THE GOOD FOOD INSTITUTE

Draft Project Report

MEAT CULTIVATION: EMBRACING THE SCIENCE OF NATURE

June 26, 2019

Summary

In order to more effectively translate research into practice, this project sought to fill a specific gap in understanding related to best approaches for communicating with segments of the public about meat produced through cellular agriculture.

The project goal was to develop transparent, familiar, science-forward messages and nomenclature for communicating with non-technical audiences.

The project was informed by empirical research and science communication theory. In particular, the project utilized the key framing concepts important to public engagement and gaining consumer trust. This involved developing audience-centered messages based on narratives, transparency, and familiarity.

The project method involved a cycle of ideation, message design, empirical consumer testing, and revisions in order to develop evidence-based communication tools for the emerging public discussion of cell-based meat with non-technical audiences.

Project outcomes include a set of recommended communication tools including a narrative text, a graphic analogy, and insights into the benefits and challenges of various nomenclature choices. The communication tools may be useful for a variety of stakeholders, including advocacy groups, cell-based meat companies, investors, and media.

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Introduction

Novel Technologies in the Public Sphere

The production of meat via cellular agriculture is a novel technology not yet widely known in the public sphere. Science topics discussed in the public sphere are typically categorized as either *controversial* (a hotly debated topic, such as genetic engineering) or *emerging* (not yet widely known). Once a topic becomes controversial, it is typically difficult to change public opinion about the topic. It is much easier to form public opinion as a science topic emerges. This increases the likelihood that novel technologies become widely accepted rather than become controversial.

Cell-based meat is in a critical period of opportunity as an emerging technology where public awareness is relatively low. Previous research suggests there will be a strong group of innovators and early adopters (Diffusion of Innovations; Rogers, 2003) for cell-based meat (Bryant et al. 2019; Bryant & Barnett 2018) and demand may even outpace supply. However, long-term market success is dependent upon forming positive awareness among early and late majority groups (Rogers, 2003) early on, so they will be primed for purchasing when supply increases and costs decrease.

In order to achieve desired outcomes related to consumer decision-making about scientific topics, it is important that communication strategy is rooted in evidence. Effective science communication efforts grounded in evidence inform consumers before public opinion has solidified.

Science Communication Literature

INFORMATION DEFICIT MODEL

Early efforts to communicate with segments of the public about science were based on the Information Deficit Model. The Information Deficit Model posits that the public is generally ignorant about scientific issues, and that increasing scientific literacy will also increase public approval of scientific breakthroughs as well as funding for scientific research and development (Weigold, 2001). However, this model has been shown to be largely insufficient: bridging the public's knowledge gap and generating positive attitudes are both more complex than simply teaching new information. Studies show that individuals assign meaning to new information based on their current attitudes and beliefs (Craik & Lockhart, 1972; Shanks, 2010). This is especially pronounced when individuals don't understand incoming information (Posner & Rothbart, 2002). In short, building knowledge is necessary but is insufficient for forming attitudes. New information must be presented both in an engaging format and in a framework that enables people to incorporate the new information into their existing belief and value systems.

Effective science communication is largely informed by the larger field of communication studies. Common models of communication posit that successful communication occurs in a transactional process wherein senders and receivers achieve mutual understanding. Effective message design begins by determining the target audience, as targeting messages to specific groups is more effective than appealing to the general population. Selecting a credible message source and an engaging communication channel are among the most important considerations. Finally, framing the message to reach a target audience with a certain style of presentation or emphasis on certain topics over others can increase effectiveness.

Framing refers to the way that information is presented, and how this presentation subsequently influences how it is interpreted and used. The way in which the information is presented will affect the audience's interest in paying attention to the message, level of engagement, and interpretation of meaning (Goffman, 1974). Framing can also be used to emphasize

some considerations or topics over others (Nisbet, 2009). In contrast to the deficit model, using message frames, such as narratives, has been shown to effectively engage with segments of the public on scientific topics.

In this current project, we focused on refining several types of message frames through the use of narrative, with a consideration for our target audience and communication channels. Below, we provide a brief overview of several types of framing that we incorporated into the project. Following this section, we provide a description of our project goals, methods, and results.

NARRATIVE FRAMING

Narrative framing considers messaging style, and specifically the degree to which a message uses narrative to present facts and other relevant information. Framing new scientific information in narrative form, including visual storytelling (Sundin et al., 2018), both engages audiences and makes it easier for them to learn the story's embedded messages. Stories are inherently influential in changing beliefs and attitudes (Dahlstrom, 2014; Lane et al., 2013; National Academy of Sciences, 2014; Schank & Abelson, 1995). Individuals can more easily process and remember information that they learned in story form (Graesser et al., 2002; Greenhalgh, 2001; Scott et al., 2013) because the cognitive process when engaged with a narrative is uniquely heuristic and low-energy-intensive (Bruner, 1985; Kahneman, 2013). Overall, stories are easier to understand (Dahlstrom, 2014) and lead to greater understanding and remembering than science information presented in a statistical or traditionally presentation format (Moore et al., 1999). For these reasons, research has tested narratives in numerous scientific contexts and found that the use of story effectively influences beliefs about scientific topics such as vaccines, HIV/AIDS, and environmental issues (Brodie et al., 2001; Vaughan, Rogers, Singhal, & Swahili, 2000; Dahlstrom, 2010).

