

MEAT THE FUTURE

CURRICULUM RESOURCE

PRESENTED BY



SPONSORED BY



Nova Scotia
Teachers Union



MARA
RENEWABLES CORPORATION™

CURRICULUM BY

.....

Mrs. Krista LeBlanc

IB Biology HL
Biology 11/12
Food Science 12

MEAT THE FUTURE

A DOCUMENTARY BY LIZ MARSHALL | AVAILABLE TO STREAM ON [CBC GEM](#)
2020 | UNITED STATES | 88 MINUTES | [TRAILER](https://meatthefuture.com/trailer/)

TEACHER'S GUIDE

This curriculum resource will guide teachers and students to enrich their viewing experience of the 2020 documentary *Meat the Future*. This resource is designed to help teachers frame discussions with their class, with viewing and post-viewing activities for the film as well as an assignment relating to the themes of the film that can be completed after viewing.

ABOUT THE FILM

Meat the Future is a timely documentary about “cell-based” meat, also referred to as “cultivated” meat, a food science that grows real meat from animal cells in a controlled and clean environment; a revolution in food production, proposing a sustainable way to feed the world in the future without the need to breed, raise and slaughter animals.

At the forefront of this urgent new frontier is cardiologist Dr. Uma Valeti, the co-founder and CEO of Memphis Meats, one of the leading start-ups in the field. From a meatball which cost \$18,000 per pound in 2016 to the world’s first cell-based poultry in 2017 for half the cost, the film follows Valeti over three years as the cost of production continues to plummet and consumers eye the birth of this industry.

Source: <https://meatthefuture.com/synopsis/>

ABOUT THE FILMMAKERS

Liz Marshall is an award-winning Canadian filmmaker. Since the 1990s she has written, produced, directed, and filmed diverse international and socially conscious documentaries.

Her work has been released theatrically, been broadcast globally, made available digitally, and has screened for hundreds of grassroots communities around the globe. Marshall’s visionary feature-length films explore social justice and environmental themes driven by strong characters.

Source: <https://meatthefuture.com/film-team/>



ECONOMICS 11 - LEARNING OUTCOMES ATTACHED TO THE FILM *MEAT THE FUTURE*

SPECIFIC CURRICULUM OUTCOME	OUTCOME STATEMENT
<p>SCO 18: Students will be expected to analyse the relationship of Economics and Environmentalism</p>	<p><i>Connections to GCOs and KSCOs In the course of working towards attainment of this SCO, students will be working towards attainment of the following GCOs and KSCOs (Individuals, Societies and Economic Decisions).</i></p> <p>GCOs:</p> <ul style="list-style-type: none"> • Demonstrate an understanding of the rights and responsibilities of citizenship and the origins, functions, and sources of power, authority and governance (Citizenship, Power, and Governance) • Demonstrate an understanding of culture, diversity, and world view, recognizing the similarities and differences reflected in various personal, cultural, racial, and ethnic perspectives (Culture and Diversity) • Demonstrate the ability to make responsible economic decisions as individuals and as members of society (Individuals, Societies, and Economic Decisions) • Demonstrate an understanding of the interdependent relationship among individuals, societies, and the environment - locally, nationally, and globally - and the implications for a sustainable future (Interdependence) <p>KSCOs: <i>By the end of Grade 12, students will have achieved the outcomes for entry-grade 9 and will also be expected to:</i></p> <ul style="list-style-type: none"> • Analyse how economic decisions are made by individuals, organizations, and government, based on scarcity and opportunity cost • Assess the role played by economic institutions and examine their impact on individuals and on private and public organizations • Evaluate the differences among traditional, command, and market economic systems and explain the development of “mixed” economies • Evaluate factors that influence the distribution of wealth locally, nationally, and internationally • Apply knowledge of economic concepts in developing a response to current economic issues such as disparity and sustainability • Evaluate the consequences of the consumer oriented society • Identify the criteria that one might use to judge the health or success of the economy

