RRI Tools

Fostering Responsible Research and Innovation

RRI in practice for schools

[Handbook for teachers]

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Author(s)	Jiménez Iglesias, M. and Pinzi, V.
Coordination	Debry, M. and Pinzi, V. European Schoolnet.
Additional Contributions	Hadjichambi, D., Kähärä, T. Oubella, M.
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Notes	--

Foreword

The RRI Tools initiative is carried out by a multidisciplinary consortium consisting of 26 partners from 19 European countries, including representatives from a wide range of stakeholders (research, civil society, policy making, education and business) and led by "la Caixa" Foundation (Spain).

Together, these partners bring considerable experience in all the key components of Responsible Research and Innovation across Europe. In addition, the project aims to be collaborative and inclusive in itself in order to increase creativity and shared ownership of the process. Researchers, civil society, educators, industry, and policy makers have joined forces in RRI Tools to work together on the design of a better relationship between research and innovation on the one hand and society on the other. The ultimate goal is bring into being a European community of practice that draws together all the active stakeholders in this new vision of scientific and social development, who can use and continuously contribute to the RRI Toolkit.

This handbook for teachers has been created with the main aim of accommodating Research and Innovation (R&I) practices in schools, and particularly in the teaching of STEM disciplines (science, technology, engineering and mathematics). It is designed as a way to guide and support educators along the process of introducing RRI in the classroom through innovative science pedagogical methods and by offering a range of inspiring resources for designing and implementing class activities.

European Schoolnet (the network of Ministries of Education in Europe), partner in RRI Tools, has coordinated the development of this handbook for teachers. More information: Maite Debry maite.debry@eun.org

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1. What is RRI?

1.1 Introduction to RRI

What is RRI?

Responsible Research and Innovation (RRI) is a dynamic, iterative process by which all stakeholders involved in Research and Innovation (R+I) practices become mutually responsive and share responsibility in both its outcomes and processes.

Which is RRI's main purpose?

The overall aim of Responsible Research and Innovation **is to create a society in which these practices work towards sustainable, ethically acceptable and socially desirable outcomes, particularly since the responsibility for our future should be shared both by citizens and institutions.** Indeed, it is through the involvement of society in these practices that research outcomes will grow progressively aligned with society values.

How can this be accomplished?

To accomplish the mentioned objectives, **RRI addresses a number of agendas and involves every key stakeholder** (including policy-makers, researchers, industry and commerce, science educators, and civil society organizations as well as the public at large) essential for a fair society. In addition, it is through a wide umbrella how different features in the relationship between science and innovation and society are brought together, comprising the dimensions of ethics, gender equality, open access, public engagement, and science education.

Which are RRI's central components?

Responsible research and innovation processes can be broken down into four components – (1) outcomes, (2) process dimensions, (3) policy agendas and (4) stakeholders.

- Specific **outcomes** act as drivers for the efforts involved in adopting responsible research and innovation practices. These can be classified into leaning outcomes, R+I outcomes and solutions to societal challenges.
- A number of **process dimensions** are essential to develop RRI practices, too. In particular, up to 8 dimensions have been identified and classified in 4 different clusters (namely Diversity and inclusion, Anticipation and Reflection, Openness and transparency and Responsiveness and Adaptive change).
- Furthermore, 6 influential **policy agendas** have been recognized by the European Commission with enough potential to maximize responsibility in Research and

Innovation and overall, to ensure all actors keep working together to achieve common RRI goals.

- Last, the involvement of certain key **stakeholders** will be necessary to work taking into account different policy agendas and outcomes of RRI processes. Within these: civil society organizations, policy makers, both the research and the education community and other business and industry actors, in addition to society as a whole.

From the mentioned components, it is essential to highlight (1) the part different process dimensions take in RRI processes and (2) the role a number of key stakeholders.