TRANSPARENCY

Underpinning much of science communication's effectiveness is the process of building consumer trust through transparency. Not only does honesty about scientific uncertainties increase audience's perceived trust in a communicator (Frewer et al., 2002; Johnson & Slovic, 1995; National Research Council et al., 2012), but importantly, this trust influences whether one wants to learn from a message source (Lupia, 2013; National Academies of Sciences, Engineering, and Medicine, 2016; Renn & Levine, 1991). People also tend to want to learn from sources who share goals and interests with them (Lupia, 2013; National Academies of Sciences, Engineering, and Medicine, 2016; Renn & Levine, 1991) and who have expertise in the field (Lupia, 2013; Renn & Levine, 1991).

UNCERTAINTY FRAMING

Closely related to transparency, uncertainty framing considers the degree to which uncertainty is emphasized or avoided in messaging. Where applicable, acknowledging uncertainty can increase trust and credibility (e.g., Frewer, 2004; Johnson & Slovic, 1995). Acknowledgement of uncertainty is not necessarily a barrier to action (e.g., Morton et al. 2011), and may increase acceptance of a technology (Frewer et al., 1998).

FAMILIARITY

Presenting new scientific information in relation to familiar concepts makes it easier for people to learn. Moreover, prior familiarity with a novel technology is a key predictor of consumer acceptance. For example, a recent survey of U.S., India, and China consumers found that, across all three countries, those who are already familiar with cell-based meat expressed greater purchase interest (Bryant, Szejda, Parekh, Deshpande, & Tse, 2019). Several surveys of consumer perceptions of cell-based meat have indicated that naturalness is a key concern for consumers (Bryant & Barnett, 2018). However, direct messaging attempts to persuade consumers that cell-based meat is natural have been found to be ineffective (Anderson, 2018). Anchoring new technologies in concepts that are already familiar may help to make novel technologies more understandable and avoid triggering a naturalness concern.

Project Goals

In accordance with the FDA's fundamental risk communication recommendations, messages are considered adequate if they enable effective action, and therefore messages should be accessible, understandable, and contain the necessary information to aid decision-making (Fischhoff, Brewer, & Downs, 2011, p. 19). Communication strategies should be continually tested to ensure their effectiveness (Fischhoff, Brewer, & Downs, 2011; Kahan, 2013 ; Maynard & Scheufele, 2016).

As a project group, our goal was to build a set of communication tools that are understandable, engaging, factual, and ultimately useful in building consumer trust in and acceptance of the technology. Our key message design considerations were to build familiar and transparent messages that are useful for consumers to make informed decisions about their food choices.

Through the application of theory and a cycle of message design and empirical testing, the project aimed to develop evidence-based communication tools to communicate with non-technical audiences about the emerging scientific topic of cell-based meat. An evidence-based strategy will help support our communication practice by ensuring that we are achieving the intended outcomes. The resulting communication tools may be useful for a variety of stakeholders, including advocacy groups, cell-based meat companies, investors, and media.

Project History and Method

September 2018
GFI Cellular Agriculture Nomenclature Study

In the summer and fall 2018, GFI conducted a four-phase research project to better understand consumer perceptions of nomenclature used to describe meat produced through cellular agriculture. The project began with a stakeholder survey, which generated 74 names to consider for further testing. A second survey assessed a shorter list of 31 names in terms of consumer perceptions of appeal and descriptiveness. Finally, two sets of online experiments tested five names (clean meat, cell-based meat, craft meat, cultured meat, and slaughter-free meat). The name "slaughter-free meat," was the only name that scored well in all of the desired outcomes (appeal, descriptiveness, differentiation, likelihood of trying, and likelihood of purchase). However, the name "slaughter-free" was not selected for widespread use, as it did not meet the need for neutral framing important to stakeholders.

Fall 2018 - Spring 2019
GFI/Mattson/Memphis Meats Messaging and Nomenclature Ideation

Following the GFI nomenclature project and inaugural GFI conference, Mattson reached out to GFI with an offer to lead a pro bono cellular agriculture naming project on behalf of GFI and the cellular agriculture industry. The primary workgroup included representatives from Mattson (Barb Stuckey, Al Banisch), GFI (Keri Szejda, Mary Allen, Annie Cull), and Memphis Meats (Maria Macedo, Steve Myrick). Based on Memphis Meats' suggestion, the team widened the project scope to include the development of a successful narrative framework to bring this new category to market.

