European Commission

NATURE-BASED SOLUTIONS LEARNING SCENARIO

Nature-based solutions to prevent forest fires and reduce risk disasters caused by deforestation.

Research and Innovation

Nature-based solutions to prevent forest fires and reduce risk disasters caused by deforestation.

European Commission
Directorate-General for Research and Innovation
Healthy Planet – C3 - Climate and Planetary Boundaries
CDMA 03/154
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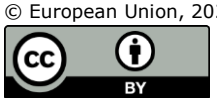
Manuscript completed in October 2020.
1st edition.

Luxembourg: Publications Office of the European Union, 2020



EUROPEAN COMMISSION

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Nature-based solutions to prevent forest fires and reduce risk disasters caused by deforestation.

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2020 EN

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ABSTRACT

Nature-based solutions (NBS) could be defined as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human wellbeing and biodiversity benefits" (Cohen-Sacham, et al., 2016). *NBS could be adopted to reduce disaster risks connected with forest fires. This is a key issue in Mediterranean countries, where climate change and desertification have increased the risk of forest fires and disasters, mainly caused by deforestation. With this learning scenario, students will analyse risks and propose NBS based on the data resulting from scientific research, making use of digital competences and real-world problem-solving skills.*

Keywords

STEM, Secondary School, Cross-disciplinary approach, Nature-based solutions, Forest Fire Resilience

1. Introduction

> *"Nature-based solutions (NBS) are solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes, and seascapes, through locally adapted, resource-efficient and systemic interventions. Nature-based solutions must therefore benefit biodiversity and support the delivery of a range of ecosystem services."*
> https://ec.europa.eu/info/research-and-innovation/research-area/environment/nature-based-solutions_en

To use this Learning Scenario more effectively, teachers are encouraged to:

- Check out the list of recent EU publications on Nature-Based solutions
- Read about Nature-based solutions: Transforming cities, enhancing well-being (also available as a PDF)
- Contact local NBS practitioners or scientists working in their area (they can be found through Oppla).
- Use the "Ask Oppla" service to request help in case of any technical/scientific question on NBS.

2. Overview

Overview	
Subject	Cross-disciplinary approach: Physical Sciences (Physics and Chemistry) Natural Sciences (Geology and Biology) Language Mathematics ICT Education for Citizenship
Topic	Disaster Risk Reduction
Age of students	14–15 (or above)
Preparation time	3 hours (if in Portugal), 5 in other countries (as time is needed to research on forest fires in own country or region)
Teaching time	3 lessons of 90 minutes each *N.B.: In Portugal, this topic could be used for developing a project of "Curricular Autonomous Dominium". The students will work autonomously with the accompaniment of several teachers for 2-3 days. In this case, teachers of Science, Language, Mathematics, and ICT teachers.*

Overview	
Online teaching material	Material for contextualisation and introduction to the problem • National Geographic News about Portuguese forest Fires: https://on.natgeo.com/3b29Xpp • Forest Fires in Central Portugal: https://www.youtube.com/watch?v=QklvNEyeVUY • Managing forest fires: https://www.efi.int/articles/managing-forest-fires • Youtube video about "Fighting catastrophic forest fires: a new vision" - http://bit.ly/2U7gWXv • For brainstorming, Mentimeter is a suggested tool: https://www.mentimeter.com/login • Forest Fire Hazard and Risk cartography methods QGIS and GRASS Apps for Booklets and eBooks: • Flipsnack: https://www.flipsnack.com/digital-booklet • Canva: https://www.canva.com/pt_pt/criar/flyers/ • Venngage: https://pt.venngage.com/features/criar-folhetos • Crello: https://crello.com/pt/create/ebooks/ Apps for poster presentation:, example https://piktochart.com/ and https://spark.adobe.com/make/posters/ How to create Poster? Check the Scientix Moodle Course http://moodle.scientix.eu/course/view.php?id=79
Offline teaching material	Students notebooks, papers and writing material (to organise students work)
NBS resources used	General: • FirESmart NBS to prevent the risk of fire seeking cost-effective NBS to maximise benefits between fire prevention and ecosystem services, and articles by its research team • Article "Can We Use Nature to Mitigate Wildfire Risk? • On the bioeconomy: Report "The bioeconomy as an opportunity to solve the structural problem of forest fires in southern Europe" and EC document on the link between bioeconomy and NBS Context-specific: • QGIS and Forest Fire Risk Mapping in Portugal Pinhel, publications (in Portuguese) about Risk Cartography and identification of Forest Fire Hazard in Portugal (case study and presentation) • NBS Case Study from Spain and Portugal on preventive fire management and sustained supply of ecosystem services • PHUSICOS Project investigating NBS in rural mountain landscapes in several European countries, including Northern Europe, and Presentation on prevention of landslides, avalanches and rockfalls after fires