1.2 Process dimensions: principles of RRI

As mentioned, **RRI process dimensions have been classified in different clusters.** From those:

- The **Diversity and Inclusion** cluster entails the involvement of a wide range of stakeholders in the development of STEM related RRI processes, in order to expand and diversify the number of experts involved and perspectives included in scientific processes as well as for other reasons related to democratic processes.
- Within the **Anticipation and Reflection** group, two areas can be distinguished. While anticipation englobes a general understanding of the impacts of research and innovation in different societal groups and individuals, reflection is understood as the contemplation of motivations, purposes and potential implications of R+I.
- **Openness and Transparency** is essential to understand those conditions necessary to ensure accountability, liability and responsibility in the R+I process that will be just as necessary to ensure public trust.
- **Responsiveness and Adaptive change** incorporates two discernable dimensions. Responsiveness refers to the ability to take account of society's needs while Adaptive change involves the capacity to change prevalent behavioral routines, structures or systems, in response to changing circumstances.

1.3 RRI is multi-stakeholder cooperation

The engagement of different actors through inclusive, participatory procedures at all stages and levels of R+I is essential, too. In particular, the involvement of key groups of people will be necessary to tackle those challenging outcomes and multiple agendas that are continuously addressed in RRI:

- As **Policy Makers**, all those actors involved in any decision making process that might have an impact in R+I (at any level, whether at European, national or local scale) will make the cut, including policy officers or research center directors.

- The **Research Community** is yet another vital group of RRI stakeholders, comprising all professionals involved in the diverse aspects of the R+I system, including researchers or research managers and innovators, just to name a few.
- Those working in the education field (again, including all capacities and levels) will form the **Education Community** stakeholder group. Not only teachers and students belong to it, but also science museums professionals, school directors or students' families.
- Likewise, **Civil society organizations** (whether individuals or organizations) are crucial in R+I. This group will be especially diverse, including NGO representatives or even media outlets.
- Finally, **Business and Industry** will also indispensable for the development of R+I, as the engines for the development of many R+I developments.

2. RRI for you

2.1 Inquiry and project-based learning methods as foundations for RRI at school

The integration of Responsible Research and Innovation (RRI) principles in educative contexts can be strongly beneficial for students, as it **supports them in the development of critical thinking and collaborative learning skills while accommodating multidisciplinary and stronger student engagement.**

Hence, **it is essential to lay out principles that will help on the implementation of RRI in teaching and learning activities in schools**. This can be done through a number of pedagogical methods such as inquiry based learning, structured research school projects or through reflections on ethical, legal and social aspects (ELSA) and basic socio-scientific issues (SSI). A number of ways to do so (at a secondary education level) are presented in the following.

Introduction of RRI concepts in study blocks

- When development a group activity or project, **critical reflection processes** could be established through the enactment of regular sessions focusing on group's processes, values, routines and final results.
- The RRI dimension of **adaptive change** could be incorporated by prompting students to make any necessary changes to their work plans and work methods, after the reflection process has taken place.
- When organising project teams, students' critical considerations on gender balance and social inclusion can be triggered while learning about different roles and levels of expertise needed in **collaborative endeavours** and reflecting on its importance in real contexts.
- Educators can dedicate some time to **identifying and reflecting on key RRI-aspects** related to the course lessons. This could serve as lessons around basic RRI principles.
- **Reflection and discussion games** could be used to trigger talks, debates or other deliberative processes about social and scientific issues or even about the ethical, legal and social aspects of a specific topic.
- Considerations on the **sustainability, social desirability and ethical aspects** of certain processes would also address the RRI areas of anticipation and refection and it could easily be implemented in classroom discussions.
- Identification of attractive **research questions** that students could solve through the utilization of scientific methods often used in research methodologies.

Stakeholders' engagement

The introduction of RRI principles in the classroom can also benefit collaborative planning and learning in school activities, especially if it involves the engagement of multiple stakeholders. In particular, the organization of events (such as workshops, exhibitions, open days or school fairs) with the aim of disseminating the results of a class activity or a school project supports the acquisition of communication and reflection skills and can be especially relevant for RRI processes if it involves stakeholders, such as parents, external experts and local communities.