The group agreed that one of the most important goals in the message strategy would be to anchor messages in the familiar and to build consumer trust through transparency. For nomenclature, the group agreed that an optimized name would follow from this messaging strategy and would need to meet multiple criteria: 1) appeal, 2) the neutrality of the term for multiple stakeholder groups, 3) descriptiveness, and 4) ability to differentiate the category from conventional and plant-based meat.

In December 2018, Mattson presented four possible messaging narratives to the project team. GFI and Memphis Meats aligned on the narrative that best communicated the science and technology underpinning cellular agriculture ("science as discovery"). GFI and Memphis Meats provided detailed feedback on the selected narrative, and Mattson then refined the narrative and designed a plant propagation analogy graphic to increase familiarity. In January 2019, the workgroup met to review the narrative and analogy, and then to ideate name options. In addition to the primary project team, an additional six Mattson staff joined the group for an ideation session. The workgroup generated over four hundred names before filtering down to the top names based on the nomenclature criteria.

March 2019
GFI Mixed-methods Consumer Survey & Focus Groups

In March 2019, GFI made minor revisions of Mattson's draft narrative and analogy. Following the revisions, GFI designed and executed a survey to elicit consumer feedback on the narrative, analogy, and top options for nomenclature. The survey (N = 161) sampled from general U.S. population (matched to age and gender). GFI then worked with researcher Dr. Courtney Dillard to design focus groups to more deeply understand public perception on these topics. Dr. Dillard conducted four focus groups in March 2019 to obtain deeper insights into consumers' perception of the narrative, graphic, and nomenclature. Each of the four focus groups consisted of 6-7 college students in Portland, Oregon (N = 27). Focus group participants expressed a diverse range of political views, and skewed toward a younger age group (primarily 18-21 years), majority female (59%), and majority omnivore.

As the purpose of these two studies was to inform the next phase of message design, we highlight here only topline results. The consumer survey and four focus groups obtained similar results. Consumers' desired messaging aligned with the stated goal of the working group, which was to develop transparent, familiar, science-forward messages and nomenclature for communicating with non-technical audiences about meat produced through cellular agriculture.

Key findings from open-ended survey responses:

- Overall, consumers were positive toward the narrative but expressed a desire for more straightforward information.
- They specifically expressed an aversion to messaging that had a marketing feel.
- They also stated a desire for more information about attributes important to them, most commonly: taste, affordability, and safety.
- In general the analogy made sense to consumers as a familiar concept, but many felt that the graphic was oversimplified and that the comparison between plant cuttings and animal cells was a stretch.

Quantitative ratings of names from survey:

- *Cultivated meat* and *cultured meat* scored most favorably in terms of appeal (2 = somewhat appealing, 3 = moderately appealing)
- *Cell-cultured meat*, *cell-based meat*, *cell-raised meat*, *cultivated meat*, *made meat*, *cellstock meat*, and *cultured meat* scored the most favorably in terms of descriptiveness (3 = moderately descriptive, 4 = very descriptive)

Name	Appeal	Accurately descriptive
Cultivated meat	2.49	3.43
Cultured meat	2.34	3.21
Made meat	1.96	3.39
Nanopastured meat	1.87	2.64
Cell-based meat	1.82	3.79
Cell-cultured meat	1.76	3.88
Cell-raised meat	1.75	3.65
Propagated meat	1.68	2.81
Cellstock meat	1.68	3.31

Note: Names are sorted by appeal rating.

Key findings from focus groups:

- After reading the narrative, participants readily understood that the product was not plant-based.
- Some participants indicated that because it was a new concept, a categorization system (i.e., conventional meat, plant-based meat, cell-based meat) would help them readily categorize it.
- Participants raised questions around cost, health benefits and risks, sensory characteristics (taste, appearance), environmental impact, specifics of the production method, and appeal concerns.
- Some participants showed skepticism, noting there was a focus on benefits with an oversimplification of the process.
- For both the narrative and graphic, participants provided specific recommendations about words, phrases, and images that resonated or should be changed
- Participants evaluated five potential names, considering appeal, neutrality, and descriptiveness criteria. Most of the responses to *cultivated* meat were positive, there were a range of responses to *cultured* meat and *cell-based* meat, and most of the responses to *cell-cultured* meat and *propagated meat* were neutral or negative.

Following these March 2019 survey and focus group studies, GFI significantly revised the narrative and analogy to incorporate consumer feedback. As a follow up, the GFI Science and Technology team provided a consultation to ensure the accuracy of the message content.

May 2019

GFI Mixed-methods Consumer Survey

In a continuation of the message design and empirical testing cycle, in May 2019 GFI conducted a final round of consumer testing to determine the degree to which the revised narrative and analogy graphic meet consumer needs. The survey also gauged consumer perceptions of four names still under consideration: *cultivated* meat, *cell-cultured* meat, *cell-based* meat, and *cultured* meat.

