

Innovative Cancer Treatment

By Paola Travascio, ABE Italy



AMGEN[®] Biotech Experience

Scientific Discovery for the Classroom

The curriculum projects designed by the 2021–22 ABE Master Teacher Fellows are a compilation of curricula and materials that are aligned with Amgen Biotech Experience (ABE) and prepare students further in their biotechnology education. These projects were created over the course of a 1-year Fellowship in an area of each Fellow’s own interest. Each is unique and can be adapted to fit the needs of your individual classroom. Objectives and goals are provided, along with expected outcomes. Projects can be used in conjunction with your current ABE curriculum or as an extension.

As a condition of the Fellowship, these classroom resources may be downloaded and used by other teachers for free. The projects are not edited or revised by the ABE Program Office (for content, clarity, or language) except to ensure safety protocols have been clearly included where appropriate. We are grateful to the ABE Master Teacher Fellows for sharing their work with the ABE community.

If you have questions about any of the curriculum pieces, please reach out to us at ABEInfo@edc.org, and we will be happy to connect you with the author and provide any assistance needed.

ABE Master Teacher Fellowship

Innovative Cancer Treatment

NAME: Paola Travascio

PROGRAM SITE: Italy

SUMMARY

Topics in Bioscience cover nowadays such wide and diverse fields of study which span from human biology to bioinformatics and industry, all with a *common thread: applying knowledge to develop biological solutions that sustain, restore, and improve the quality of life* (humans, plants, and animals) in our world. However, I have realized that when it comes to human life and health, people and in particular young people show a remarkable interest and engagement in learning about life-saving therapies and procedures.

The project aims at engaging and creating/deepening students' experience and expertise in the field of "Cancer Cells" and "Innovative Therapies for recurring or difficult-to-treat cancers", and in particular about those which work by harnessing the power of the immune system, called immunotherapy.

The project is intended to benefit also from the Amgen oncology platform and to focus, in particular, on two of several *immunotherapies for cancer treatment: CAR T-cells and BiTE immuno-technology*.

The learning and possible comparison of these two modalities has the following final goals:

1. bringing cutting-edge science to the classroom;
2. acquiring a deeper and broader experience in the processes, tools and hard work of people to make biological medicine as therapies, and in particular immunotherapy for cancer treatment;
3. providing students of the last year of High school with organized materials (possibly a pathway on LabXchange) for the science/biotechnology part of their final exam;
4. avoiding misinformation and misinterpretation of scientific work, data and news, build a solid bridge between people-students and biotechnology industry people (so to not to feel that science is working "on them" but "for them");
5. contributing to the "preparedness for life" of our young citizens through the understanding of the deep connection/interchange between the knowledge of science and science-based technology, and how new scientific knowledge leads to the development of new technologies and vice versa (new technology helps generate new ideas in scientists' minds and make them to become real);

6. contributing to the “scientific literacy” of our students and enabling them, as future citizens, to make informed choices, namely choices involving science and technology with scientific awareness.

Estimated Project Duration: (# weeks/class periods)

3–4 weeks, second quadrimester (February–March)

Big Ideas

As a result of this project and associated learning activities, Students will realize that:

- Despite many remarkable advancements in science, millions of lives are and will be lost globally to cancer, and new therapies to patients with complex cancers are needed beyond surgery with chemotherapy and radiation therapy.
- The deep understanding of specific biological processes (like those involved into the intricate interactions of immune system with cancer cells) can lead to cutting-edge therapeutic approaches (such as those which harness the power of the immune system).
- The “natural” defense mechanisms of our body can be empowered with the help of the design and production of a variety of anticancer immune molecules by genetic engineering.
- Thanks to the hard work of world-class scientists with a talent for applying novel approaches to treat disease in biotech companies, state-of-the-art science is leveraged to pave the way for new solutions and to create medicines for challenging diseases (such as cancer).
- Biotech companies can create high-quality Biosimilars (a medicine that is very close in structure and function to a biologic drug, which is made from proteins or pieces of proteins using a living system, such as yeast, bacteria, or animal cell) that offer the potential to increase patient access to vital medicines.

Student Understandings/Learning Outcomes:

CANCER-IMMUNE SYSTEM-IMMUNOTHERAPY

CANCER - Learning Outcomes (KNOWLEDGE-COMPREHENSION-APPLICATION-ANALYSIS-SYNTHESIS)

- **Students will be able to know that** cancer is a group of more than 100 diseases that develop across time and involve the uncontrolled division of the body's cells, and **recognize** that basic processes that produce cancer are quite similar in all forms of the disease.
- **Students will be able to describe the** 10 main characteristics of tumor cells and **identify** the main differences between a benign and a malignant tumor.
- **Students will be able to analyze** the main differences in behaviour between normal cells and tumoral cells and **construct** a compare-contrast table.