RRI transversally in schools

Moreover, while RRI should be integrated at **different levels of STEM education**, including different school education stages (primary and secondary as well as at university level), it should also be incorporated in **lifelong learning initiatives** and in informal learning contexts like science centers or science festivals.

RRI in STEM

Finally, the introduction of RRI concepts in the classroom will most likely foster the development of receptive and open mind-sets in students which, in turn, will improve their understandment of the outside world and will prepare them to make better informed and evidence-based societal choices. Nonetheless, one must not forget that **STEM education -in particular- has a critical role for the implementation of RRI principles, as it provides with the necessary knowledge and skills to empower today's students to become tomorrow's active citizens in nowadays knowledge society.**

In that sense, it is essential to make students better understand science and innovation as a whole as well as its relations with different aspects of society. STEM education should become a central environment where students are provided with the necessary scientific and technological knowledge, skills and methodologies to develop critical thinking on Research and Innovation. Besides, integrating RRI principles in STEM teaching will help make STEM careers more attractive and improve students' employability and career perspectives.

2.2. RRI-oriented educational practices

To start introducing RRI principles at organisational level, educators and educational organisations can implement a **self-reflection process to determine how RRI-oriented their practices are.** This process is a continuous exercise that can be done between a small group of teachers developing lesson plans for a single class; at school council level and across curricula; at local level for a group of schools in the same district; and at a wider level, for example, within the activities of a national teachers' association or professional development courses.

The process can be initiated as an informal activity, or proposed as an additional formal step of the school or local council's internal evaluation. Either way, it will require the involved parties to get familiar with the basic RRI principles as well as to bet set up in a format that enables discussion and participation, since integrating these aspects is not a checklist but rather a practice.

To support and continue this process in the long term, the RRI Toolkit also offers a specific tool, the so-called Self-refection tool, that can be used with or without registration in the portal and that guides the user through six policy agendas, offering various questions that target a number of aspects to reflect on.

The user can start with any of the policy agendas presented and proceed to answer progressively all the relevant questions for their context. A general suggestion to receive useful feedback is to answer, at least, two questions for each policy agenda. The full set of question can also be downloaded in PDF and can be used to support and inspire the group activities proposed.