GFI obtained the sample from Positly, with a total of 183 respondents matched to the US population by age and gender. Respondents were ineligible if they took part in previous GFI studies on cellular agriculture. Participants provided open-ended feedback to the narrative ("What is your general reaction to this narrative?" "What other information would you need in order

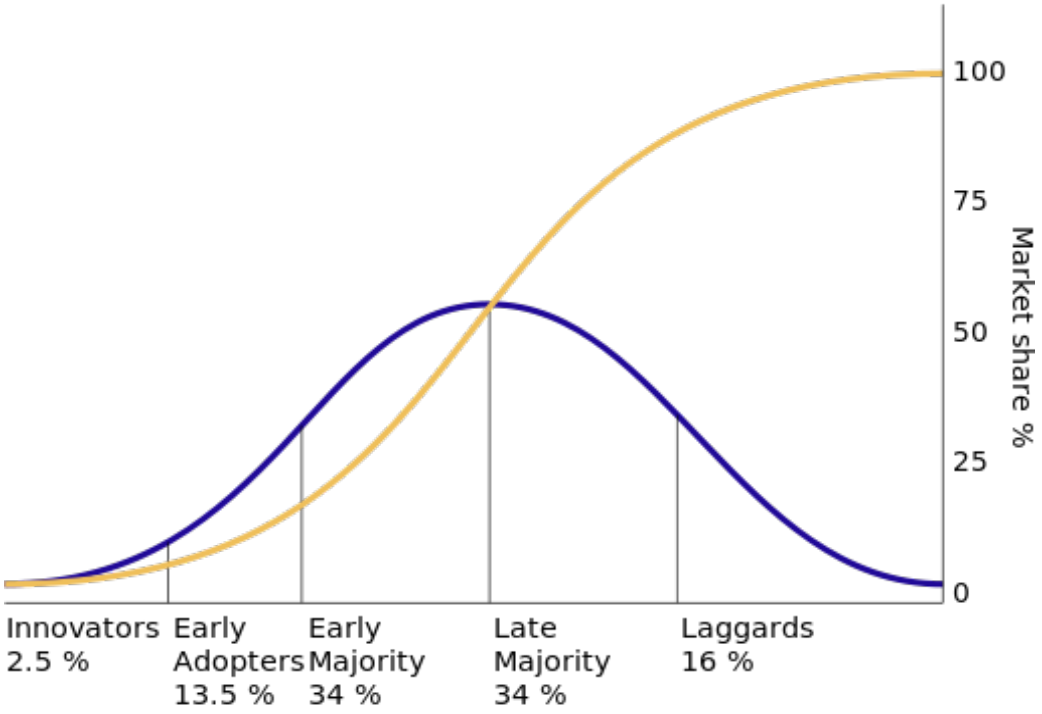
to decide whether this is for you?") and the analogy graphic ("What is your general reaction to this analogy?" "What questions do you have?"). On a 1-5 scale, participants rated each of the four terms in terms of their appeal, descriptiveness, differentiation from conventional meat, and differentiation from plant-based meat. Higher scores indicate more positive responses (i.e., for appeal, 1 = not at all appealing, 2 = somewhat appealing, 3 = moderately appealing, 4 = very appealing, 5 = extremely appealing).

CONSUMER SEGMENTATION RESULTS

Analysis of open-ended responses indicated that consumers could be segmented into three main groups: enthusiastic supporters (18%), those in the skeptical but intrigued middle (68%), and those opposed on moral grounds (14%). In light of the emergence of these three groups, we recommend targeting the largest and most malleable consumer segment: the skeptical but intrigued group in the middle. In the Diffusion of Innovations framework (see Figure 1; Rogers, 2003), these consumers are likely to represent the early and late majority segments. The enthusiastic supporters are excited and comfortable with change; they are likely to be the innovators and early adopters. Individuals in the opposition segment are resistant on moral grounds and are less likely to be influenced by messaging.

Figure 1 shows the (blue) bell curve of the typical distribution of a population across adopter categories. This normal distribution is typically observed across different innovation contexts - as long as they are successful. The (yellow) S curve shows the increasing market share as successive groups of consumers adopt the innovation.

Figure 1. Adopter categorization on the basis of innovativeness



Source: Wikimedia Commons. Based on Rogers, E. (1962). Diffusion of innovations. London, NY: Free Press.

For each group, we used a Diffusion of Innovation lens to briefly describe what is known about each type of consumers. We then follow with a summary of each category's typical responses.

1. Enthusiastic supporters: Innovators and early adopters consumer segment (18%)

Group description (based on analysis of open-ended responses):

- The enthusiastic consumers are already supportive or quickly became supportive after learning about the technology.
- This consumer group didn't feel like they needed more information to know whether the products were right for them.

Exemplary comments:

- "I think it is brilliant, and solves many of the central objections that have been raised regarding the sustainability of current agricultural production."
- "I think it sounds great and I am excited for the technology."
- "I love it. I am hopeful we can stop the slaughter of millions of animals, stop deforestation, and find more productive uses for land."
- "I think it is a good idea to help address the need for more food with less animals killed."