3. Integration into the curriculum

The learning scenario (LS) can be integrated as a cross-disciplinary project developed as "Curricular Autonomous Dominium" which is a part of the Portuguese National Curriculum since 2018. The scenario could be integrated into the new subject introduced in Portugal, Education for Citizenship, under the following topics: Environmental Education for Sustainability or Risk Prevention Education.

Besides, the LS could address contents related to:

Physics

- Forces and movements.
  - Newton's laws of dynamics in interpreting motion situations.
  - Friction in the movement and the need to control it in various situations.
- Forces, movements, and energy
  - Different forms of energy from the two fundamentals: potential and kinetic.
  - Transformations of potential gravitational energy into kinetic, and vice versa.
  - Transference of energy between systems through the action of forces.
- Forces and fluids
  - Archimedes' Law, applying it in the interpretation of situations of fluctuation or sinking.

Chemistry

- Chemical reactions
  - Identify reagents and products, distinguishing between fuel and oxidiser.
  - Conclude about consequences of combustions.
  - Problems related to forest fires.
- Kinetic of Chemical Reactions - the speed of a chemical reaction.

Natural Sciences

- Distinguish catastrophes of natural origin from a catastrophe of anthropic origin.
- Identify the causes of the main disasters of anthropic origin.
- Explain how deforestation, fires and biological invasions affect ecosystems.
- Impact of science, technology, and sustainable development in the quality of life of populations.
- Importance of plants for life on Earth and conservation measures for the autochthonous forest.

ICT

- Digital tools to support the research process and online research.
- Identify the means and applications for communication and collaboration.
- Present and share products developed using digital means.

Mathematics

- Calculation of areas and volumes.
- Geometrical Figures.
- Solve problems using geometric ideas in mathematical and non-mathematical contexts.
- Develop the capacity for abstraction and generalisation, and to understand and construct arguments mathematical and logical reasoning.

Language

- Make oral presentations of themes, ideas, opinions, and critical appraisals.
- Intervene in debates by systematising information and making pertinent contributions.
- Argue to defend and/or refute positions, conclusions or proposals.
- Read various media texts of the genres: scientific dissemination, critical reviews and comments.
- Elaborate texts of argumentative nature.

Because of the interdisciplinary characteristic of this LS, this is a good opportunity to work with different teachers from different subjects and/or departments.

4. Aim of the lesson

This lesson has several aims, such as: a) raising student’s awareness of the disaster risks associated with deforestation caused by forest fires; b) increasing students’ knowledge of NBS available to prevent those risks and to increase territorial resilience to forest fires and associated deforestation.

Students will furthermore analyse and identify the risks, applying their knowledge from natural-scientific subjects (physics, chemistry, geology, and biology). Through data analysis of research results available, they will also work collaboratively and propose NBS to prevent such risks (such as forest barriers for erosion protection, plant coverage to prevent floods after fire events, forest

restoration that increases resilience to fire, plant covering to prevent fire dissemination, governance and planning policies and a sustainable bioeconomy).