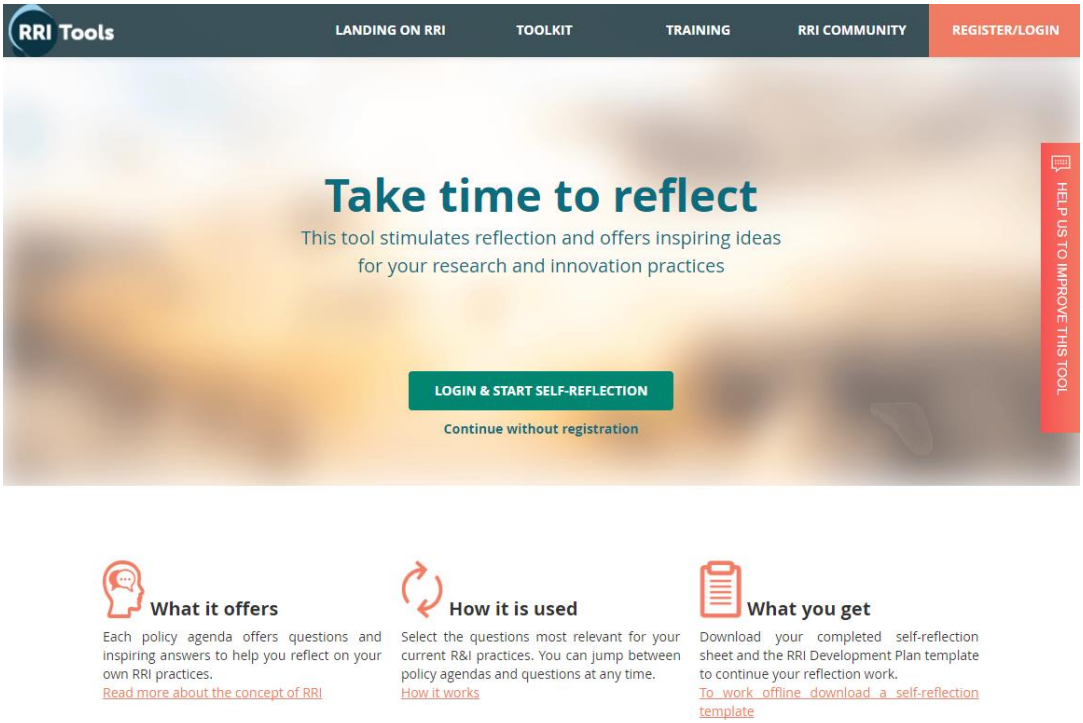

Figure 1: Screenshot of the Self-Reflection Tool entry page available in the RRI Tools website.

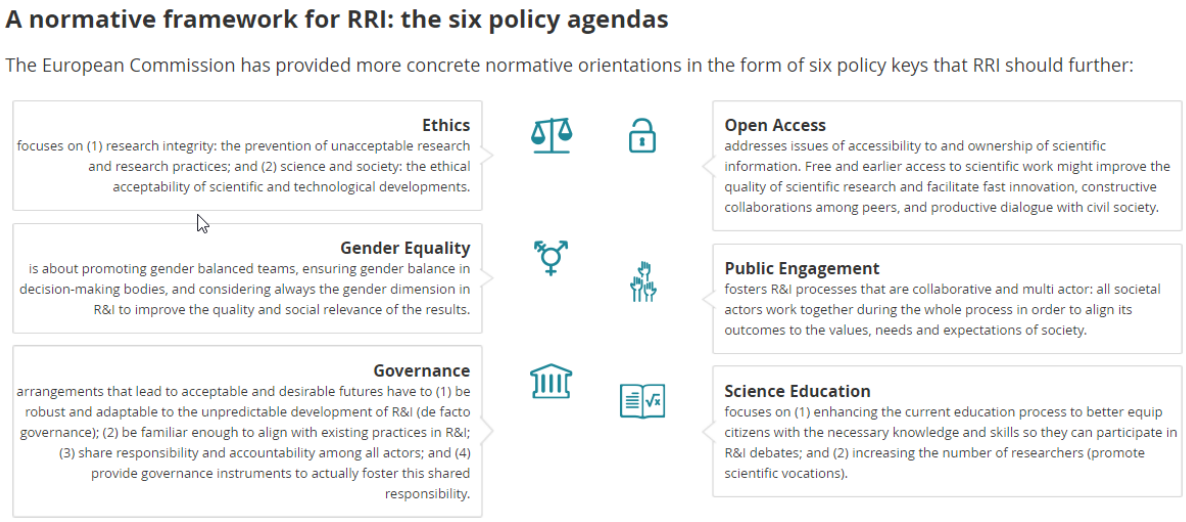

Figure 2: Six policy agendas to develop in Responsible Research and Innovation.

In the following section, we propose a set of short exercises that can be carried out by a group of educators and school staff, even including the participation of students, parents or counsellors. This exercises can be used as a self-reflection tool to start analyzing how RRI-oriented their practices are.

2.2.1. Self-reflection exercises

Practice 1 - How RRI are you?

