

FUTUREBIO COMPETENCE MAP					
Chapter	Module title	Sub Chapter / Learning Unit	LEARNING OUTCOMES The learner is expected/able to ...		
			K Knowledge	S Skill	RA Responsibility and Autonomy (Competence)
1	POLYMERS	1.1 Definition of Polymers	1.1.K1 Recognize polymers 1.1.K2 Detail basic polymer chemistry	1.1.S1 Analyze the strengths and weaknesses of alternative solutions, outcomes and/or approaches to problems using logical reasoning	1.1.RA1. Transfer in written, oral and visual formats to national and international groups in the field of polymers by providing current development information in the field of polymers with quantitative and qualitative data.
		1.2 Nomenclature of Polymers	1.2.K1 Explain the naming of polymers	1.2.S1 Distinguish the name composition of polymers	
		1.3 Mechanisms of Polymerization	1.3.K1 Define polymerization and characterization methods 1.3.K2 Distinguish the structure-property relationship in polymers 1.3.K3 Explain the kinetics of polymerization reactions	1.3.S1 Analyze by asking questions appropriately, paying attention to what is being said on the polymer, taking time to understand the points made	1.3.RA1 Combine the knowledge gained in the field of polymers with social life, creating awareness on issues such as the environment in social life, bringing a critical view when necessary, and categorizing the norms that shape social relations when necessary, and to take action to change the norms that guide social relations.
		1.4 Modification of Polymers	1.4.K1 Explain polymer synthesis methods, highlighting their differences, and how the polymer is modified	1.4.S1 Demonstrate the implications of new information for current and future problem solving and decision making	1.4.RA1 Define and teach these values by considering social, scientific and ethical values in the stages of collecting, interpreting, applying and announcing the data related to the polymer field, developing strategies, policies and implementation plans on related issues.
		1.5 Types of Polymers	1.5.K1 Distinguish polymer types 1.5.K2 Explain the differences of polymer types	1.5.S1 Apply polymer types effectively and correctly in necessary areas	1.5.RA1 Revise currently used polymers considering the effects of polymer types on human and environmental health
		1.6 Applications of Polymers	1.6.K1 Describe in which areas polymers can be used according to their properties	1.6.S1 Apply polymers to new areas	1.6.RA1 Transfer this information to the authorities and the society by creating new quality processes in the development of policies that will give importance to environmental health in the use of polymers
		1.7 Biopolymeric Materials	1.7.K1 Recognizes biopolymeric materials 1.7.K2 Identify basic information about the chemistry and physics of biopolymers 1.7.K3 List the basic properties of biopolymers 1.7.K4 Express the importance of biodegradable plastics for a green future	1.7.S1 Express the information that can reveal the strengths and weaknesses of biopolymers 1.7.S2 Explain the physical and chemical structures of biopolymeric materials 1.7.S3 Distinguish biodegradable bioplastics from others	1.7.RA1 Characterize biopolymers as a sustainable material 1.7.RA2 Compare materials with a critical perspective 1.7.RA3 Evaluate biopolymeric materials
		1.8 Preparation of Biopolymers	1.8.K1 Explain the synthesis methods of biopolymer 1.8.K2 Describe the properties of different materials according to their biopolymeric structures 1.8.K3 List modification techniques of biopolymers 1.8.K4 Recognize the principles for the preparation of biodegradable bioplastics	1.8.S1 Select preparation methods for biopolymers 1.8.S2 Analyze environmental and economic methods 1.8.S3 Prepare new biopolymer materials in line with the needs that may arise	1.8.RA1 Develop plans for the preparation of biopolymers 1.8.RA2 Interpret basic data related to the synthesis of biopolymers 1.8.RA3 Predict the post-synthesis properties of biopolymers by evaluating their structures
2	INDISPENSABLE POLYMERS OF LIFE: PLASTICS	2.1 Polymeric Structures of Plastics	2.1.K1 Express the information about the chemical structures and properties of plastics, production methods and mechanical properties	2.1.S1 Use the information about polymeric plastic structures effectively and correctly in necessary areas	2.1.RA1 Be a pioneer in shaping the future by developing the plastics used today emphasizing the effects of polymeric structures on human and environmental health