Students will also become aware that NBS solutions are not universal to all cases studied, and that there is not one solution to each problem, but multiple solutions.

5. Outcome of the lesson

Each group of students will present a poster or booklet with their NBS for disaster risk prevention identified (such as forest barriers for erosion protection, plant coverage to prevent floods after fire events, forest restoration that increases resilience to fire, and plant covering to prevent fire dissemination).

All NBS for disaster risk prevention will be compiled in an eBook published in their native language and English (translating to another language will be an extension of this learning scenario, to improve students' English skills).

6. Trends

STEM Learning – integrated approach to learning which involves a cross-curricular connection between two or more standards from Science, Technology, Engineering and Mathematics.

Problem-Based Learning – students will work with open-ended questions inspired by digital material (such as photos and videos of forest fires, floods and mountain disasters caused by desertification). PBL allows desirable skills and competences for solving societal, and often local, challenges to be developed. Besides knowledge acquisition, this includes transferable skills such as critical thinking, collaboration, and communication. Students need to work collaboratively and devise a solution to a relatable problem by themselves, and therefore often become more motivated to be part of the learning process.

7. 21st-century skills

During this learning scenario several competences will be developed:

- Key subjects & 21st Century Themes: Global Awareness; Environmental Literacy.
- Learning & Innovation Skills: Creativity and Innovation; Critical Thinking; Problem Solving; Communication; Collaboration. The latter is important since students will work in groups and need to collaborate with their peers.
- Information, Media & Technology Skills: Information Literacy; ICT Literacy

These competences will be addressed while students read and select relevant information, find patterns, mobilise prior disciplinary knowledge to identify risks, identify and select the NBS adequate to prevent each risk, use ICT tools to produce booklets or posters, communicate their results and improve linguistic competences in the translation process.

8. Activities

Name of activity	Procedure	Time
Lesson 1		
Presentation of the topic forest fires	The teacher presents material about fires in Portugal https://on.natgeo.com/3b29Xpp and/or https://www.youtube.com/watch?v=QklvNEyeVUY A brief discussion about the forest fires in Portugal and factors that contribute to this dangerous problem that we face every summer.	10 min
Video about forest managing	The teacher shows the video about managing forest fires and introduces the concept of managing forest and forest resilience – Preventing the risk of fire (YouTube video: http://bit.ly/2U7gWXv) The teacher shows this Prezzi presentation from Phusicos highlighting the risks related to mountainous zones affected by the fire. https://prezi.com/p/xbp32glsmbzs/phusicos/	20 min

Name of activity	Procedure	Time
Teacher Challenge and Group Discussion	The teacher asks some questions: • How can we increase the resilience of forest landscapes, strengthening ecosystem services and reducing the risks of catastrophic fires? • How can we manage salvage logging to prevent dangerous build-up of fuel loads? • Are there better plant species to reduce the combustible charge and flammability of forest? • After the fires, how can landscapes be restored? • Why is important to fast restore lands after fires? • What are the main risks for land, especially in the mountains, if the burnt land is not reforested? • How to prevent the risk of floods after forest fires? • How to prevent landslides, avalanches and rockfalls? Students will come up with ideas and try to answer each question through discussions in small groups[1] and making use of prior knowledge. They must write their main ideas to answer these questions in a collaborative tool (e.g. Mentimeter or other collaborative tools).	20 min
The teacher addresses the whole class regarding the challenge	Assessment of student's ideas resulting from the previous activity. This will be explored by the teacher to foster student's curiosity enabling them to find out more about these topics.	5 min
Identify the risks associated with forest fires and consequent deforestation	The teacher provides students some research materials (see NBS resources section) to be explored and understand how to manage the forest and how to increase resilience to fire. The teacher also introduces students to the topic of NBS. This part of the lesson will focus on identifying the Forest Fire Risk and propose a solution to reduce it. • Part I – Identify the risks related to forest management in a specific area in the study case country (Presentation of a risk map) • Part II – Propose NBS to reduce the fuel charge in the forest and to increase the resilience to fire. The teacher indicates that reducing salvage logging can contribute to preventing dangerous build-up of fuel loads. Introducing better/different plant species to reforest will also reduce the combustible charge and overall flammability of the forest. Students must read the selected material and identify the risks by mobilising their scientific knowledge (such as combustions, forces, movement, soil erosion, landscape movement, mountain risk of floods after fires, the role played by plants and roots in the fixation of lands and the role of local governments and economies). The teacher must mediate students to work and provide insights and resources that could support students' work.	60 min
Lesson 2		