Objective: To get to know better basic RRI principles and reflection areas on key questions, either individually or with your colleagues.
When/who: Small group of educators in informal meetings or working groups.
Duration: 30’ per session.
Preparation: The link to RRI Tools video for the Education Community should be shared with the participants in advance.
Activity: Reflection on professional practices at organisation level in an open discussion. For this activity, the following key questions are recommended: • *What does RRI mean to me and to my context?* • *What relevant aspects to my work are already being taken into consideration?* • *Which relevant aspects need more reflection and consideration?* • *In which kind of activity or event could I integrate RRI dimensions and how?*

- *How do I see my organisation collaborating with other stakeholders?*
- *Which stakeholders would I consider collaborating with (museums, policy makers, researchers, industry, etc.)?*
- *What do these kind of practices have to do with my organisation values, programme, objectives etc.?*

Practice 2 - RRI Obstacle and Opportunities map in our school

Objective: To reflect on specific aspects related to the implementation of RRI principles at school or in a classroom activity, with colleagues.

When/who: In meetings with teachers and school staff.

Duration: Two sessions, 30' each.

Preparation: Section 1.1 and 2.1 of this booklet and the link to RRI Tools video for the Education Community should be shared with the participants in advance. It would also be useful to select 2 or 3 educational resources from Section 3 of this booklet or from the RRI Tools toolkit to provide concrete examples of RRI in practice.

Activity 1: Obstacles and Opportunities

This exercise is carried out in small groups of 4 or 5 people. The following question should be presented: *Think of RRI in education: To what extent do you think RRI and its processes can and should inspire STEM education*? After a general reflection, the following steps should be followed:

- **Reflect on specific obstacles and opportunities of RRI processes**
- **Write, at least, 3 obstacles (in red) in different cards**
- **Write, at least, 3 opportunities (in green) in different cards**

A summary of the Obstacles and Opportunities map of the ideas is built by sticking the cards on a flipchart. These can be organised by obstacles and opportunities, by aspects or by stakeholders involved (for example: tools and processes, outcomes or objectives).

For further information on this exercise: The Xplore Health showcase

Activity 2: How to improve your educational activities

This exercise is carried out in small groups, the steps below should be implemented.

- Select one educational resource, activity or practice.

- Read one of the templates in Section 3 of this booklet (depending on the type of activity selected) and briefly reflect, with your group, on the guidelines and examples chosen.
- Outline a short proposal on how to integrate one or more RRI dimensions regarding the selected activity.

For further information on this exercise: The Xplore Health showcase

Practice 3 - School project simulation

Objective: To simulate a meeting to plan the implementation of RRI principles in a school activity while engaging different stakeholders and including a practical approach.

When/who: In meetings with educators, school staff and other interested parties, such as students, parents, local authorities, cultural organisations, museums or industry partners.

Duration: 1 hour per session.

Preparation: The link to the article How to integrate RRI in secondary education **is shared with** the participants, in advance.

During the 10' sessions' introduction, a particular goal, scenario and workflow for the activity should be disclosed, as well as the rationale of the "how to" article.

Afterwards, a particular scenario for the practical implementation of the "how to" should be introduced. For example, organizing of a meeting, such as an open day at a secondary school.

In order to develop the mentioned scenario, the following group roles should be randomly assigned to different students:

- **A head master**
- **Different STEM teachers (biology, chemistry, physics, etc.)**
- **Teachers of other disciplines (art, economics, language etc.)**
- **School lab technicians**
- **School counsellors**
- **Educators from local museums (natural history, contemporary art etc.)**

As a last remark, the educator should ensure that RRI principles are introduced, at all times, during this activity.

Activity 1 - Work with the "how to" (30')

- Read individually or in groups the How to integrate RRI in secondary education.
- Have a quick look at the resources of the mentioned link, briefly reading the first page summary.
- Take notes on the usability and usefulness of the "how to" (structure, language, level of the content) and provide feedback.

Activity 2 - Group reflection (20')

- Put together notes and comments on the usability level of the "how to".
- Including a facilitator, make a basic clustering activity, using the terms Usable and Useful, using flip charts.

Practice 4 - Stakeholders exercise

Objective: To kick-off the implementation of RRI principles in one or more school wide activity, such as an open day, allowing all parties to reflect on their role and level of engagement.