		2.2 Types of Plastics	2.2.K1 List the plastic types and the differences between them and each other	2.2.S1 Evaluate the use of plastic in terms of the environment and the future, ensuring that it is used effectively and correctly when necessary	2.2.RA1 Be a pioneer in shaping the future by developing the plastics used today emphasizing the effects of plastic types on human and environmental health
		2.3 Production Methods of Plastics	2.3.K1 List the production methods of plastics	2.3.S1 Use the information about production methods of plastics effectively and correctly in necessary areas	2.3.RA1 Be a pioneer in shaping the future by developing the plastics used today emphasizing the effects of production methods of plastics on human and environmental health
		2.4 Usage Areas of Plastics	2.4.K1 Detail the usage sectors of plastics		
		2.5 End of Life of Plastics	2.5.K1 Differentiate End of Life options for plastics with special knowledge on reusability and recycling	2.5.S1 Use technical terms concerning the End of Life of plastics 2.5.S2 Show the importance of life cycle thinking	2.5.RA1 Lead specialist discussions on recycling and other EoL options for plastics by applying technical terms
3	BIOPLASTICS	3.1 Definition and Classification of Bioplastics	3.1.K1 Classify bioplastics	3.1.S1 Distinguish plastics and bioplastics	3.1.RA1 Replace plastics with bioplastics
		3.2 The Usage and Importance of Bioplastics	3.2.K1 Describe applications of bioplastics and the importance of their usage	3.2.S1 Ensure care about health, environment and greenization	3.2.RA1 Devise alternative usage areas of bioplastics
		3.3 Sources and Production Methods of Bioplastics	3.3.K1 Describe the sources of bioplastics and production procedures	3.3.S1 Distinguish the sources of bioplastics for production of bioplastics	3.3.RA1 Depict new alternative sources and regeneration processes for the production of bioplastics, taking care of social, environmental and economic aspects
		3.4 Formation Mechanisms of Bioplastics	3.4.K1 Explain the formation of bioplastics	3.4.S1 Provide the best options for the production of bioplastics from social, environmental and economic perspectives	3.4.RA1 Refer the steps of the procedure which is formed during the production processes as an alternative approach
		3.5 Recycling Mechanism of Bioplastics	3.5.K1 Describe recycling mechanisms of bioplastics	3.5.S1 Provide the best end of life option for a given bioplastic according to the type and application of the bioplastic itself	3.5.RA1 Develop a novel awareness of all the end of life options available for bioplastics
		3.6 Daily Examples for Bioplastics	3.6.K1 List examples of bioplastics	3.6.S1 Ensure care about health, environment and greenization	3.6.RA1 Transfer of knowledge between science and society, combining scientific life with daily life, and thinking about the

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4	PROPERTIES OF BIODEGRADABLE PLASTICS	4.1 Chemical Structures	4.1.K1 Characterize the chemical composition of polymeric materials and Bioplastics 4.1.K2 Distinguish the chemical composition of specific types of Bioplastics	4.1.S1 Discriminate what are the chemical components of bioplastics 4.1.S2 Distinguish what are the chemical characteristics of a specific bioplastic material	4.1.RA1 Prepare a multimedia presentation concerning the chemical bonds present in specific types of polymers or bioplastics indicating, in addition, what they are used for
		4.2 Chemical Properties	4.2.K1 Describe the principal chemical qualities of some materials of polymeric or Bioplastic type 4.2.K2 Clarify the chemical characteristics of a particular type of Bioplastic	4.2.S1 Examine the chemical qualities of bioplastics 4.2.S2 Figure out the chemical qualities of a specific bioplastic material	4.2.RA1 Create a multimedia presentation concerning the chemical qualities of the bioplastics proposing examples of products made from specific bioplastic materials or specific polymers
		4.3 Physical Properties	4.3.K1 Describe the general structural and functional characteristics of polymeric and Bioplastic materials 4.3.K2 Express the mechanical properties of a particular type of Bioplastic	4.3.S1 Classify the mechanical properties of bioplastics 4.3.S2 Illustrate the mechanical properties of a specific bioplastic material	4.3.RA1 Prepare a project to show the mechanical properties of different types of Bioplastics indicating a possible common or innovative use for one of them