[1] A possible way of creating similar groups, is for students to find their learning style from online testing of *Honey and Mumford* styles and then put them in groups with 1 activist, 1 theorist, 1 pragmatist and 1 reflector so that we get the best from each thinking style.

Name of activity	Procedure	Time
Group work and data analysis of research results available	This lesson will focus on identifying the better NBS for disaster risk prevention in areas affected by fires. Teachers should highlight the importance of the risk assessment before coming up with solutions to risk reduction. • Part I – Identify the risks of erosion in a specific mountain landscape affected by fire (e.g. recent fires in Pedrógão and Monchique, Portugal) • Part II – Propose NBS to afforest specific mountainous zones to prevent landslides, avalanches and rockfalls. As a minimum, the options proposed must create forest barriers for erosion protection and plant coverage to prevent floods after fire events. The forest restoration must increase resilience to fire, and plant covering adopted in that solutions must prevent the spread of fire. Stronger solutions will be those that arise from an analysis of whether the NBS can conflict with the interests of local stakeholders, and if so, consider how such conflicts can be addressed. The teacher must mediate students to work and provide insights and resources that could support students' work.[2] In this lesson, students could use information and data collected during a field trip or the teacher could provide information about a specific landscape. Students will explore that region or location and assess the risk in that location. These locations could be selected by students or the teacher could select a region/location for each group of students. The students need to assess the risks and propose solutions.	60 min
Lesson 3		
Preparation of Posters or Booklets: NBS preventing risks	Each group of students will prepare a poster or booklet that identifies NBS for disaster risk prevention identified (such as forest barriers for erosion protection, plant coverage to prevent floods after fire events, forest restoration that increases resilience to fire, and plant covering to prevent fire dissemination).	90 min

Note 1: To reduce the time for this learning scenario, the poster or booklet preparation could be done after the lesson (homework). Students can collaborate in sharing the platforms and apps they use.

Note 2: To extend this learning scenario, students could create an eBook with all NBS risk prevention and translate them into the English language.

9. Assessment

For students' assessment, a Rubric could be used (see Annex 1).

10. Teacher's remarks

A version of this Learning Scenario for online implementation can be found in Annex 2.

As an extra activity, the school could invite a firefighter to come and speak with students about fire safety and forest fires. However, teachers must always return to the main idea of this LS during discussions.

11. References

Cohen-Shacham, E., Walters, G., Janzen, C., Maginnis, S. (2016). Nature-based Solutions to address global societal challenges. Switzerland, IUCN.

[2] During this lesson, teachers may wish to include a visit to a forest to touch and learn from burned areas firsthand or do an activity about NBS in the forests themselves. Students could identify the risks given in a specific forest.

