Teacher handout for a class visit to the Wonders of Medicine exhibition

Theme: Genetic Engineering – A medical revolution?

Novartis Pavillon

1 Introduction

Theme: Genetic engineering – A medical revolution?

Target group: Secondary school students

Format: Group work

Location: Novartis Pavillon, St. Johanns-Hafen-Weg 5, 4056 Basel, Switzerland

Time required for the exhibition visit: about 60 – 90 minutes

Anregung für den Ausstellungsbesuch
Rationale for the exhibition visit

Learning environments outside the classroom can help inspire enthusiasm among students for science-related topics, open their minds to new ideas, and spark deeper pursuit of knowledge and understanding. The exhibition "Wonders of Medicine" covers multiple themes related to human biology and medicine. It awakens curiosity with creative use of storytelling and interactive technology. The exhibition can be a useful resource for teachers looking for ways to support instruction on topics ranging from human biology and scientific inquiry, to how powerful new technologies in medicine and healthcare could affect society. A general introduction to the exhibition is available online (insert link).

Learning objectives

This study guide focuses on the specific topic of genetic engineering. It directs teachers and students to specific installations in the exhibition that explore several aspects of genetic engineering in an engaging and accessible way. The exhibition allows students to learn how gene editing and gene therapies are sparking a medical revolution that could soon enable doctors to treat many illnesses at their genetic roots. Students can also review the historical milestones that led medical science to the latest breakthroughs in genetic engineering. And they have a unique opportunity to participate in a virtual discussion with two experts about the far-reaching ethical and societal implications of this new technology.

Links to the classroom

The exhibition covers the contents of the Swiss curriculum "Lehrplan 21" in the areas of nature and technology starting in the 9th grade. At upper secondary level the exhibition covers portions of the biology curriculum, among other topics.

The exhibition can also help build middle school students' general competencies for:

- Making independent, sophisticated, analytical arguments
- Properly use technical terms
- Writing scientific reports

The exhibition covers specific focus areas related to genetics and allows students to:

- Describe selected methods of genetic engineering and discuss examples where it is applied
- Discuss ethical and social aspects of genetic engineering based on recent examples

2 Preparing for a visit to the exhibition

Registration: At least two weeks prior to the visit, by email (pavillon.novartis@novartis.com)

Suggestions for the exhibition visit

Before the visit, the class can be split into groups of 3–4 students. Each group can be assigned a specific topic to focus on during the exhibition visit.

Students can review vocabulary they will encounter in the exhibition, for example by using the glossary available on the yourgenome.org website.

- Biotechnology
- DNA
- Embryo
- Genetic disease
- Gene
- Genetics
- Genetic code
- Genome
- Genetic engineering
- Gene therapy
- Immune system
- Germ line therapy
- Germ line cell
- Virus

yourgenome.org

3 The exhibition visit

- Arrive at the Pavillon; greeting, brief introduction to the exhibition and distribution of audio guides
- Students proceed to the theater and watch the film for a general introduction to human medicine and the exhibition
- Using maps of the exhibition floorplan (See appendix A), groups navigate to the installation for a specific topic selected from the list below and watch and/or listen to the narrative.
- After discussing what they learned, students create a 3- to 5-minute report (video, powerpoint, etc.) summarizing what they learned and including their personal perspective or commentary on the topic.

Specific topics for students

A

How gene editing and cell and gene therapies work

In the **"Future of Healthcare"** section of the exhibition

- "Humanity 2.0" – listen to the introduction to genetic engineering, then watch the deep dives on individual tablets on the following topics: gene editing, gene therapy and cell therapy

B

Ethical dilemmas of genetic engineering

In the **"Future of Healthcare"** section of the exhibition

- Discussion booth "Humanity 2.0" – Watch the introduction film with moderator Katja Reichenstein, then choose topic #3 and listen to the discussion, "Designer babies and the ethics of gene editing."

C

Personal and societal implications of genetic engineering

In the **"Future of Healthcare"** section of the exhibition

- Discussion booth "Humanity 2.0" – Watch the introduction film with moderator Katja Reichenstein, then choose topic #2, "Slowing ageing: Would you like to live to 150?

D

The milestones that led to genetic engineering

In the **"Steps through time"** section of the exhibition

- **Screen #3, 1799–1869** "The dawn of modern medcine" (Listen to these specific milestones: 1866, Gregor Mendel; 1869, DNA discovered)
- **Screen #6, 1950–1980** "Advancing Science bears fruit" (Listen to these specific milestones: 1953, Structure of DNA; 1961 Cracking the genetic code)
- **Screen #7, 1982–2011** "Breakthrough medicines" (Listen to these specific milestones: 1996, First cloned adult mammal; 2000, Human genome map)
- **Screen #8, 2012–today** "Age of cell and gene therapies" (Listen to these specific milestones: 2012, CRISPR gene editing tool; 2012, First gene therapy approved in the EU; 2017, First gene therapy approved in the USA; 2018, First cell therapy; 2019, Pioneering gene therapy

E

The genetic roots of some illnesses

In the **«Fragility of life»** section of the exhibition

Explore an example of a genetic disease (hemophilia) and how genetic mutations can play a role in causing some cancers

- Theme: Blood (Listen to the introduction and deep dive about hemophilia)
- Theme: Cells and cancer (Listen to the introduction and deep dive about breast cancer)
- Listen to the story of a breast cancer patient (in the third booth)

4 After the exhibition visit

Each team presents a report on their topic to the entire class, responds to questions and leads a brief discussion. This might be done in the multipurpose area on the ground floor of the Pavillon (must be reserved ahead of time!), or back in the classroom.