Effective influence strategies (Diffusion of Innovations framework):

- Innovators desire novelty and their interest is easily sustained. Simply raising awareness is the best way to influence the innovators.
- Early adopters are often thought leaders in their community and are comfortable with change. Again, convincing this group is not necessary, but explaining the new technology in understandable ways and showing them ways to implement it is helpful.

2. Skeptical but intrigued middle: Early and late majorities consumer segment (68%)

Group description (based on analysis of open-ended responses):

- Consumers in the middle group were a bit skeptical and sometimes had a slight disgust response, but were overall intrigued by the benefits offered by the technology.
- This consumer group expressed interest as well as a strong desire for more information.
- The most common types of information desired by this group were related to the product's taste, affordability, and safety for humans.

Exemplary comments:

- "Cool but weird."
- "This sounds kinda freaky, but I'm on board."
- "At first I was skeptical about cultivated meat but after the process was compared to what happens in a greenhouse and it was mentioned that it would require the use of less natural resources I felt a bit more positive about the process. Also, noting that the FDA and USDA would jointly regulate to ensure safety I felt way more positive about cultivated meat and would/will consider purchasing and consuming."
- "My reaction is mostly positive. While this is definitely an unconventional way to produce meat and seems a little weird, it sounds like it's cheaper and better for the environment than the traditional method of raising cattle."

- "I think it is an interesting concept. I can see how it could be valuable but I think it sounds very weird and would be hard for me to get used to."

Effective influence strategies (Diffusion of Innovations framework)

- Individuals in the early majority take time to consider the decision to change and need evidence of the innovation's worth. Conversion stories are often effective for this group. They need to try the innovation for themselves before committing.
- The late majority members are described as skeptical. Though reluctant to change, they will adopt an innovation after it becomes more observable and is the social norm. Influencing this segment involves demonstrating observable benefits, such as taste, price, safety, and social acceptance.

3. Opposed on moral ground: Laggards consumer segment (14%)

Group description (based on analysis of open-ended responses):

- The opposed consumers had visceral, values-based negative responses.
- This group's opposition was primarily based on religious grounds, but a smaller sub-segment was opposed based on naturalness unrelated to religion.
- This consumer group did not express any openness to learning more.

Exemplary comments:

- "I don't think this is okay. It's like playing with what God intended when it comes to animals and food."
- "Too close to playing God in my opinion."
- "That is not within the boundaries of what should be done, gross."
- "There is no way I would eat this unless it is the last food on Earth. It does not matter how well it is monitored or regulated."
- "The intellectual concept make sense but it is so unnatural according to the laws of nature that I am sickened by it... Thanks for the nightmare."

Effective influence strategies (Diffusion of Innovations framework)

- The laggard group is more traditional and extremely avoidant of change.
- Influencing this group requires showing how the innovation is in alignment with the group's values and experiences.

NARRATIVE RESULTS

Overall the narrative was well received by the "enthusiastic supporters" and the "skeptical but intrigued middle". The responses in this latest round of testing indicated that the narrative was on-target in terms of revisions requested by consumers in previous rounds of testing. Whereas consumers previously interpreted the narrative as oversimplified, lacking sufficient science information, and having too much of a marketing feel, the consumers in this latest round of testing experienced the narrative to be on-target in terms of the depth and type of information needed.

ANALOGY RESULTS

Overall the analogy was also well received by the "enthusiastic supporters" and the "skeptical but intrigued". In general, the comparison between plant cultivation and meat cultivation successfully anchored the new concept in a familiar idea, making it more understandable for these consumers. However, many did not see the analogy as a perfect comparison between plants and animals. Consumers felt there was more complexity involved in cultivating meat, and they desired more information about the production process. One way to meet consumers' stated needs for more information would be to change the visual from a

static graphic to an interactive infographic, in which interested readers can easily click and access more detailed information as desired on a topic-by-topic basis.

Exemplary positive reactions:

- "It seems nice and simple and not gross."
- "This is a good analogy because it is simple and takes something that people can easily understand in order to explain something new that people might be skeptical about. It normalizes something novel and probably would make people more willing to accept it."
- "Makes the concept totally understandable."
- "It is simple and logical. Does not make the process seem that scary."

Exemplary neutral and negative reactions:

- "Makes sense.. kinda."
- "This analogy seems good. The animal part seems much more technological but I'm sure that is because of the newness of the science."
- "The idea is there, but I don't think meat works the same way as plant cuttings."
- "Taking a cutting from a plant is understandable. To do the same with an animal, you would have to take a leg and stick it in the ground. It's just not the same."
- "It's not perfect because a plant cutting just creates a new plant, as compared to cow cells tuning into just meat without the animal."

NOMENCLATURE RESULTS

We tested four names in this final step of nomenclature testing: *cultivated meat*, *cell-cultured meat*, *cell-based meat*, and *cultured meat*. The four primary criteria were: 1) appeal, 2) the neutrality of the term for multiple stakeholder groups, 3) descriptiveness, and 4) ability to differentiate the category from conventional and plant-based meat. The names were selected based on these criteria after several ideation and empirical testing cycles, including four quantitative assessments and four qualitative assessments. Below are the consumer ratings from this final testing phase.