IB BIOLOGY HL 12 - LEARNING OUTCOMES ATTACHED TO THE FILM *MEAT THE FUTURE*

TOPIC	OUTCOME STATEMENT
<p>1.1.U7 The capacity of stem cells to divide and differentiate along different pathways is necessary in embryonic development and also makes stem cells suitable for therapeutic uses.</p>	<ul style="list-style-type: none"> • Define zygote and embryo. • List 2 key properties of stem cells that have made them on the active areas of research in biology and medicine today. • Explain why stem cells are most prevalent in the early embryonic development of a multicellular organism.
<p>1.1.A4 Ethics of the therapeutic use of stem cells from specially created embryos, from the umbilical cord blood of a newborn baby and from an adult’s own tissues.</p>	<ul style="list-style-type: none"> • Discuss the benefits and drawbacks in using adult stem cells. • Discuss the benefits and drawbacks in using embryonic stem cells. • Discuss the benefits and drawbacks in using cord blood stem cells.
<p>4.4.U1 Carbon dioxide and water vapor are the most significant greenhouse gases.</p>	<ul style="list-style-type: none"> • State the sources of CO₂ and water vapor in the atmosphere. • Outline the mechanism by which greenhouse gases trap heat in the atmosphere.
<p>4.4.U2 Other gases including methane and nitrogen oxides have less impact.</p>	<ul style="list-style-type: none"> • State the sources of methane and NO gases in the atmosphere.

IB BIOLOGY HL 12 - LEARNING OUTCOMES ATTACHED TO THE FILM *MEAT THE FUTURE* (CONTINUED)

TOPIC	OUTCOME STATEMENT
4.4.U3 The impact of a gas depends on its ability to absorb long wave radiation as well as on its concentration in the atmosphere.	<ul style="list-style-type: none"> State two factors that determine the warming impact of a greenhouse gas. State two variables that determine the concentration of a gas in the atmosphere. Compare the impact of atmospheric methane to CO₂. State how long water, methane and CO₂ remain in the atmosphere, on average.
4.4.U6 Global temperatures and climate patterns are influenced by concentrations of greenhouse gases.	<ul style="list-style-type: none"> Explain why atmospheric CO₂ concentration would logically impact global temperatures. Outline the effect of global temperature on climate, specifically location and frequency of rain and frequency of severe storms.

FOOD SCIENCE 12 - LEARNING OUTCOMES ATTACHED TO THE FILM *MEAT THE FUTURE*

UNIT	OUTCOME STATEMENT
Food Constituents	<p>Protein:</p> <ul style="list-style-type: none"> 1.5 Describe the structure of proteins found in various foods, including essential amino acids
Preservation Factors	<p>Food Microbiology and Food Safety: Preservation Microbiology:</p> <ul style="list-style-type: none"> 2.3 Describe the role that processing and food additives play in eliminating, inhibiting, or delaying the growth of spoilage microorganisms
	<p>Food Microbiology and Food Safety: Food Safety Microbiology:</p> <ul style="list-style-type: none"> 2.4 Explain simple measures that can be taken to keep foods safe 2.5 Explain how viruses, bacteria, moulds, and parasites can cause disease
Food Quality and Commodities	<p>Food Commodities:</p> <ul style="list-style-type: none"> 3.1 Analyze the properties of specific food commodities 3.2 Select and use different resources and materials to collect information about their commodity 3.3 Devise and conduct an experiment on their commodity
	<p>Food Quality:</p> <ul style="list-style-type: none"> 3.4 Identify psychological factors used to market and develop food products 3.5 Collect and compare sensory data
	<p>Product Development - Schemes and Stages:</p> <ul style="list-style-type: none"> 3.6 Explain how well a product is designed to meet consumer wishes
Food Packaging	<p>Food Packaging and Food Labels:</p> <ul style="list-style-type: none"> 4.1 Explain the functions and considerations for food packaging 4.2 Identify and explain the information required for labels on food products made in Canada
	<p>New Food Product:</p> <ul style="list-style-type: none"> 4.3 Design, develop, make, and present a food product identifying and anticipating major variables that may impact on the final quality of the product