IMMUNE SYSTEM-Learning Outcomes (KNOWLEDGE-COMPREHENSION-APPLICATION-ANALYSIS-SYNTHESIS)

- **Students will be able to sketch** the types of immune responses- “Innate and adaptive”, **recall** the “Humoral adaptive immunity vs. cell-mediated adaptive immunity” **and illustrate** some relations between the immune cells that the adaptive immune system relies on and their role (B cells and T cells).
- **Students will be able to analyze and compare** in a chart some of the important parts of each immune system (innate and adaptive immune system).

IMMUNOTHERAPY-Learning Outcomes (KNOWLEDGE-COMPREHENSION-APPLICATION-ANALYSIS-SYNTHESIS)

- **Students will be able to demonstrate an understanding of core knowledge** of how tumour cells are sensed and destroyed by cells of the immune system and how tumours can evolve to evade immune-mediated elimination.
- **Students will be able to illustrate** how scientists are developing new immunotherapies that help the immune system to ‘fight back’.

- **Students will be able to describe** some types of cancer immunotherapies which are designed to help T cells find and eliminate cancer cells to fight off cancer (CAR T-cell and BiTE).
- **Students will be able to** apply the acquired knowledge to explain the basic design of anticancer immune reagents using antibodies in the form of single-chain variable fragments (scFv).
- **Students will be able to** simulate the building of a BiTE molecule and its action in the tumor environment on the Amgen BiTE interactive platform and to apply critical thinking and analytical skills for the “release” of the BiTE molecule that targets a tumor-associated antigen.
- **Students will be able to synthesize** scientific information acquired through the organized materials and activities and to appraise how immunotherapy is becoming integrated into treatment across a broad range of hematologic and solid tumor malignancies.
- (Hopefully) **Students will be able to acquire** the correct terminology for a possible presentation of the processes examined and possibly to demonstrate written, visual, and/or oral presentation skills to communicate scientific knowledge.

Assessments:

Pre-Assessment

Activities on basic knowledge about the immune system and key-role players of the immune defence against cancer cells

Formative Assessment

Activities on:

- The main and emerging hallmarks of tumor cells
- Basic knowledge on how Immunotherapy uses the body’s immune system to fight cancer
- The mechanism of action of two specific cancer immunotherapies, CAR T-cell and BiTE
- The basic design of BiTE molecules

Standards:

Learning Standards

Dimension I – Scientific and Engineering Practices:

- Asking questions and defining problems
- Developing and using models
- Analyzing and interpreting data -
Developing explanations and designing solutions
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Dimension III – Disciplinary Core Ideas:

LS (Life Science) 1

- From molecules to organisms: Structures and Processes, Structure and Function, Information Processing

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Italy

<p>Summative Assessment: Oral presentation on cancer cells and immunotherapy with a focus on CAR T-cell and /or BiTE technology</p>	<p>ETS (Engineering ,Technology, Application of Science) 1- Engineering design</p> <p>Biotechnology:</p> <p>Biotechnological applications ranging from applications in agriculture and food production medical healthcare</p> <p>Focus on:</p> <ul style="list-style-type: none">• Biotechnology applications in medicine and biotechnology medicines• Gene therapy technologies to treat diseases (focus on cancer cells) <p>Source: <i>Next Generation Science Standards: For States, By States</i></p>
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Opening “Hook”

Students will engage with a podcast and a video about a cancer disease story from the patients’ side and the work/research on cancer disease treatments from the researcher/doctor’s side.

VIDEO-ENGAGING with true stories from real patients
Series Every Patient Counts, Every Story Matters-AMGEN YOUTUBE

General

<https://www.youtube.com/playlist?list=PL4Tuh0XPkChSofrrG4PVAmuOnZSRmo1G>

in particular (easy for Italians with narrative writings)

Every Patient Counts, Every Story Matters: Jeff and Dr. Ravi Salgia

<https://www.youtube.com/watch?v=qYB4BhER-cU>

in particular

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Italy

Every Patient Counts, Every Story Matters: Kevin and Kathleen Lloyd on Multiple Myeloma

[https://www.youtube.com/watch?v=4nDpiNQGuxM&list=PL4Tuh0XPkChSofrrG4PVAmuOnZSRmo1G &index=12](https://www.youtube.com/watch?v=4nDpiNQGuxM&list=PL4Tuh0XPkChSofrrG4PVAmuOnZSRmo1G&index=12)

VIDEO ENGAGING-Spotlight on Scientists-Lauren V. Wood, M.D.