Possible questions for students to explore for individual topic areas

A

- What are gene therapies?
- Cell therapies?
- How does gene editing work?
- What types of illnesses can potentially be treated with these new types of therapies?
- How important do you think the field of genetic engineering will be in healthcare 20 years from now?

B

- What are some of the ethical questions related to genetic engineering?
- How should society address these questions?
- What might be some of the societal consequences of genetically designing babies to be smarter, stronger, or better looking?
- Do we need clear rules on how genetic engineering should (and should not) be used?
- How confident are you that society will be able to use this technology for good?

C

- Do you think genetic engineering will enable people to live to 150 years old in the near future?
- Why or why not?
- Would you want to live that long?
- Under what conditions?
- What impact would the ability to live that long have on society?
- On the way people live their lives?

D

- Which milestone in the history of genetics do you think is most important and why?
- Was there a “eureka moment” and why or why not?
- What does the history of genetics tell you generally about the nature of scientific progress?
- What do you think motivates scientists to persevere despite sometimes slow progress?

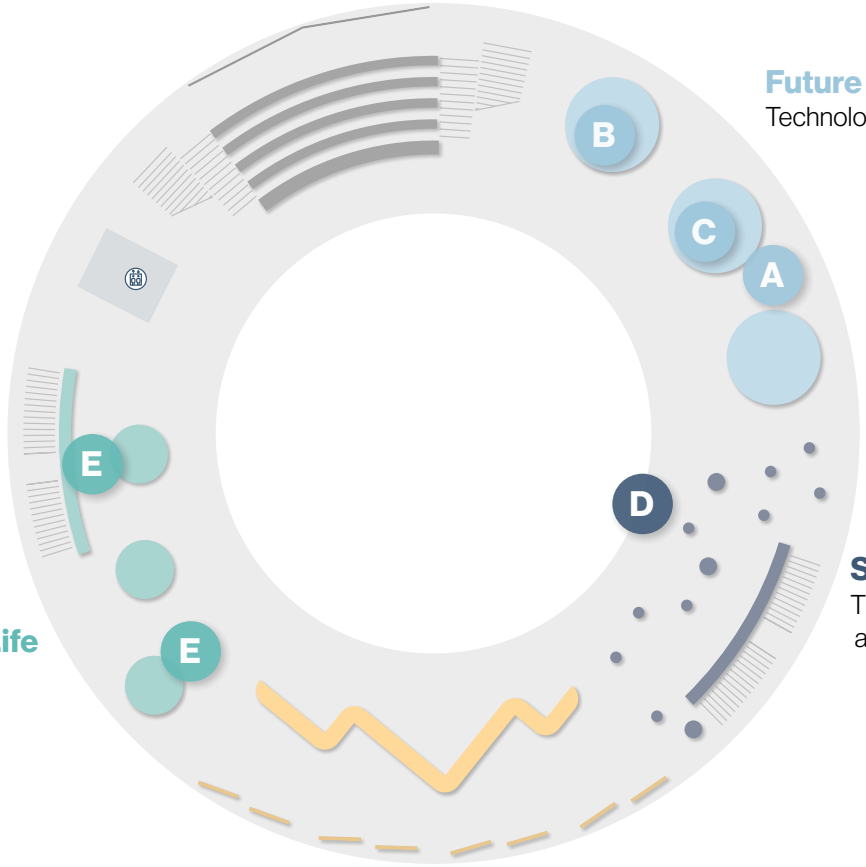
E

- What is a genetic disease?
- What genetic diseases can you name?
- What role does genetics play in cancer?
- What diseases can be treated today with gene therapies?
- Are there illnesses that can be cured by gene therapies?
- What do you think the future potential of gene therapies is and why?

5 Location of individual topics in the exhibition

- A How gene editing and cell and gene therapies work
- B Ethical dilemmas of genetic engineering
- C Personal and societal implications of genetic engineering
- D The milestones that led to genetic engineering
- E The genetic roots of some illnesses

Making Medicine
An introduction video



Future of Healthcare
Technology and Society

Steps through Time
The History of Medicine and Novartis

Fragility of Life
Seeking ways to fight disease

From Lab to Patients
The Journey of Medicine

Opening hours Exhibition:
Tue–Sun 10 a.m.–6 p.m.

St. Johanns-Hafen-Weg 5, 4056 Basel

pavillon.novartis.com