GLOBAL GEOGRAPHY 12 - LEARNING OUTCOMES ATTACHED TO THE FILM *MEAT THE FUTURE*

UNIT	OUTCOME STATEMENT	RELEVANT THEMES
Feeding the Planet: Food for Thought	<p>4.2 The Harvester: Humanity's Quest for Nourishment Objective:</p> <ul style="list-style-type: none"> To examine the nature and distribution of humanity's effort to harvest the land and sea in order to feed itself. <p><i>NOTE: It is critical that students appreciate the role of culture in humanity's search for food. There are many influences—religion, history, gender roles, land/human interaction, etc., that combine to create cultural perspectives that govern the quest for nourishment (see 4.2.1, 4.2.4 and 4.2.5).</i></p>	<p>4.2.1 The Culture Factor Primary Theme: Culture</p> <ol style="list-style-type: none"> Land/ocean within cultural settings Cultural landscaping: irrigation, terracing, damming, breakwaters, etc. Harvester roles: women and men, children Tastebuds: the cultural menu <hr/> <p>4.2.2 Crops and Grazing Land Primary Theme: All</p> <ol style="list-style-type: none"> Type of area Distribution <hr/> <p>4.2.3 Ocean Shoals Primary Themes: Location, region, pattern</p> <ol style="list-style-type: none"> Distribution Importance of oceans as a protein source <hr/> <p>4.2.4 Production for the Global Larder Primary Themes: Culture, human/environment interaction, region</p> <ol style="list-style-type: none"> Various types of harvesting methods <ul style="list-style-type: none"> Hunter/gatherer Slash and burn Labour intensive agriculture Capital intensive agriculture <hr/> <p>4.2.5 Distribution and Consumption Leading to Hunger and Glut Primary Themes: Culture, pattern, region, spatial interaction, location</p> <ol style="list-style-type: none"> Eating to live and living to eat Haves versus have-nots Agribusiness (cash crops versus local use) Related health problems Political problems
	<p>4.3 The Land/Ocean Crisis Objective:</p> <ul style="list-style-type: none"> To research and analyze crisis facing lands and oceans today. 	<p>4.3.5 Genetic Erosion Primary Themes: Human/environment interaction, culture</p> <ol style="list-style-type: none"> Animals: disappearing species (reasons) Plants: disappearing species (reasons) Relationships: animal, plant, and human Genetic engineering: a mixed blessing and who decides? <ul style="list-style-type: none"> livestock productivity wild and domestic: the urge to improve or tamper?

BEFORE VIEWING THE FILM...

Before we begin write a few jot notes down about the following questions, we will circle back to these questions during the film and in our post film activities:

- *What is meat?*
- *Where does meat come from?*
- *Are we currently able to feed the world's population?*
- *What risks do you see with our global food trends?*
- *What does food sustainability look like?*

INTRODUCTION

Meat the Future pushes our imagination to consider feeding the world using “Clean Meat” produced using cell growing technology. Scientists estimate that 45% of the world’s landmass is used to grow cattle/chickens and other animal live-stock or animal feed for human consumption. Rearing cattle produces more greenhouse gas than cars! The film follows Dr. Uma Valeti, the brains behind Memphis Meats who encourages us to consider a world that is meat inclusive but does not require slaughter. As you watch the film, consider the following: Would you invest in Memphis Meats? How would the world look if cell based meat was delicious, affordable, and sustainable?

1) Outline how stem cell tissues are used to yield high amounts of meat.

2) What is “cellular agriculture”?

- 3)** Uma has a diverse team of people who are working at Memphis Meats: chefs, geneticists, biologists with specialties in urban agriculture, food packaging developers, publicists, paralegals, enterprise program managers, mechanical engineers, quality control specialists, regulatory affairs managers, sensory scientists and software engineers. These titles are certainly more specific than farmer! As you watch, which role would you like to have in this innovative food production team?