- Appeal:
    - The names *cultivated meat* and *cultured meat* were somewhat to moderately appealing to consumers.
    - *Cell-based meat* and *cell-cultured meat* were close to somewhat appealing to consumers.

- Descriptiveness:
    - *Cultivated meat* and *cultured meat* were moderately descriptive.
    - *Cell-based* and *cell-cultured* were moderately to very descriptive.

- Differentiation from conventional meat:
    - *Cultivated*, *cell-based*, and *cultured* were moderately differentiating.
    - *Cell-cultured* was moderately to very differentiating.

- Differentiation from plant-based meat:
    - All terms were moderately differentiating.

Table 1. Mean Name Criteria Ratings from GFI May 2019 survey

	Cultivated	Cell-based	Cell-cultured	Cultured
Appeal	2.73	1.83	1.74	2.50
Accurately descriptive	3.27	3.50	3.70	3.04
Differentiates from conventional meat	2.86	3.27	3.51	2.90
Differentiates from plant-based meat	2.78	3.06	3.21	2.86

Note: All measures were rated on the following scale:
1 = "not at all", 2 = "somewhat", 3 = "moderately", 4 = "very", and 5 = "extremely".

Comparison of 2019 Nomenclature Results to 2018 Survey Study

Multiple terms are currently in use by cellular agriculture companies, scientists, and advocacy groups. For comparison purposes, we note in Table 2 appeal and descriptiveness ratings of key names from GFI's 2018 nomenclature study. An important difference between the two studies was that participants in the 2018 study read a brief product description prior to rating the terms, whereas participants in the 2019 study read the meat cultivation narrative and viewed the graphic analogy.

Table 2. Comparison of Name Criteria Ratings from 2018 and 2019 Survey Studies

	Cultivated	Cell-based	Cell-cultured	Cultured	Clean**	Slaughter-free**
2018 Appeal*	2.27	1.91	1.85	2.30	3.03	2.63
2019 Appeal	2.73	1.83	1.74	2.50	-	-
2018 Descriptive*	3.41	3.94	3.88	3.20	2.80	3.78
2019 Descriptive	3.27	3.50	3.70	3.04	-	-

Notes:
All measures were rated on the following scale:
1 = "not at all", 2 = "somewhat", 3 = "moderately", 4 = "very", and 5 = "extremely".

**Participants in the 2018 study were exposed to the following description: "One recent breakthrough in food innovation allows us to produce meat in a new way. This meat is identical at the cellular level to conventional meat. This meat is real meat grown directly from animal cells. It is produced in a clean facility, similar to a brewery. The process does not involve raising and slaughtering farm animals. The final product has an identical taste and texture to conventional meat. This type of meat offers significant benefits for human health, the environment, and animal welfare. Several companies have already successfully produced and taste-tested this type of meat. The products will be available for retail purchase in 1-5 years."*

***Although clean meat and slaughter-free meat both performed well in appeal, they were not selected for further testing in the current project due to not meeting the neutrality criterion.*

Recommended Communication Strategies

The project group recommends the adaptation and use of two communication tools: a narrative and graphic visual. These tools completed the cycles of ideation, application of science communication theory, message design, and empirical testing. The tools can be adapted to meet the needs of individual organizations. For instance, cellular agriculture companies may want to add a message source from their organization (i.e., add characters to the narrative), taking care to demonstrate expertise in the topic and shared interest with the audience. Educational groups, advocacy groups, or regulatory agencies could also adapt and utilize these tools. The graphic visual could be adapted to become an interactive infographic to allow for more detailed information as needed.

Tool 1: Narrative

Meat Cultivation: Embracing the Science of Nature
We can now diversify and bolster the protein supply by producing meat in a new way. Rather than raising and slaughtering animals, we can cultivate meat. This is done by starting with the basic building block of all life - the cell.

Beginning with a small sample of animal cells, we can directly grow the cells into the same meat, poultry, and fish products we enjoy eating today. In conventional animal farming, cell growth occurs in an animal. But we can grow the same cells in what's known as a cultivator.