		4.4 Preparation Methods	4.4.K1 Express, theoretically, what methods are used to formulate Bioplastic or polymers 4.4.K2 Detail, concretely, a specific preparation method to formulate a polymer or Bioplastic	4.4.S1 Analyze machines and equipment peculiar to chemical production 4.4.S2 Explain the possible limitations or problems for the formulation of a specific type of Bioplastics or polymers	4.4.RA1 Combine specific knowledge for designing a testing experience 4.4.RA2 Organize, theoretically, an application experience by writing a step-by-step procedure (as a protocol) focusing on a specific production method and taking care of organization, materials needed, and the safety rules to be followed during the execution of the proposed procedure
		4.5 Recycling Mechanism of Biodegradable Plastics	4.5.K1 Differentiate the recycling mechanisms of biodegradable plastics, listing which biodegradable polymers are suitable for any given recycling mechanisms 4.5.K2 Recognize that biodegradation is not the only possible end of life option for biodegradable bioplastic	4.5.S1 Exemplify the recycling pathways of the most important biodegradable plastics, identifying the stress and weaknesses of the various recycling mechanism	4.5.RA1 Select the most suitable recycling pathways for any given bioplastic waste
5	CHARACTERIZATION OF BIODEGRADABLE PLASTICS	5.1 Introduction	5.1.K1 Introduce a general definition and overview of different characterization approaches of biodegradable plastics		
		5.2 Morphological Characterization	5.2.K1 Identify the different techniques that can be used to characterize from a morphological point of view the biodegradable plastics	5.2.S1 Select the proper technique to characterize the biodegradable plastics	5.2.RA1 Select the proper morphological method analyzing the information derived from it
		5.3 Chemical Characterization	5.3.K1 Identify the different chemical techniques and information that can be obtained on biodegradable plastics	5.3.S1 Select the proper chemical technique to characterize the biodegradable plastics	5.3.RA1 Select the proper chemical method analyzing the information derived from it
		5.4 Mechanical characterization of biodegradable plastics	5.4.K1 Describe the different mechanical characterization techniques for bioplastics	5.4.S1 Identify the right mechanical characterization technique for the target property to be measured and the target application	5.4.RA1 Select the right mechanical characterization technique for the target property to be measured and the target application
		5.5 Thermal characterization of biodegradable plastics	5.5.K1 Describe the different thermal characterization techniques for bioplastics	5.5.S1 Identify the right thermal characterization technique for the target property to be measured and the target application	5.5.RA1 Select the right thermal characterization technique for the target property to be measured and the target application
		5.6 Functional characterization of biodegradable plastics	5.6.K1 Describe the different functional characterization techniques for bioplastics	5.6.S1 Identify the right functional characterization technique for the target property (gas barrier, electrical conductivity, etc.) to be measured and the target application	5.6.RA1 Select the right functional characterization technique for the target property to be measured and the target application
6	CURRENT APPLICATIONS OF BIODEGRADABLE PLASTICS	6.1 Applications of Biodegradable Plastics in the Biomedical Field	6.1.K1 Classify the different applications of the biodegradable plastics in medicine	6.1.S1 Illustrate the possible interaction of biodegradable plastics with human fluids and tissues	6.1.RA1 Summarize the possible employment of biodegradable plastics for human health
		6.2 Applications of Biodegradable Plastics in Agriculture and Horticulture	6.2.K1 List some of the agricultural applications of biodegradable plastics and the most widely used biodegradable bioplastics in this field 6.2.K2 Distinguish the use of a particular biodegradable plastic instead of another for a given agricultural application	6.2.S1 Predict the properties a biodegradable plastic should have to be employed for a given agricultural application 6.2.S2 Distinguish if and when a biodegradable plastic should be preferable to a conventional plastic	6.2.RA1 Judge the possibility of replacing a conventional plastic with a biodegradable bioplastic in agricultural applications, highlighting the pros and the cons