- 4)** Uma states that we “are at the edge of human knowledge and looking at the food industry to change”. What connections do you see between science, technology and sustainable food production?

- 5)** What major arguments are presented between the FDA and the USDA for the introduction for cell based meat research? Research if Canada has any limitations on cell based meat production.

- 6)** In the movie we hear that the richer the world becomes, the more meat it eats. Why would Tyson Food Conglomerate brand be interested in a venture capitalist investment with Memphis Meats?

- 7)** Do you believe that cell based meat is a solution the world is looking forward to? Explain.

- 8)** It is estimated that it will take 20-30 years to advance food technology to make cell based “Clean Meat” a competitive product on the market for authentic meat. The movie echoes that the time to incorporate ethics into your food choice is now. Do you agree with this statement? How do you incorporate food ethics into choices on your daily plate?

9) At the Good Food Meat Conference, we hear from doctors that cell based meat will result in fewer zoonotic diseases for humans. What other benefits come from consuming meat that is grown in a lab rather than grown on a farm?

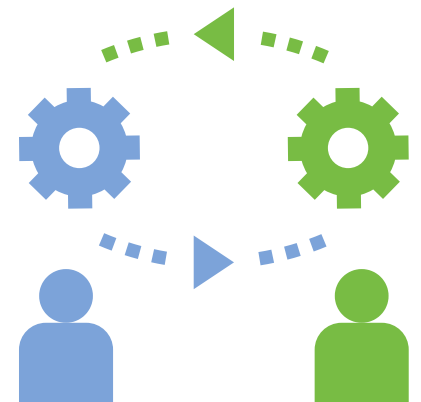
10) One hour into the film, Uma Valeti compares the growing time for cell-based meat to traditional meat that is grown on a ranch. Are you impressed with the notable difference in grow times for cell based meat? How will this decrease in time from lab to table ripple into an environmental impact?

11) “There is an intense need for food and we need to do more with less, we need to grow nutrient dense food with less resources to get meat.” What lasting impressions do you have of cell based meats from the film?

POST-VIEWING REFLECTION

Now that you have completed watching the film, return to the original 5 guiding questions we started with.

How has your thinking shifted as a result of this film? Have you experienced a paradigm shift?



INTRODUCTION

Imagine that it is 2040 and you are living in Nova Scotia. You are a successful career person with an expertise in an area of either science, business, medicine, etc. As you are well respected in the community, you have been invited to participate in a town hall meeting that will help your community decide whether to be an expansion location for a Memphis Meats, a “Clean Meat” facility, in the large vacant land close to your town. The Memphis Meats facility will bring technology and science rich jobs to your community, but many farmers in Nova Scotia are skeptical that they won't be able to operate should this development happen.

You are one of the many experts that have been asked to gather and express your opinions. You have arranged to consult with your colleagues and come with a decision for the following class. Please gather as a team, prepare your arguments and thoughts and be prepared to respectfully voice your support or concerns about the addition of the Memphis Meats on Nova Scotia grounds. Keep in mind that it is 2040, and cell based meat technology has been able to come to market at the same retail value as traditional meat products.

Working together with your colleagues, you must decide whether bringing Memphis Meats to Nova Scotia is in the best interests of everyone. You must be ready to argue your position and back-up your facts with evidence.

The elected mayor of the town will moderate the town hall. You and your classmates will be assigned a role for this activity, and will work in interest groups. Remember that the bulk of your research should be related to the role you are assigned to. It would be beneficial for your team to divide the research evenly and share the key points with one another. This worksheet has been designed to help guide your research.

Please prepare at least three arguments in support of your opinion(s), and be prepared with counter-arguments against those opposing your opinion. Bring all group work/paperwork to class tomorrow. You may also be asked to respond to questions, so everyone in the group should be comfortable with the information you find.