Annex 1: Assessment Rubric for Students' Work Project

Assessment Rubric for Students' Work Project

	Low	**Fair**	**Good**	**Very Good**
Contribution to project goals	Only when requested	Sometimes presents his/her contribution	Fulfil his/her role on the group work	Very active and instigates others to work with him
Respect for the opinions of the others	Sometimes his not gentle or respectful with colleagues	Show some respect for the others.	Gives constructive opinions about his/her colleagues work	Valorise the initiatives of his colleagues.
Contribution with insight, information, new ideas and solutions	Only when solicited	Some contributions and ideas	Present some important insights and ideas in crucial moments	Present important insights and ideas in crucial moments. Organise and dynamise the group work
Share with others	Does not share his/her ideas with others.	Share some ideas	Share with others. Takes initiative. Motivate their colleagues	Identifies the group needs. Scaffold their colleagues. Show initiative and autonomy.
NBS proposed	There were any NBS proposed for reduce the risk of fire and deforestation associated risks	There are at least one NBS proposed for reduce the risk of fire but not for deforestation associated risks. The rationale also needs to be improved.	There are several NBS proposed for reduce the risk of fire and for deforestation associated risks. However, they are presented in a simplistic way. The proposals need to be sustained	The NBS proposed are adequate for the risks they intend to prevent and are well described and grounded also taking non-environmental risks and conflicts of interests into account.
Poster presented or booklet produced	Hard to read, not creative and not attractive	Readable, but less creative or attractive	Easy read, creative, attractive, and generally well written.	Very easy to read, creative, attractive and very well written.

Annex 2: Learning Scenario adapted to online teaching

Adaptation of the Learning Scenario to distance learning (online)

Preparation Time	4-5 hours
Teaching time at distance learning	1 videoconference lesson of 60 minutes 1 working week for the development of student's autonomous work

Name of activity	Procedure	Time
Lesson 1 – Through Videoconference		
Presentation of the topic forest fires	Through videoconference (example of tool that can be used: Google Meet, Zoom, GoToMeeting, School Platform) teacher presents material about fires in Portugal, the video and briefly discusses the forest fires in Portugal and factors that contribute to this dangerous situation that we face every summer.	5 min
Video about forest managing	Teacher shows the video about managing forest fires and introduces the concept of managing forest and forest resilience – Preventing the risk of fire (YouTube video: http://bit.ly/2U7gWXv) Teacher shows Prezzi from Phusicos highlighting the risks related with mountainous zones affected by fire. https://prezi.com/p/xbp32glsmbzs/phusicos/ (This action also through videoconference)	20 min
Teacher Challenge and Group Discussion	Teacher asks some questions: • How can we increase the resilience of forest landscapes, assuring the ecosystem services and reducing the risks of catastrophic fires? • How can we manage salvage logging to prevent dangerous build-up of fuel loads? • Are there better plant species to reduce the combustible charge and flammability of forest? • After the fires, how can landscapes be restored? • Why is important to fast restore lands after fires? • What are the main risks for land, especially in the mountains, if the fired land is not reforest? • How to prevent the risk of floods after forest fires? • How to prevent landslides, avalanches and rockfalls? Students will try to achieve an answer to each one of these questions, through discussion in small groups, based in their previous knowledge and ideas. They must write their main ideas to answer these questions in *Mentimeter or some other collaborative code* (Performed at distance – teacher would need to share the menti.com code or similar)	20 min
Teacher returns to all class and reinforce the challenge	Assessment of student's ideas written in the *Mentimeter*. This will be explored by teacher to foster student's curiosity enabling them to find out more about these topics. This can also take place through videoconference.	5 min
Teacher introduces students with research	Teacher introduces to students the concept of Nature Based Solutions and provides the resources to be explored and investigated. Students need to learn about NBS to reduce forest fire risk and to increase their resilience to fire. Also, about NBS solution to reduce the	10 min

