predictions for future growth are, of course, highly speculative, though several such reports note strong growth of highly meat-like plant-based foods in the past few years. See, for example, the rising success of Beyond Meat.

27 Willingness to buy ranged from 16% to 46%.

28 In a survey of researchers, grant-makers, and community builders in the effective animal advocacy movement (to be published soon), we asked the following question: “Imagine an individual who is skilled and motivated enough to be a good (but not outstanding) candidate for roles in effective animal advocacy nonprofits. I.e., after a few applications, they are likely to secure a role, but they are not likely to be substantially better than the next best candidate, at least in their first paid role. How much money would you estimate that that person would have to be able to donate per year, on average, to effective animal advocacy nonprofits, to be indifferent (from an impact perspective) between focusing on a career “earning to give” vs. a career in animal advocacy nonprofits?” The average figure given by the 13 respondents was $28,200. Donating this amount seems achievable in technical research roles; we only found salaries publicly listed for 5 jobs in our Animal product alternatives for-profit roles spot-check, but the average salary for those 5 was $138,875.

29 See the answers by Petra and Jeremiah. This was also commonly noted by some of the job postings for more entry-level research roles.

30 See the answer by Petra. This was also commonly noted by some of the job postings for more entry-level research roles.

31 See the answer by Birgit.

32 See the answer by Petra. This was also commonly noted by some of the job postings for more entry-level research roles.

33 See the answer by Petra. This was noted by many job postings, especially those marked under both the research and “Other technical” categories in our spot-check.

34 See the answer by Jeremiah.

35 These distinctions were made by Robert and seemed to be borne out in our spot-check, although precise definitions and role delineations will vary by company or university.

36 This was the view of Andra Necula, CSO at New Age Meats. Petra also noted that sometimes academic environments are more funding constrained.

37 See the answers by Petra and Birgit (to the question beginning “Are there any other reasons...”).

38 See the answers by Petra (to the question beginning “How transferable is the career capital...”) and Jeremiah.

39 See the answers by Petra and Jeremiah.

40 See the answers by Petra. It was also discussed in a talk by Mark Post on May 20th 2020 entitled “How to get publishable research in academia.”

41 See the answer by Petra.

42 See the answer by Petra.

43 See the answers by Robert (in answer to the question beginning “Overall, across all the different technical bottlenecks...”), Petra (in answer to various other questions), and Jeremiah. At a talk by Mark Post on May 20th
2020 entitled “How to get publishable research in academia,” we asked Post the same question and his first response was to list relevant academic disciplines.

See the answers by Birgit, Petra, Elliot (1:58:50), and Christie (49:04). At a talk by Mark Post on May 20th 2020 entitled “How to get publishable research in academia,” we asked Mark the same question and he commented: “The other characteristic which is almost equally important [as technical expertise] is that we are extremely fortunate that most of the people who work in this area are very passionate about it. We’ve found in the past that people who do this as a regular job, without passion for it, they don’t match with the rest of the group basically... so if you want this job to pay for your hobbies,” it might not be for you.

Although it was uncommon to see something this explicit, in the job ads by Vow for their senior scientist roles, the first bullet point on the “About you” list is: “Above all you are mission aligned: you want to apply your skills in science to build a better food system and a brighter future. For some of us this is about animal welfare, for others it’s saving the environment or caring deeply about developing incredibly delicious foods - all different perspectives on the same mission.”

See the answers by Robert and Christie (49:04).

See the answer by Petra (to “What does a typical day involve?”). Noted by Christie (49:04) and Jeremiah at various points.

See the answer by Robert.

See the answers by Jeremiah and Robert.

See the answer by Robert.

See the answers by Jeremiah and the staff at Miyoko’s Kitchen and Finless Foods here.

See the answers by Petra and Jeremiah.

See the answers by Robert and Petra, as well as by Jeremiah to “What does a typical day involve?”

See the answers by Petra and Elliot (1:58:50). This was also discussed in a talk by Mark Post on May 20th 2020 entitled “How to get publishable research in academia.”

Robert noted to us after the interview that this was his experience.

Elliot agrees that the skills are “fairly segmented” between the two areas.