<https://www.labxchange.org/library/items/lb:LabXchange:d9f0a26a:video:1>

and then I would like to get students intrigued about immunotherapy with a general video about CAR T-cell immunotherapy with a brainstorming on the interactive presentation platform on Mentimeter

What is CAR T-cell therapy. Dana Farber Cancer Institute

<https://m.youtube.com/watch?v=OadAW99s4Ik>

Prior Knowledge and Skills:

Since immunotherapy uses the body's immune system to fight cancer, I would like to take a quick review with my students about the basic cells and molecules involved in the immune response (focus on adaptive immune system) to refresh their skills on it

Cultural Relevancy and Personal Connections:

After the engagement with the podcast of a tumor patient and the interview of a researcher, ask students:

- If they have "experienced" a story of cancer in their families or with people important in their lives
- How they would feel to be on the patient's side and/or on the doctor's/researcher's side

IMMUNOTHERAPY - CAR T cells and BiTE - AND CANCER CELLS PROJECT FRAMEWORK

1st Stage ENGAGE
LES_0 (for deep
motivation and to
raise awareness and
empathy toward
humankind health
and, in particular,
towards personal
stories of patients
affected with
cancers)

VIDEO-ENGAGING with true stories from real patients

Series Every Patient Counts, Every Story Matters-AMGEN YOUTUBE
general

<https://www.amgen.com/stories/2021/11/every-patient-counts-every-story-matters>

YouTube

<https://www.youtube.com/playlist?list=PL4Tuh0XPkChSofrrG4PVAmuOnZSRmo1G>

in particular (easy for Italians with narrative writings)

Every Patient Counts, Every Story Matters: Jeff and Dr. Ravi Salgia

<https://www.youtube.com/watch?v=qYB4BhER-cU>

in particular

Every Patient Counts, Every Story Matters: Kevin and Kathleen Lloyd on Multiple Myeloma

<https://www.youtube.com/watch?v=4nDpiNQGuxM&list=PL4Tuh0XPkChSofrrG4PVAmuOnZSRmo1G> &index=12

<https://youtu.be/4nDpiNQGuxM>

Every Patient Counts, Every Story Matters: Jim and Bob

<https://youtu.be/KPlxb6IRdio>

(discuss how women save their husband's lives from Prostate cancer)

ACTIVITY

Students listen to conversations of hope and support between patients, caregivers, doctors, nurses, researchers and advocates, talk in small group for about 5-min about the testimony they listened to and raise awareness about different types of cancer (e.g., lung cancer, multiple myeloma, acute lymphoblastic leukemia [ALL], breast cancer, prostate cancer, colorectal cancer), then write personal reflections and possibly, group reflections

VIDEO ENGAGING-

Spotlight on Scientists-Lauren V. Wood, M.D.

<https://www.labxchange.org/library/items/lb:LabXchange:d9f0a26a:video:1>

ACTIVITY

Students listen to the personal testimony of Dr. Wood and are divided in 2 groups for a short debate about the possibility for research to find

a cure for cancer:

Group 1: "Oh cancer, we're never going to cure that!"

Group 2: "We can. We have to believe that we can..... "

Lindsey Draper, M.D., Spotlight on Scientists

<https://www.youtube.com/watch?v=1FmrOSqaPmE>

Lindsey Draper is a scientist who tells how she became interested in cancer research and discusses what it's like to work on immunotherapy clinical trials, in particular on T cell immunotherapy, with Dr. Christian Hinrichs at the National Cancer Institute's Center for Cancer Research.

2nd Stage REVISION/
LES_1 REVIEW

HOW IMMUNE SYSTEM WORKS AND WHAT ARE THE MAIN CELLS INVOLVED

<https://www.khanacademy.org/science/in-in-class-12-biology-india/xc09ed98f7a9e671b:in-in-human-health-and-disease/xc09ed98f7a9e671b:in-in-types-of-immunity-and-the-immune-system/a/hs-the-immune-system-review>

(only first 2 issues)

<https://www.khanacademy.org/test-prep/mcat/organ-systems/the-immune-system/a/adaptive-immunity>

(only first 3 issues)

LabXchange INTERACTIVE

https://www.labxchange.org/library/items/lb:LabXchange:6f1b3ece:lx_simulation:1

ACTIVITY

CHECKPOINT:PRACTICE QUESTIONS

<https://www.khanacademy.org/test-prep/mcat/organ-systems/the-immune-system/e/immune-system-questions?modal=1>

EXTRA-ACTIVITY

Student will create a compare/contrast table about the two classes of the Immune System: Innate and Adaptive immune system

[Innate vs Adaptive Immune Syts Comp Contr Table.docx](#)

3rd Stage EXPLORATION
LES_2 (Student watch
different videos for
each group-work or