Potential Roles: Conservationist, Biologist, Nourish Nova Scotia, Nova Scotia Federation of Agriculture (NSFA), Nova Scotia Cattle Producer, 4H Group, Doctor (with specialties in zoonotic diseases), Geneticist, Gardener, Fishers of Nova Scotia Coalition, Innovacorp (early-stage venture capital), Hotel Chef, Director of Tourism Nova Scotia, Local Community Member, Town Mayor, Centre for Women in Business/Women in STEM Group, Ulnooweg Indigenous Business Services

Group Member Names: _____

Community Job / Group Title: _____

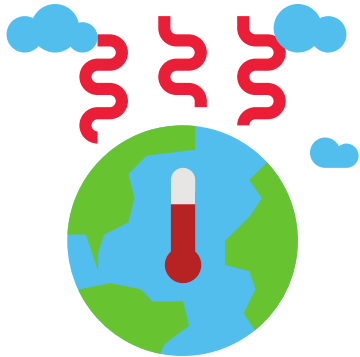
Are you FOR or AGAINST Memphis Meats developing a facility in Nova Scotia? _____



**MEMPHIS
MEATS**

BACKGROUND INFORMATION

- 1) What is "Clean Meat" or cell-based meat?
- 2) Where does it come from?
- 3) How does it grow?
- 4) How is it harvested?
- 5) What is the role of clean meat in the ecosystem?
- 6) How will Memphis Meats contribute to/decrease the greenhouse effect?
- 7) How does clean meat impact the human populations?
- 8) Does it carry diseases or pathogens?
- 9) What is the history/rationale for cell-based meat?
- 10) Aside from beef, what other types of meat does Memphis Meats manufacture?
- 11) What ethical considerations should be noted when selecting to purchase and eat clean meat versus traditional farm raised meat products?
- 12) Why is meat/protein important for human growth and development? How much protein would you need to consume per day?
- 13) How much protein is required per day to feed the planet?



IMPACT OF GREENHOUSE EFFECT & GLOBAL WARMING / CLIMATE CHANGE CONNECTIONS

- 1) What is a greenhouse gas? What is the Greenhouse Effect?
- 2) Explain the relationship between the rise in concentrations of atmospheric carbon dioxide, methane and nitrogen oxides and global warming.
- 3) The oceans act as a natural carbon sink; what impact will selecting land meat consumption sources have on our ocean?
- 4) Why must we be reconsidering our consumption patterns of protein in 2040? Speculate what has changed with our local Nova Scotia ecosystems.

TECHNOLOGY

- 1) Is it possible to feed the world using clean meat? If yes, how? If no, why?
- 2) Is it ethical to use technology to increase food production to feed the planet? Do you think/believe there is a carrying capacity constraint to the planet?
- 3) Would clean meat be genetically diverse? Does your group think this is important?
- 4) Should you opt to have Memphis Meats build their clean meat plant, would Nova Scotians want to limit their carbon emissions? Would there be taxes on this company should they locate it in Nova Scotia?

ASSESSMENT

OUTCOME (BIOLOGY 12)	2	1.5	1	0.5	0
114-2	Support position with well-researched, academic evidence	Support position with good evidence	Support position with evidence, with lack of detail	Support position with some evidence, but did not include relevant details	Did not support position with evidence
118-6	Clearly establish opinion/ position with strong arguments	Clearly establish opinion/ position	Opinion/position somewhat unclear	Opinion/position is unclear	No attempt to establish opinion/ position
213-6	Use research tools to collect high-quality information from a variety of sources	Use research tools to collect information from a variety of sources	Use research to collect information	Did not collect sufficient information	Did not attempt to collect information
215-4	Actively listen to others' points-of-view and attempt to provide counter-arguments	Actively listen to others' points-of-view and attempt to engage in discussions	Listen to others' points-of-view and some participation	Not consistently listening or participating in discussion	Not listening or participating
316-3	Reference to Nature of Science (NOS), evolution, diversity and class content throughout argument	Some reference to NOS, evolution, diversity and class content throughout argument	Some reference to concepts from the class, with lack of explanation	Very little reference to concepts from class	No reference to class content

TOTAL SCORE: /10