When/who: In meetings with educators, school staff and other interested parties, such as students, parents, local authorities, cultural organisations, museums, industry partners etc.

Duration: 2 sessions, 1 hour each.

Preparation: The website of the Xplore Health project and the sections 1.1. and 2.1 of this booklet should be shared in advance with participants. It is suggested to read briefly all the materials and watch one video from the project's resource repository.

Activity 1 (1 hour)

An exercise about different contexts and about collaboration between stakeholders is carried out and participants are asked to outline a scenario of multi-stakeholder collaboration for an existing initiative selected by the group. The following steps should be followed:

- Mapping the stakeholders involved and the aims of different collaboration - In groups, choose one of the worksheets for students and explore how it invites them to collaborate with different actors.
- Analyse the different stakeholders involved and the aim of the interactions.
- End by sharing the results with the group.

For further information on this exercise: The Xplore Health showcase, p. 20

Activity 2 (1 hour)

A process exercise is carried out about the engagement during different phases of the R+I process. Particularly, participants are asked to reflect on the level of engagement and the different phases of the initiative as well as about the group of stakeholders identified in Activity 1.

- Participants should reflect about STEM education within the different phases of the R+I process and write the conclusions on a flipchart.
- Participants should share the results with their groups. During a plennary session, each group will present a flipchart with the conclusions extracted on the topic of the engagement of different stakeholders in R+I phases.

For further information on this exercise: The Xplore Health showcase, p. 21

2.2.2 The RRI Toolkit for educators

The full RRI Tools Toolkit for educators includes **the RRI Tools portal, along with the collection of existing resources identified and described during the project's length, as well as additional resources added through the RRI Community of Practice and by the RRI Tools partners** (including this handbook).

The portal is accessible to registered and non registered users. A registered user has access to additional functionalities, such as posting events and contributions to the forum, adding resources to the Toolkit and commenting and rating existing resources.

Specifically, the RRI Toolkit offers:

- Different landing pages focusing on benefits, needs, and obstacles of each stakeholder (including the Education community) and of each policy agenda (including Science education).
- A self-reflection tool that, as we have presented, supports reflection on the application of Responsible Research and Innovation in any context.
- A resources database (including a search engine page) that allows filtering by stakeholder, topic, type of resource or expertise required, among others.

As mentioned, a specific section of the portal is dedicated to the RRI Tools Community of Practice, with the aim to support multi-actor collaboration and the sharing of knowledge (events, forum etc.).

For an initial usage of the Toolkit, the following steps are suggested:

- Explore one of the landing pages in education and its content (either by stakeholder or policy agenda).