WHAT ARE THE MAIN CHARACTERISTIC OF TUMOR CELLS

VIDEO_1 (EN, from Khanacademy)

<https://www.youtube.com/watch?v=RZhL7LDPk8w>

some paper to deepen their understanding on the proposed subject “Cancer Cells and their hallmarks”)

INTERACTIVE: WHAT IS CANCER

(LabXchange from

[https://app.us.lifeology.io/viewer/lifeology/default/what-is-cancer?__hstc=122224916.fb18008b20ce8bbad91c8f93c444fc12.1639995784110.1639995784110.1639995784110.1&__hssc=122224916.2.1639995784110&__hsfp=2571723563#/\)](https://app.us.lifeology.io/viewer/lifeology/default/what-is-cancer?__hstc=122224916.fb18008b20ce8bbad91c8f93c444fc12.1639995784110.1639995784110.1639995784110.1&__hssc=122224916.2.1639995784110&__hsfp=2571723563#/)

https://www.labxchange.org/library/items/lb:LabXchange:f33d813e:lx_simulation:1

VIDEOS_2(IT)

<https://www.ifom.eu/it/ifom-outreach/risorse-digitali/videopillole/videopillole-cellule-tumoralis.php>

ACTIVITY

CHECKPOINT: PRACTICE QUESTIONS

(Google forms)

<https://docs.google.com/forms/d/1FSJN4RKc6-2FLUWhQ1OIXUcsXTxb6uxFQzok9yIhsRI/edit>

<https://forms.gle/vqJVZUssJrAsZc1t8>

or

<https://docs.google.com/forms/d/e/1FAIpQLSfo2UNYgXP8ePeCoAuRuViMaQ-pitvwTLJkaX65fZ6AbOXMfA/viewform>

EXTRA-ACTIVITY

<https://www.cancer.gov/about-cancer/understanding/what-is-cancer>

Student will create a compare/contrast table about the behaviour of normal vs. tumoral cells

Normal_vs_Tumor_Comp_Contr_Table.docx

Antitumor Immune Response (from AMGEN PLATFORM)_with interactive experience

The Cancer Immunity Cycle and Cancer Evasion Mechanism

<https://cic.medthinkscicom.com/app>

TAKE a QUIZ included

3rd Stage EXPLORATION
LES_3 (Student watch
different videos for
each group-work or

IMMUNOTHERAPY VIDEOS

(from Nature)

<https://www.youtube.com/watch?v=K09xzIQ8zsg>

some paper to deepen their understanding on the proposed subject “Tumour Immunology and Immunotherapy“)

(from IFOM)

<https://www.ifom.eu/it/ifom-outreach/risorse-digitali/videopillole/videopillole-immunoterapia-cancro.php>

(from LabXchange)

Cancer Immunotherapy - Explaining the Science Behind the Revolution)

<https://www.labxchange.org/library/items/lb:LabXchange:70f52fa4:video:1>

(from LabXchange)

Immunotherapy: How the Immune System Fights Cancer

<https://www.labxchange.org/library/items/lb:LabXchange:de335307:video:1>

VIDEO

<https://www.labxchange.org/library/items/lb:LabXchange:c58527ac:video:1>

OR THE SAME ON YOUTUBE

<https://www.youtube.com/watch?v=kfi-2fPp4dE>

Immunotherapy uses the body’s immune system to fight cancer. This animation explains one type of immunotherapy called T-cell transfer therapy that is used to treat cancer.

ASSESSMENT

(as an opportunity to become familiar with the phenomenon students will study)

ACTIVITY

CHECKPOINT: PRACTICE QUESTIONS

LabXchange pathway

<https://www.labxchange.org/library/pathway/lx-pathway:8cfbeef1-f782-4884-9876-131b626f03c3>

3rd Stage

ENGAGE

(for deep

LES_4

motivation and to raise natural curiosity/empathy in the student’s minds and, at least in part, to make sense of the world around and inside

CAR T cells -Immunotherapy

CASE STUDY

OVERVIEW

Students explore the case of a 6-year-old girl, Emily Whitehead, who suffered from a recurrent lymphoblastic leukemia which did not respond to over 16-month of chemotherapy treatments. Her parents decided to enrol their daughter in a clinical trial of a new IMMUNOTHERAPY treatment called “CAR T cell therapy”, which had never been tested in a child before.

them!)