Bruce Friedrich of GFI argued this in a podcast episode with 80,000 Hours: “Oddly enough, somewhat counterintuitively, there’s probably more opportunity to be pioneering in plant-based meat than in clean meat... Our expectation was that there was going to be a lot more scientific uncertainty in clean meat. It’s been the opposite of that. We learn stuff on almost a weekly basis about the science of plant-based meat that we didn’t know we didn’t know... One of the things about clean meat is that this is basically taking the techniques of therapeutics, of regenerative medicine, and applying it to food. And there are billions of dollars in regenerative medicine and lots and lots of scientists in all aspects of it. But with plant-based meat, you’re basically creating an industry where there is no industry... So up until five years ago, it was just soy and wheat and then Ethan Brown came along and introduced peas. But there is the same work that’s been done with wheat and soy and peas to be done with at least dozens and maybe more additional proteins. So lots and lots of exciting stuff that could happen in plant biology.”


Bruce Friedrich of GFI has commented that “the people who are most thoughtful, the people who are pioneers, the people who are just starting [animal product alternatives] companies” are “crazy accessible” because “everybody who’s involved is super excited to talk with really smart, thoughtful people who might get involved.”

GFI’s student guide notes that “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!” Petra Hanga also commented that it will often be possible to volunteer in a lab doing relevant work, to gain experience, although these opportunities might not be advertised. Robert also emphasised concrete lab experience, as did Elliot.

See the answers to the questions beginning “To what extent do companies tend to struggle...” “Who do you think struggles more...”, and “If someone has relevant expertise...” on the interview findings spreadsheet. Contrastingly, back in 2017, Bruce Friedrich of GFI was optimistic that “for people coming out of grad school with PhDs in bioengineering, there are going to be a lot of jobs in clean meat directly... for the people who are actually going to do the science, I think you have a very high likelihood of getting that job if you’re particularly skilled and hardworking.” See also the “How many roles were there for each area of expertise?” section in the “Animal product alternatives for-profit roles spot-check.” We haven’t conducted surveys of companies like we have done for animal advocacy companies, so we’re not confident that companies don’t need technical researchers more or less than they need other role types.

Consider how, for example, Christie Lagally, a mechanical engineer, founded Rebellyous Foods and subsequently hired a VP of Business Development and a Director of Business Operations.

There are at least 55 different venture capital firms investing in animal product alternatives. According to the Good Food Institute, there had been $747 million invested in plant-based meat, eggs, and dairy based in or selling in the US in 2019 alone, compared to $274 and $77 million invested globally in fermentation and cultivated meat, respectively, in the same year.

E.g. when compared to the estimated $150-180 million spent annually on farmed animal advocacy internationally. The funding needs for new animal product alternatives, as a developing sector, far exceed the funding that the animal advocacy movement is likely to be able to provide.

Consider that the US Congress (i.e. the legislature in a single country) passed a spending bill for 2019 that included over $45 billion for cancer research (i.e., nearly 600 times the amount spent globally on cultured meat research in that year). Internationally, $272.9 billion was invested in renewable energy capacity in 2018. Another comparison, much closer to the funding for animal product alternatives, is provided by Open Philanthropy Project’s note that “$4.5B of capital investment went toward tissue engineering efforts worldwide between 1990 and 2002, and over 90% of the investment came from the private sector.” GFI’s 2018 report shows that orders of magnitude more money were invested in each of “food tech,” “cannabis,” “ag tech,” “clean tech,” and “life sciences” than in plant-based food or cultivated meat (see page 20 of the cultivated meat report).

See the answers by Elliot (1:25:07 and 1:32:08), Petra, and Jeremiah, though Birgit had a different impression.

The two columns in the table below use slightly different methodologies; see the full spot-check write-up for more detail.

In GFI’s older list of “24 universities that have phenomenal potential to become global leaders in plant-based and clean meat research,” selected based on “the key characteristics – including relevant technical expertise, research capabilities, and private-sector partnerships – that are important for catalyzing academic research that will accelerate the development and commercialization of appetizing, affordable, and accessible plant-based and clean meat products,” 10 of the 24 were in the United States. 2 were in Australia and 2 were in Japan. Belgium, Canada, China, Germany, the Netherlands, Singapore, South Korea, Sweden, and the United Kingdom each had 1 university on these lists.