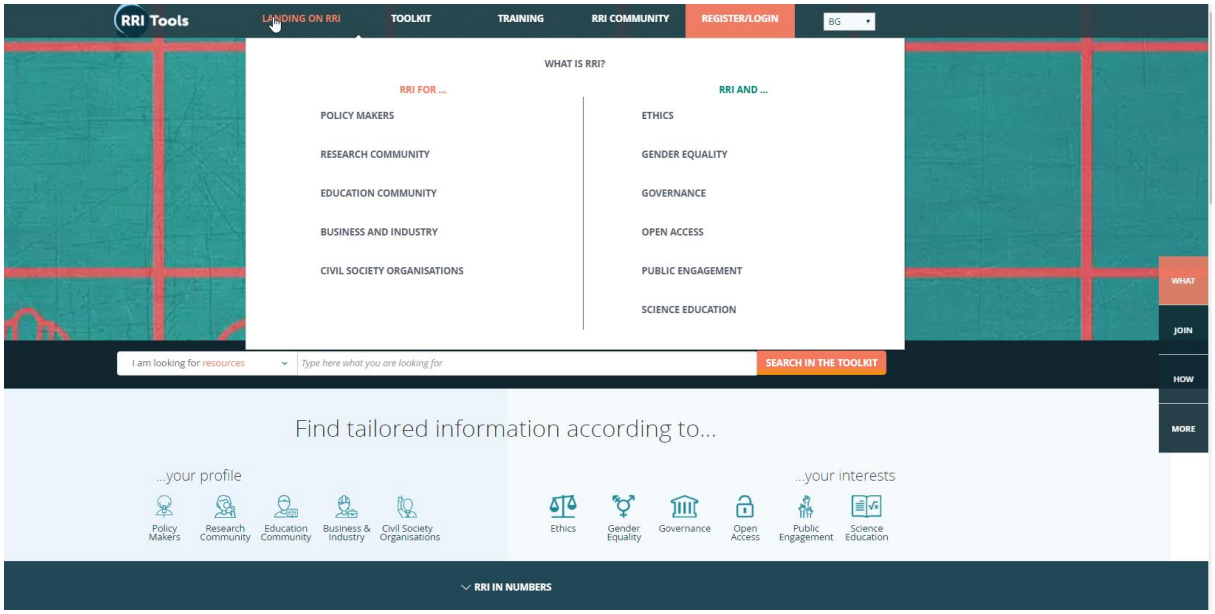

Figure 3: "Landing on RRI" options, by stakeholder and by policy agenda available in the RRI Tools website.

- Explore some of the resources showcased in the Toolkit landing page. Search for resources in the Toolkit and think about purposes and needs the resources should match (for example, general information about RRI in education, specific educational resources for science teaching, interesting projects with activities at national level etc.), using the keyword search and the basic filter by type (library, tools, projects and inspiring), stakeholder (Education community) and -if relevant- agenda (Science Education).

- Refine the search using the additional filter (function 'more filters') on different categories, such as expertise or language.