EXPLORATION
(Student watch introductory videos about the proposed subject “CAR T cells immunotherapy”, then are split into groups to answer to some questions and to confront their group-work to fix some key-ideas about the proposed subject “CAR T cells Immunotherapy”)

Engage-Explore

IT-text

<https://aulascienze.scuola.zanichelli.it/multimedia-scienze/come-te-lo-spiego-scienze/scacco-matto-tumori-immunoterapia/>

EN

Engage video

https://youtu.be/Sz11e0r2L_s

Explore text

<https://www.cancerresearch.org/immunotherapy/stories/patients/emily-whitehead>

ACTIVITY

Elaborate

QUESTIONS

[CASE_study_Emily_Whitehead_ACTIVITY.pdf](#)

Extend-Homework

Students read “An interview with Dr. Carl June”

<https://www.cancerresearch.org/immunotherapy/stories/scientists/carl-h-june-md>

VIDEO-1

T-Cell Transfer Therapy

<https://www.labxchange.org/library/items/lb:LabXchange:c58527ac:video:1>

VIDEO_2

What is CAR T-cell therapy. Dana Farber Cancer Institute

<https://m.youtube.com/watch?v=OadAW99s4Ik>

ACTIVITY

Students, after watching both the introductory videos (first time with audio, the second time without audio and with EN subtitles, and the last time with both) about “CAR T cells Immunotherapy”, are split into groups to answer to some questions relative to the videos; finally, the different groups gather together to confront and discuss about their answers to fix some key-ideas about the proposed subject.

The set of questions are presented to the students in two forms:

- *as slides in a PowerPoint file,*
- *by the use of the interactive presentation tool Mentimeter, that*

allows to engage students in real time.

ACTIVITY

CHECKPOINT: QUESTIONS

FILES (group-work)

powerpoint_video1_2_CARTcell_intro_questions.pptx

Same Questions about the videos on the interactive tool "Mentimeter" with the use of students' mobile phones:

<https://www.menti.com/4z9yrnx2qo>

<https://www.menti.com/afae4u1mw7>

<https://www.menti.com/q936drg2ko>

<https://www.menti.com/mh4954cbu4>

(Students use the PowerPoint presentation or the Mentimeter interactive presentation tool and interact among the group and with their teacher while answering to the questions)

READINGS (group-work)

AMGEN RESEARCH ON CAR T-cells

<https://www.amgenbiotechexperience.com/car-t-therapy-and-other-immunotherapies>

<https://www.amgenoncology.com/modalities/cartcell.html>

<https://www.amgen.com/stories/2018/08/the-shape-of-drugs-to-come/car-t-cell>

NATIONAL CANCER INSTITUTE

[https://www.cancer.gov/about-](https://www.cancer.gov/about-cancer/treatment/types/immunotherapy/t-cell-transfer-therapy)

[cancer/treatment/types/immunotherapy/t-cell-transfer-therapy](https://www.cancer.gov/about-cancer/treatment/types/immunotherapy/t-cell-transfer-therapy)

<https://www.cancer.gov/about-cancer/treatment/research/car-t-cells>

DANA-FARBER CANCER INSTITUTE

<https://blog.dana-farber.org/insight/2017/06/car-t-cell-therapy/>

FDA Approval-Readings

2017

<https://www.fda.gov/news-events/press-announcements/fda-approves-car-t-cell-therapy-treat-adults-certain-types-large-b-cell-lymphoma>

2020

<https://www.fda.gov/news-events/press-announcements/fda-approves-first-cell-based-gene-therapy-adult-patients-relapsed-or-refractory-mcl>

EXPLORATION

(Students are broken into teams and explore different readings/texts about Car T cell immunotherapy to deepen their understanding on the proposed subject "CAR T cells")

EXPLORATION
(Students read a Text and watch some videos to gain a basic knowledge about the “Manufacturing of CAR T cells” and use part of the ABE -lab (wet lab or simulations) as an ACTIVITY to understand the genetic engineering process behind it)

ACTIVITY

After readings students complete a Table about “Advantages/Disadvantages of CAR T cell Immunotherapy”



<https://learningapps.org/display?v=p9sn3if6322>

Manufacturing CAR T cell

TEXT

<https://www.dana-farber.org/cellular-therapies-program/car-t-cell-therapy/how-car-t-cell-therapy-works/>

VIDEO

Manufacturing CAR T Cells to Accelerate Cancer Immunotherapy
Research-National Cancer Institute

<https://www.youtube.com/watch?v=Wpbep-i7ERg>

(Fully-accessible 508-compliant version of this video:

[https://smartplayer.captionsync.com/play.php?vid=1613675027jswarz_910560ba3def6881&embed=t\)](https://smartplayer.captionsync.com/play.php?vid=1613675027jswarz_910560ba3def6881&embed=t))

The 8 Steps of CAR T-Cell Therapy- Dana-Farber Cancer Institute

<https://www.youtube.com/watch?v=WN6TfgDMdFc>

ACTIVITY

ABE-cluster IT

Lab-Activity: Building a Recombinant Plasmid-Restriction Enzymes
Interactive: How do RE cut plasmid?