		6.3 Applications of Biodegradable Plastics in the Packaging Field	6.3.K1 List some of the packaging applications of biodegradable plastics and the most widely used biodegradable bioplastics in this field 6.3.K2 Distinguish the use of a particular biodegradable plastic instead of another for a given packaging application	6.3.S1 Predict the properties a biodegradable plastic should have to be employed for a given packaging application 6.3.S2 Distinguish if and when a biodegradable plastic should be preferable to a conventional plastic	6.3.RA1 Judge the possibility of replacing a conventional plastic with a biodegradable bioplastic in packaging applications, highlighting the pros and the cons
		6.4 Applications of Biodegradable Plastics for Consumer Goods	6.4.K1 List some of the applications of biodegradable plastics in the field of consumer goods and the most widely used biodegradable bioplastics in this field 6.4.K2 Distinguish the use of a particular biodegradable plastic instead of another for a given consumer goods application	6.4.S1 Predict the properties a biodegradable plastic should have to be employed for a given consumer goods application 6.4.S2 Distinguish if and when a biodegradable plastic should be preferable to a conventional plastic	6.4.RA1 Judge the possibility of replacing a conventional plastic with a biodegradable bioplastic for consumer goods, highlighting the pros and the cons
		6.5 The Others - Environmental and Nanotechnology Applications	6.5.K1 Classify various applications of biodegradable plastics such as separation, purification and environmental technologies	6.5.S1 Predict the properties of biodegradable plastic should have in various applications	6.5.RA1 Summarize the applications of biodegradable plastics in different industries
		7.1 Importance of Biodegradable Plastics	7.1.K1 Explain the importance of bioplastic	7.1.S1 Identify the alternative of using biodegradable plastic	7.1.RA1 Present the feedback of new plastic biodegradable plastic



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7	IMPACT OF BIODEGRADABLE PLASTICS: MARKET TRENDS FOR BIODEGRADABLE PLASTICS	7.2. Why are Bioplastics so Important?	7.2.K1 Explain the reason of using biodegradable plastic	7.2.S1 Identify the reasons of using biodegradable plastic	7.2.RA1 Support the use of new plastic
		7.3. Challenges of Using Biodegradable Plastics	7.3.K1. Explain the new type of plastic	7.3.S1 Identify the new fields of using biodegradable plastic	7.3.RA1 Present the new alternatives of waste management
		7.4. What To Do with Waste?	7.4.K1 Explain the recycling process of plastic	7.4.S1 Identify the impact of standardization in waste management	7.4.RA1 Present the results of waste management
		7.5. Benefits of Biodegradable Plastics	7.5.K1 Detail the benefits of biodegradable plastic	7.5.S1 Identify the alternative of using biodegradable plastic	7.5.RA1 Identify the benefits of biodegradable plastic in daily life
		7.6. Disadvantages of Biodegradable Plastics	7.6.K1 Detail the disadvantages of biodegradable plastic	7.6.S1. Identify the effects of using biodegradable plastic	7.6.RA1. Identify the negative aspects of using biodegradable plastic
		7.7. Sustainable Environment	7.7.K1 Discuss how it is possible to sustain the environment	7.7.S1 Expose some economical aspects of plastic influence	7.7.RA1 Summarize plastic pollution in economical activities
		7.8. Circular Economy	7.8.K1 Describe the elements of circular economy	7.8.S1 Identify the stages of circular economy	7.8.RA1 Depict a cycle for a plastic product in circular economy
		7.9. Greenization Factor as a Sustainability	7.9.K1 Explain the significance of greenization	7.9.S1 Identify the greenization for different economical activities	7.9.RA1 Support the need of green action in economy
		7.10. Opportunities and Human Resources	7.10.K1 Describe the new job opportunities on market	7.10.S1 Identify the economic sectors and jobs opportunities created by replacement of plastic	7.10.RA1 Support the need of new jobs by replacement of plastic
		7.11. Market drivers and development	7.11.K1 Explain the new market and diversification	7.11.S1 Identify the market drivers	7.11.RA1 Summarize the effects of circular economy on market
8	PAST, CURRENT AND FUTURE OF BIODEGRADABLE PLASTICS: INNOVATIVE APPLICATIONS	8.1. Brief History of Plastic and Bioplastic	8.1.K1 Give an historical overview of plastic and bioplastic	8.1.S1 Outline a history of plastic technological applications and related products	8.1.RA1 Depict the role of the plastic in the technology development
		8.2. Plastic Impact on Society and Culture	8.2.K1 Explain the impact of plastic in our society and style of life 8.2.K2 Explain the links between plastic material and world wide culture	8.2.S1 Identify the full impact of the plastic in the world	8.2.RA1 Depict the role of the plastic in society and culture



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