Name of activity	Procedure	Time
materials available and NBS resources[3]	erosion and floods risks after fires (through presentation shared during videoconference).	
Autonomous work – distance learning		
Group work to identify the risks and propose NBS to reduce the fuel charge in the forest and to increase the resilience to fire	Students will be divided into groups: Groups 1 and 2 (ideally four students each) work on identification of Forest Fire Risks in a specific are and propose NBS to reduce it. Group 3 and 4 (ideally four students each) work on identification of risks in areas affected by fire (mainly mountain landscapes) and propose NBS for related disaster risk prevention. The students' groups 1 and 2 will work collaboratively with available tools (Example: Google Docs, Google Presentations Google Meetings, Padlets, eBook on Canva) to: • Part A – Identify the risks related with forest management in a specific area in our country Portugal. • Part B – Propose NBS to reduce the fuel charge in the forest and to increase the resilience to fire. Teacher indicates that reducing salvage logging can contribute to preventing dangerous build-up of fuel loads; as well as introducing better/different plant species to reforest and reduce the combustible charge and flammability of forest. Students must read the selected material and identify the risks by mobilising their scientific knowledge (such as combustions, forces, movement, soil erosion, landscape movement, mountain risk of floods after fires, role played by plants and roots in the fixation of lands and the role of local governments and economies).	2 -3 days
Group work to identify the risks and propose NBS	Here, group work will be carried out to identify the risks and propose NBS to afforest specific mountainous zones to prevent landslides, avalanches and rockfalls The groups of students (group 3 and 4) work collaboratively with available tools (Google Docs, Google Presentations Google Meetings, Padlets, eBook on Canva) This lesson will be focus on identify the better NBS for disaster risk prevention in areas affected by fire. Part A – Identify the risks of erosion in a specific mountain landscape affected by fire (recent fires in Pedrogão and Monchique, Portugal) Part B – Propose NBS to afforest specific mountainous zones to prevent landslides, avalanches and rockfalls. As a minimum, the options proposed must create forest barriers for erosion protection and plant coverage to prevent floods after fire events.	2-3 days

[3] This might also be a good moment to talk to students about plagiarism and its risks. As students will be working on their own texts and produce an eBook, students should be aware that plagiarism is wrong.

Name of activity	Procedure	Time
	The forest restoration must increase resilience to fire, and plant covering adopted in that solutions must prevent the spread of fire. Stronger solutions will be those that arise from an analysis of whether the NBS can conflict with the interests of local stakeholders and, if so, consider how such conflicts can be addressed. The teacher must mediate students to work and provide insights and resources that could scaffold the students work.	
Final Products		
Preparation of Posters or Booklets for proposing NBS to prevent risks	Each group of students will prepare a poster or booklet with their NBS for disaster risk prevention identified (such as forest barriers for erosion protection, plant coverage to prevent floods after fire events, forest restauration that increases resilience to fire, and plant covering to prevent fire dissemination). The products are shared with the other students during a videoconference. Other types of final projects are also possible, such as presentation or TV news report role-play, and each implementation should decide what works best for them.	1 day

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About the NBS project

The NBS project is initiated and funded by the European Commission Directorate-General for Research and Innovation and coordinated by PPMI, in collaboration with European Schoolnet (EUN). PPMI (www.ppmi.lt/en) is a leading European research and policy analysis centre, aiming to help public sector and civil society leaders from around the world, presenting evidence in a way that is simple, clear and ready to use. European Schoolnet (www.eun.org) is the network of 34 European Ministries of Education, based in Brussels. EUN aims to bring innovation in teaching and learning to its key stakeholders: Ministries of Education, schools, teachers, researchers, and industry partners. Find out more about nature-based solutions: https://ec.europa.eu/research/environment/index.cfm?pg=nbs and all the NBS Learning Scenarios created in this project as well as the overall reports can be found at http://www.scientix.eu/pilots/nbs-project

The NBS project pilot has also been supported by the STE(A)M Partnerships programme of Scientix, funded from the European Union's H2020 research and innovation programme – project Scientix 4 (Grant Agreement N. 101000063), coordinated by European Schoolnet (EUN). The content of the document is the sole responsibility of the organizer and it does not represent the opinion of the European Commission (EC), and the EC is not responsible for any use that might be made of information contained.

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Studies and reports

Publications Office
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