https://www.labxchange.org/library/pathway/lx-pathway:9eac0913-7b95-4aed-b184-2b185b695575/items/lx-pb:9eac0913-7b95-4aed-b184-2b185b695575:lx_simulation:bea72d10?source=%2Flibrary%2Fclusters%2Flx-cluster%3Aabe-italiano

Simulation: RE Digest

https://www.labxchange.org/library/pathway/lx-pathway:9eac0913-7b95-4aed-b184-2b185b695575/items/lx-pb:9eac0913-7b95-4aed-b184-2b185b695575:lx_simulation:310d3c14?source=%2Flibrary%2Fclusters%2Flx-cluster%3Aabe-italiano

Simulation: RE Digest

**Lab Activity: Building a Recombinant Plasmid-Ligase
Interactive: The Role of DNA Ligase in Gene Cloning**

https://www.labxchange.org/library/pathway/lx-pathway:7ed4f8a7-5790-4723-8ca4-418f69f3a830/items/lx-pb:7ed4f8a7-5790-4723-8ca4-418f69f3a830:lx_simulation:b6cdb0bc?source=%2Flibrary%2Fclusters%2Flix-cluster%3Aabe-italiano

Simulation: Ligating DNA Fragments

https://www.labxchange.org/library/pathway/lx-pathway:7ed4f8a7-5790-4723-8ca4-418f69f3a830/items/lx-pb:7ed4f8a7-5790-4723-8ca4-418f69f3a830:lx_simulation:a4e6692f?source=%2Flibrary%2Fclusters%2Flix-cluster%3Aabe-italiano

**Lab-Activity: Verifying a Recombinant Plasmid-Gel Electrophoresis
Interactive: Separating DNA with GE**

https://www.labxchange.org/library/pathway/lx-pathway:0e1acb55-bfd3-40da-acf1-9b05133ea1d1/items/lx-pb:0e1acb55-bfd3-40da-acf1-9b05133ea1d1:lx_simulation:e5313a67?source=%2Flibrary%2Fclusters%2Flix-cluster%3Aabe-italiano

Simulation: Verifying a Recombinant Plasmid by GE

https://www.labxchange.org/library/pathway/lx-pathway:0e1acb55-bfd3-40da-acf1-9b05133ea1d1/items/lx-pb:0e1acb55-bfd3-40da-acf1-9b05133ea1d1:lx_simulation:b88d5ddc?source=%2Flibrary%2Fclusters%2Flix-cluster%3Aabe-italiano

**Lab-Activity: Tools and Techniques in Biotechnology- Bacterial
Transformation**

Simulation: Transforming Bacteria

https://www.labxchange.org/library/pathway/lx-pathway:776963b2-af80-4df7-98f8-026fe20cea00/items/lx-pb:776963b2-af80-4df7-98f8-026fe20cea00:lx_simulation:fd506862?source=%2Flibrary%2Fclusters%2Flix-cluster%3Aabe-italiano

Simulation: Plating Transformed Bacteria

https://www.labxchange.org/library/pathway/lx-pathway:776963b2-af80-4df7-98f8-026fe20cea00/items/lx-pb:776963b2-af80-4df7-98f8-026fe20cea00:lx_simulation:fad2b77e?source=%2Flibrary%2Fclusters%2Flix-cluster%3Aabe-italiano

LabXchange
pathway

<https://www.labxchange.org/library/pathway/lx-pathway:edd0ff99-2d84-4b1e-8b2f-27cebdb7887c>

3rd Stage
LES_5

EXPLORATION
(Student watch different videos for each group-work or some paper to deepen their understanding on the proposed subject “BiTE”)

EXPLORATION
the future of cancer treatment?
(Student read in their group-work the article to widen their understanding on possible novel cancer treatments)

BiTE-Immunotherapy

TEXT

AMGEN -oncology platform_READING the BiTE the Engager, an educational resource on BiTE technology

<https://www.amgenoncology.com/resources/BiTE-the-Engager.pdf>

VIDEOS

<https://www.amgenoncology.com/bite-platform.html>

“See BiTE technology in action”

<https://www.youtube.com/watch?v=1zAIDPv-qc8>

<https://www.amgen.eu/amgen-media-release/featured-news/amgen-bite-technology-development>

(direct observation by microscopy after bringing together the tumor cells, T-cells and a BiTE[®] molecule. Since static images would not show the speed of progress, a computer program to turn the images into a video was used. This dramatic video shows that T-cells are not only efficient tumor fighters but are also capable of changing in the presence of a BiTE[®] molecule into a search and destroy mode thereby killing multiple tumor cells over time.)