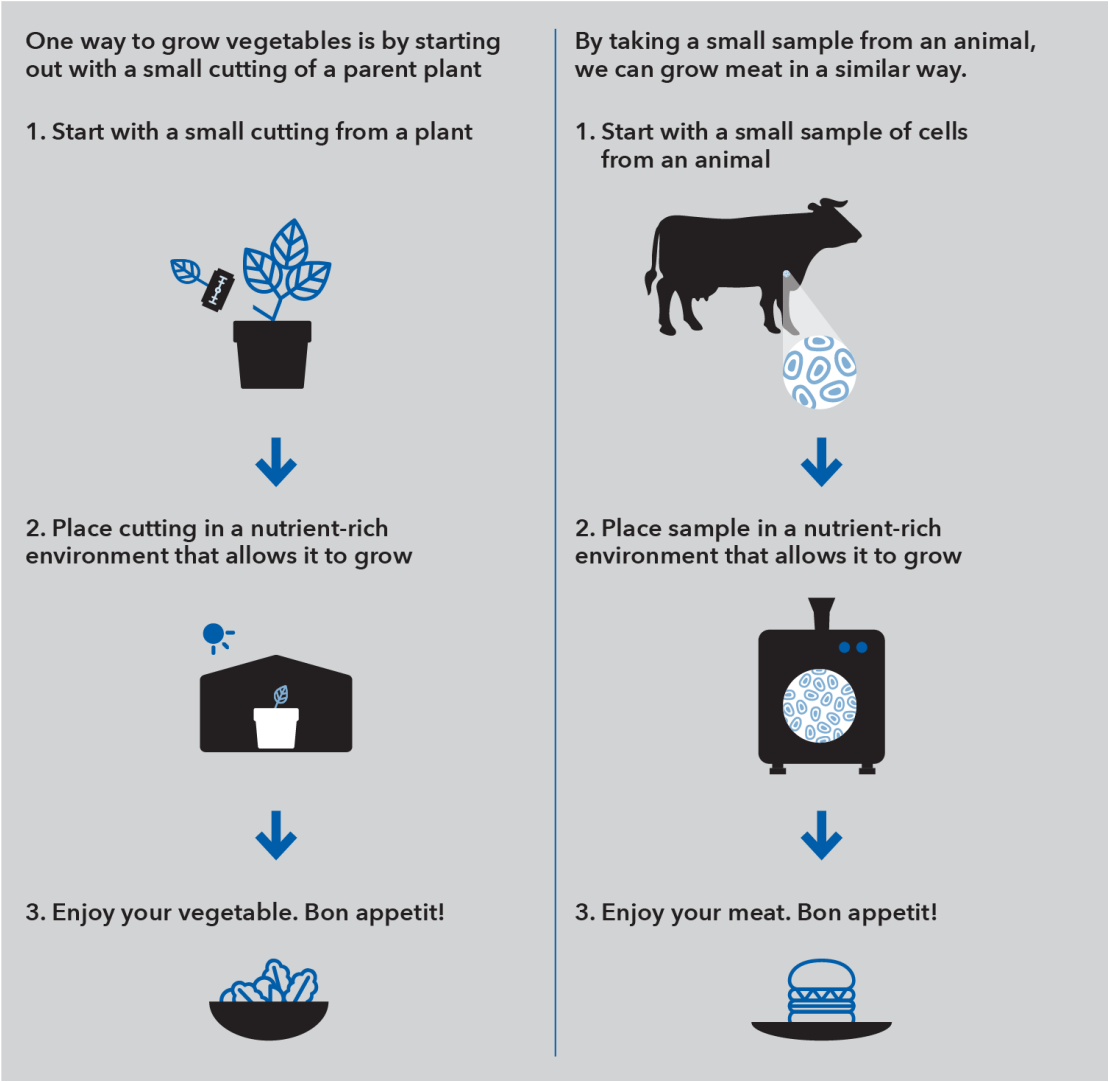
The cultivator facilitates the same biological process that happens inside an animal by providing warmth and the basic elements needed to build muscle: water, proteins, carbohydrates, fats, vitamins, and minerals. Cultivating meat is similar to the way we help plant cuttings to take root in a greenhouse that provides warmth, fertile soil, water, and nutrients.

This new method of meat production harnesses the wonders of nature but does it in a different environment. The result is an abundance of pure meat, identical to conventional meat at the cellular level. It looks, tastes, and cooks the same.

Compared to conventional meat production, meat cultivation requires only a fraction of the natural resources, decreasing the rate of methane emissions, deforestation, antibiotic resistance, biodiversity loss, and foodborne illnesses. Because this new method of production requires fewer resources, it should ultimately be possible to cultivate meat at a lower cost.

Innovators around the world are working to bring this new way of producing beef, poultry, pork, fish, and seafood to market at a competitive price point. The FDA and the USDA will jointly regulate and ensure the safety of this new form of meat production in the United States.

Tool 2: Graphic Representation of the Cultivation Analogy



Benefits and Challenges with Nomenclature Choices

Our project involved several phases of nomenclature ideation and testing. We agreed upon four primary criteria for the category name: 1) appeal, 2) the neutrality of the term for multiple stakeholder groups, 3) descriptiveness, and 4) ability to differentiate the category from conventional and plant-based meat. Each name meets the neutrality criteria essential for gaining acceptance among stakeholder groups but poses benefits and challenges with respect to consumer appeal and descriptiveness/differentiation. Please refer to Table 1 for the mean name criteria ratings in the GFI May 2019 survey results section.