See the answers by Robert (in answer to the questions beginning “Beyond technical qualifications...” and “How transferable is the career capital between academia, roles at startups, and nonprofit roles?”), Petra, and Birgit.

See the answer by Petra.
This was suggested by Varun Deshpande of The Good Food Institute India, though our forthcoming survey of nonprofits didn’t suggest that “natural sciences” was an especially difficult area to hire good candidates for.

For those that don’t explicitly ask this, we imagine that not having any relevant university training would still be a substantial disadvantage.

They didn’t necessarily specify that the experience had to be in animal product alternatives, though presumably this would help if you can secure experience as directly relevant as that.

See the answer by Robert to the question beginning “Overall, across all the different technical bottlenecks…”

For example:
- Future Meat job ad asked for “Hands on experience in mammalian cell culture, metabolic analysis and microscopy.”
- Artemys Foods’ senior scientist job ad seemed to require mammalian experience, as did an engineering role working with mammalian cell culture process development.

For example:
- Mosa Meat’s job ad noted: “Experience with cell culture and aseptic technique (essential), 3D tissue culture experience (desirable) although no specific knowledge of bovine, muscle cell culture is required.”
- New Age Meats had “Mammalian reactor culture, preferably stem cells” as required experience in a bioengineer job ad.
- Peace of Meat only referred to “previous experience with avian or mammalian hepatocytes and adipocytes” as “a plus” in their “Translational cell biologist” job ad.

See his answer to the question beginning “Do you have any concrete tips…”

See the section “What are the entry requirements?” and the answer by Petra.

See the answers by Birgit, Petra, Jeremiah, Elliot (1:30:09), and Christie (48:05).

Marie Gibbons noted on the “My Food Job Rocks” podcast that her background was in veterinary medicine. Gibbons also noted: “For a really long time I didn’t pursue [cultivated meat research] because I didn’t think that I had the right experience for it... but now I know that that didn’t really matter because 1) the experience I had was pretty applicable in a lot of different ways, and 2) I was able to learn a lot on the job and 3) I think when you’re really passionate about something, nothing can get in your way.”

Jeremiah (who works at New Harvest) added after our interview that “the side-effect learning has been great (just in hearing the common technical problems researchers face).” It’s unclear to us whether, all-things-considered, you should prioritise this sort of experience or less directly relevant academic experience if you can’t land your ideal role straight away. This might depend on your longer-term goals (e.g. academia or for-profit companies) and the quality of available opportunities for you.

Both Elliot (2:04:17) and Christie (55:18) noted this benefit.

In general, our interviewees didn’t have much to add. Petra did add “Biochemical engineering and bioprocessing engineering.” Marie Gibbons of GFI also discussed promising routes in an 80,000 Hours podcast episode and her list is similar. At a talk by Mark Post on May 20th 2020 entitled “How to get publishable research in academia,” Post commented: “We have cell biologists, chemists, biochemists, mechanical engineers, bioprocessing people, so it’s highly multidisciplinary... Currently we don’t have specific people in food technology or in flavouring or in any of these areas, but mostly on really the fundamentals of cell biology and tissue engineering. There we find that people biomedical, chemical engineering, cell biology backgrounds usually fit well with the rest of the team.”

The idea was suggested by Marie Gibbons, former research fellow at GFI. Of our interviewees Robert and Jeremiah were quite excited about this type of path, too, especially given that the cultivated meat industry is quite young and given that there isn’t much funding for academic research in this space at the moment. Elliot mainly saw the value of this riskier career approach in terms of entrepreneurial career paths, however, rather than technical research roles (2:15:07).


According to this page, accessed 20th March 2020.

One article notes that “Professor Mark Post of Maastricht University secured financial support from Google co-founder Sergey Brin to produce the world’s first cultured beef burger, which was cooked and eaten in a London press conference in August 2013 (O’Riordan, Fotopoulou and Stephens, 2016; Post, 2014).”