ACTIVITY

Students are divided in 2 groups:

1st group reads the document

2nd group watch the introductory video

then the 2 groups come together and write on a board the key-idea about:

- 1. BiTE mechanism of action,**
- 2. BiTE molecule design,**
- 3. Table with Tumor and tumor-associated antigen**

https://www.amgenoncology.com/resources/bite_interactive/

AMGEN -oncology platform_INTERACTIVES (kind of scrollables), which allow students:

- to LEARN how to DESIGN a BiTE molecule to target a specific cancer cell
- to EXPLORE 4 different tumor environments

ACTIVITY

All students read the document *BiTE the Engager.pdf*, and then *EXPLORING* actively the interactive [“Learn about BiTE molecule”](#) (focused on design of BiTE molecule)

then they are divided in 4 groups to *EXPLORE* each of the 4 interactives

[“Explore tumor environment”](#),

focusing on the

Multiple Myeloma (Bone marrow), Acute myeloid leukemia AML (Blood Vessel), Small-cell lung cancer SCLC (Bronchus), Prostate Cancer (Prostate acinus)

ACTIVITY

Students complete the task given on the website [Learningapps.org](https://learningapps.org)

[“Tumor and BiTE Technology”](#)



<https://learningapps.org/display?v=pmdbj3uyt22>

[“BiTE Design and Mechanism of Action”](#)

<https://learningapps.org/display?v=pu0g55eoj22>



(Video used

<https://www.amgenoncology.com/bite-platform.html>

“See BiTE technology in action”

<https://www.youtube.com/watch?v=1zAIDPv-gc8>)

ABOUT CLINICAL TRIAL PHASES

TEXT from LabXchange

<https://www.labxchange.org/library/items/lb:LabXchange:c3ea1299:html:1>

VIDEO from LabXchange

<https://www.labxchange.org/library/items/lb:LabXchange:1260f48f:video:1>

(same video on youtube

<https://www.youtube.com/watch?v=dsfPOpE-GEs>)

(not used!!!!

website from National Cancer Institute

<https://www.fda.gov/patients/drug-development-process/step-3-clinical-research>)

ACTIVITY

Question set on LabXchange

https://www.labxchange.org/library/items/lb:LabXchange:db736fac:lx_assignment:1

ACTIVITY

Students, as a group work, explore the Amgen website

AMGEN PIPELINE

<https://www.amgenpipeline.com/>

searching and selecting the required information to complete the task given on the website Learningapps.org

“BiTE Molecule and clinical phase trial”

<https://learningapps.org/display?v=pf47gtdzj22>



Final Video from LabXchange about

Participating in Cancer Clinical Trials: What You Need to Know

<https://www.labxchange.org/library/items/lb:LabXchange:c23127a2:video:1>

LabXchange
pathway

<https://www.labxchange.org/library/pathway/lx-pathway:37c979e0-4dc5-4c3b-b8c6-6ff3a7d734c4>

3rd Stage
LES_6

EXPLORATION-
OPTIONAL
(By these optional materials students can deepen their knowledge and understanding about:

1. Comparison between T cell Redirection Strategies: CAR T-cell and BiTE

2. Monoclonal antibodies- Characteristics and Production

1.

ACTIVITY READING AND COMPREHENSION

Scientific Paper

CARs versus BiTEs: A Comparison between T Cell–Redirection Strategies for Cancer Treatment

<https://aacrjournals.org/cancerdiscovery/article/8/8/924/10166/CARs-versus-BiTEs-A-Comparison-between-T-Cell>

Scientific Paper

“The landscape of bispecific T cell engager in cancer treatment | Biomarker Research

<https://biomarkerres.biomedcentral.com/articles/10.1186/s40364-021-00294-9>

2.

ACTIVITY VIDEO WATCHING AND COMPREHENSION

Monoclonal Antibodies: Characteristics and Production

Video_1 (from FuseSchool)

<https://www.youtube.com/watch?v=M3zllm8QbCM>

Video_2 (from LabXchange)

<https://www.labxchange.org/library/items/lb:LabXchange:a67f4b74:video:1>

How Monoclonal Antibodies Treat Cancer

Video_3 (from LabXchange)

<https://www.labxchange.org/library/items/lb:LabXchange:0161b0a1:video:1>

ACTIVITY -READING AND COMPREHENSION

Text_EN

<https://courses.lumenlearning.com/microbiology/chapter/polyclonal-and-monoclonal-antibody-production/>

Text_IT

web-links to Italian web site which explain monoclonal antibodies and their production

<https://www.infomedics.it/servizi/biotecnologie/la-storia.html>

<https://www.issalute.it/index.php/la-salute-dalla-a-alla-z-menu/a/anticorpi-monoclonali-mab>