USE OF CULTIVATION LANGUAGE

In addition to these criteria, project members agreed that successful nomenclature would best emerge from the creation of a successful narrative rooted in evidence-based communication strategies. As discussed in the review of the science communication literature, bringing an emerging technology to market requires a different strategy than marketing existing

food products. The use of narrative is a key framing strategy, since information about novel technologies must be presented in a format that actively engages thought and aids consumers in incorporating the new information into their existing belief and value systems. Consumer acceptance of newly emerging science topics is best driven by messaging that builds trust and credibility. This can be achieved through transparency and acknowledging uncertainties, demonstrating shared interests and the expertise of the message source, and anchoring the unfamiliar in already understood concepts.

Using these principles, the project group created a narrative and visual message with consideration for the target audience ("skeptical but intrigued middle"). The project group agreed that framing messages around the idea of meat cultivation was neutral, appealing, descriptive, and familiar. The following are examples of language choices in the narrative that engage the familiar and appealing concept of cultivation:

- Rather than raising and slaughtering animals, we can cultivate meat.
- But we can grow the same cells in what's known as a cultivator.
- The cultivator facilitates the same biological process that happens inside an animal by providing warmth and the basic elements needed to build muscle: water, proteins, carbohydrates, fats, vitamins, and minerals.
- Cultivating meat is similar to the way we help plant cuttings to take root in a greenhouse that provides warmth, fertile soil, water, and nutrients.

Whether or not the term "cultivated meat" is selected as a category descriptor, we recommend the broader use of cultivation-related language as a way to bring this category to market in an understandable, familiar, and appealing way that resonates with consumers.

ADDITIONAL FACTORS NECESSARY FOR MARKET SUCCESS

Ideally a name would meet all four criteria, optimizing appeal while also achieving necessary levels of neutrality, descriptiveness, and differentiation from conventional and plant-based meat.

It is also useful to consider the most important target audience when considering a name. In this project, we identified the "skeptical yet intrigued middle" as the most crucial for diffusing this new innovation through society. This early and late majority consumer segment expressed a strong desire for transparency and straightforward scientific information in messaging. From this standpoint, selecting a technical name (*cell-cultured meat*, *cell-based meat*) may have utility in building their consumer acceptance, even though the name itself is not as immediately appealing as other name options (*cultivated meat*, *cultured meat*).

In addition to taste and price, safety concerns were high for this group. Selecting a name that matches commonly used regulatory terms (and down the line, labeling terms on product packages) may also contribute to greater consumer acceptance (and generate less confusion).

Due to the established use of the term *cultured fish* in the aquaculture fishing industry, we view the terms *cultivated*, *cell-cultured* and *cell-based* as more viable names as they are applicable to all types of meat produced through cellular agriculture (beef, pork, poultry, fish and seafood).

In Table 3, we note the benefits and challenges associated with each name.

Table 3. Summary of benefits and challenges with name choices

Category Name	Cultivated Meat	Cell-cultured Meat	Cell-based Meat	Cultured Meat
Products	Cultivated beef, pork, poultry, fish, and seafood	Cell-cultured beef, pork, poultry, fish, and seafood	Cell-based beef, pork, poultry, fish, and seafood	Cultured beef, pork, poultry N/A: cultured fish and seafood*
Benefits	Cultivation is a trusted, understandable, and familiar concept that flows well with the narrative and analogy.	Cell-cultured is an established name in the scientific community and used in regulatory literature.	Cell-based is an established term in the cellular agriculture industry and used by advocacy groups.	Cultured is an established term used by academic and advocacy groups and used by one cellular agriculture company.
	Cultivated meat scored moderately descriptive and differentiating.	Cell-cultured scored highest in descriptiveness and differentiation from other types of meat.	Cell-based scored moderately descriptive and differentiating from other types of meat.	Cultured scored moderately descriptive and differentiating from other types of meat.
	In both qualitative and quantitative assessments, cultivated scored highest in consumer appeal. Focus groups participants stated that this term presented no confusion with plant-based meat.	A transparent, technical name may generate acceptance for the target consumer segment.	A transparent, technical name may generate acceptance for the target consumer segment.	Cultured was somewhat to moderately appealing. A transparent, technical name may generate acceptance for the target consumer segment.
Challenges	Though cultivated meat was moderately descriptive and differentiating from other types of meat, cell-cultured and cell-based scored higher.	Cell-cultured is lower in appeal and would need to be balanced with other familiar and appealing messaging strategies.	Cell-based is lower in appeal and would need to be balanced with other familiar and appealing messaging strategies.	Cultured meat presents some challenges as it is a duplicate food term (e.g., cultured yogurt, cultured fish). *Cultured fish is an established term in the aquaculture industry and therefore is not a viable name for fish and seafood produced through cellular agriculture.

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About GFI

The Good Food Institute is a global nonprofit building a sustainable, healthy, and just food system. Our scientists, entrepreneurs, lawyers, and policy experts are harnessing the power of food innovation and markets to accelerate the transition of the world's food system to plant-based and cell-based meat, eggs, and dairy.