<https://www.airc.it/cancro/informazioni-tumori/lo-sai-che/gli-anticorpi-monoclonali-si-usano-gia-da-tempo-in-oncologia>

3. BiTE Production-

Bispecific antibodies

Students watch some videos and read some Text/Scientific papers as a group-work to deepen their understanding on the proposed subject “Car T-cell and monoclonal antibodies, BiTE and bifunctional proteins”)

3.
Video (from Genentech)

A Bispecific Revolution
<https://youtu.be/ARVGphZuzjk>

The complete guide to the structure of bispecific antibodies (from Labtube)

<https://www.labtube.tv/video/MTA2NzUw>

Text document prepared by me with a sort of summary-Table of BiTE production

3rd Stage INVESTIGATION
(Design and Conduct virtually or hands-on Science investigation on the proposed subject)

Possible University or CNR research sites as a host for some Seminars and possible wet labs with students:

ICB (Institute of Biomolecular Chemistry)_CNR Pozzuoli

OMICS

Biomarcatori da scienze omiche nei settori biomedico ed agroalimentare

Analisi genetiche su tumori umani

<https://www.icb.cnr.it/attivita/omics/>

Dr. Pietro Amodeo- pamodeo@icb.cnr.it

ISASI (Institute of Applied Sciences and Intelligent Systems)_CNR Pozzuoli

Research group_ Mapping matter & physical space

https://www.isasi.cnr.it/?page_id=127#

Gruppo di olografia digitale (Digital Holography)

Riconoscere le cellule tumorali analizzando la loro struttura 3D

<https://www.isasi.cnr.it/?p=2822>

Abstract:

La rilevazione di cellule tumorali circolanti (**CTC**) nel sangue periferico, la cosiddetta biopsia liquida, consente il monitoraggio in tempo reale della progressione della malattia e ha implicazioni significative nel trattamento terapeutico personalizzato dei tumori. In questo ambito si inserisce il progetto **‘Morfeo’** (MORphological biomarkers For Early diagnosis in Oncology), finanziato dal Miur tra i Programmi di ricerca

scientifica di rilevante interesse nazionale, con capofila il gruppo di olografia digitale del Cnr-Isasi di Pozzuoli.

University of Naples Federico II-Dep.of Molecular Medicine and Medical Biotechnologies (DMMBM)

https://www.mmbm.unina.it/en_GB/ricerca/progetti-di-ricerca

Medical Biotechnologies

Prof. Dr. Zambrano- zambrano@unina.it

https://www.mmbm.unina.it/en_GB/ricerca/progetti-di-ricerca#oncomol

https://www.mmbm.unina.it/en_GB/ricerca/progetti-di-ricerca#immuno

https://www.mmbm.unina.it/en_GB/ricerca/progetti-di-ricerca#traslaz

ISTITUTO NAZIONALE TUMORI-IRCCS-Fondazione Pascale

Prof. Paolo Antonio Ascierto – p.ascierto@istitutotumori.na.it

Dip. Oncologia Clinica sperimentale e Terapie Innovative

http://www.istitutotumori.na.it/IstitutoPascale/CCVV/CV_AsciertoPaoloAntonio.pdf

<https://newportal.istitutotumori.na.it/dipartimenti/dipartimento-di-ricerca-traslazionale-a-supperto-dei-percorsi-oncologici/modelli-immunologici-innovativi/>

4th Stage SUMMATION
(Explanation,
Elaboration,
students should be
ready to synthesize
what they have
learned as a group
and
come to some final
conclusions)

4th Stage EXHIBITION
(Evaluation,
students
communicate their
new understanding
to a wider audience,

teachers and other
group-works in their
class)

ABE Master Google Drive_paola_travascio

<https://drive.google.com/drive/folders/1HJl01sxb4UZ-hhFh4KVkQGcergGq898C?usp=sharing>

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ibse

[https://www.fondation-lamap.org/sites/default/files/upload/media/Guide_Designing%20and%20implementing%20IBSE_fina
l_light.pdf](https://www.fondation-lamap.org/sites/default/files/upload/media/Guide_Designing%20and%20implementing%20IBSE_fina%20light.pdf)

Standards

[https://www.esa.org/ldc-preprod/wp-
content/uploads/sites/79/2013/03/NGSSandLifeSciMar2013.pdf](https://www.esa.org/ldc-preprod/wp-content/uploads/sites/79/2013/03/NGSSandLifeSciMar2013.pdf)

)

LabXchange Course:

Immunotherapy (CAR T cell, BiTE)

Class code: 7E0CB1

<https://www.labxchange.org/classes/4e380266-3cf1-4d54-a0b7-b046b398f1c1>