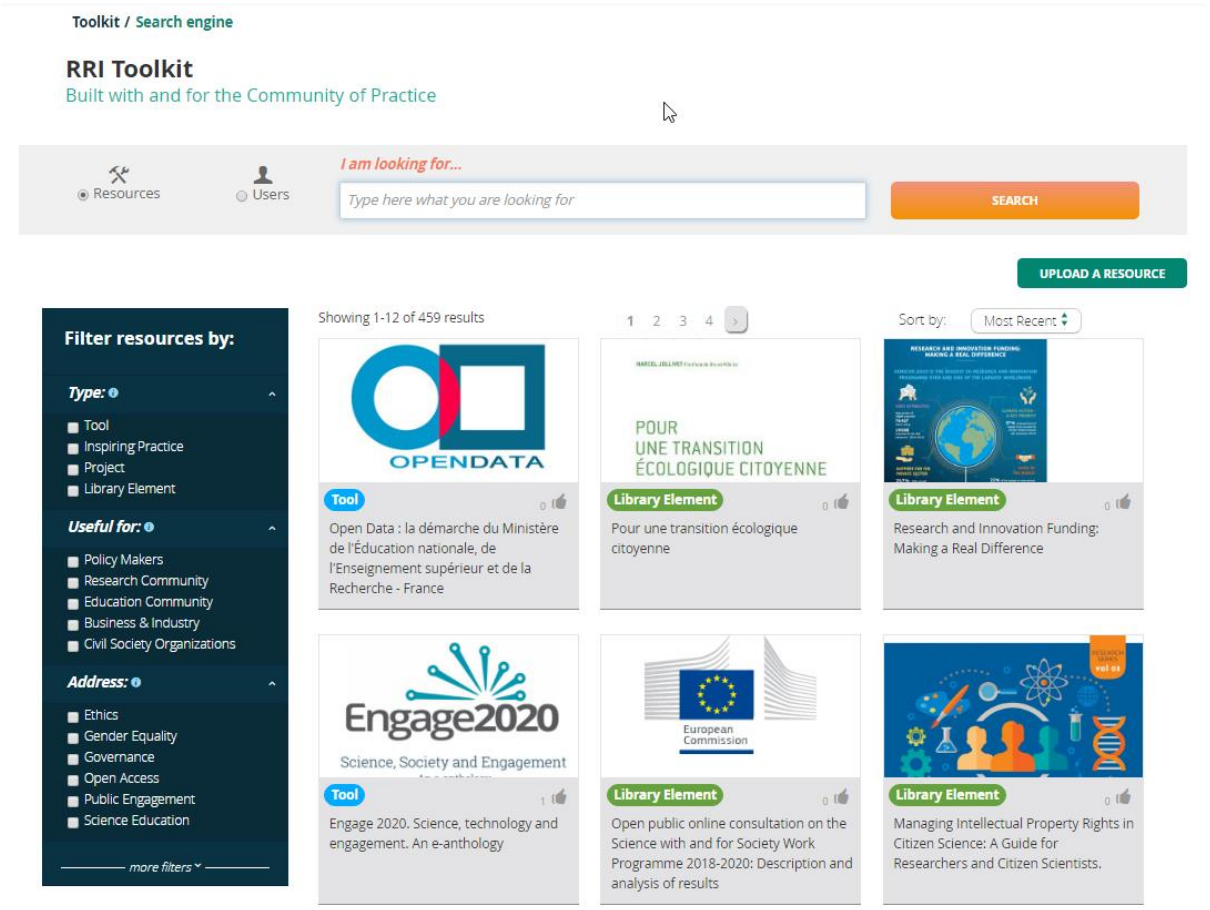

Figure 4: Search engine option available on the RRI Tools website

For an advanced usage of the Toolkit, the following steps are suggested:

- Register as a user of the Community of Practice;
- Complete the personal profile information;
- Search and connect with other users of the Community;
- Interact with the Toolkit resources (voting, commenting and sharing existing resources, opening a new conversation in the forum);
- Create and upload a new Toolkit resource.

For further information on the toolkit structure and functionalities: RRI Toolkit training module

3. RRI at school

3.1. Integrate RRI in everyday school activities

A. RRI-oriented creation process of educational resources and practices

In this section, a process and templates to design RRI-oriented educational practices are proposed. In particular, the set contains a **general template that describes the overall process** –with guidelines relevant for any type of practice- and **3 extra templates for a specific set of activities**: (1) Getting started with RRI (2) Experiments and labs activities and (3) Reflection and dissemination.

These templates are created to support educators in designing academic practices integrating RRI dimensions and principles for any subject chosen and for both primary and secondary school levels (depending on the type of activity). Their main aim is to provide guidelines to **set up a dynamic process of creating educational resources and to foster capacity building and cooperation among teachers and any other relevant stakeholders within a school, a district or a wider community.**

This design process is supposed to support the creation of practices that can be easily:

- Tested and adjusted;
- Shared with other teachers and re-used by them;
- Revised in time, adapting content, methods and processes;
- Adapted to other subjects matters and contexts, including translating them in other languages.[1]

The mentioned templates and these guidelines support a collaborative workflow, in order to make the creation process explicit, shareable and re-usable and to foster reflection at any stage. In this sense, **we suggest to make the template and the guidelines available along the practices, when sharing them with other educators or when uploading them in an online repository.**

Last, the templates are thought to support the design process of an RRI school-wide initiative, which can be carried out along the school year (or along multiple years) and across different disciplines. Nonetheless, each template can also be used independently to create one or two stand-alone activities.

B. Workflow to get started

[1] For more information on the concept of Open Educational Resources and how to re-use, adapt and redistributed these resources, you can consult the handbook ''Going open with LangOER''.

Understanding RRI principles

- Read the two introductory chapters of this handbook ("What is RRI?" and "RRI for you").
- Focus, in particular, on the RRI process dimensions, on the project stages and on the examples for the links between process dimensions and project stages.
- Take a look at some of the other resources proposed. We suggest to read the two "how to's", dedicated to the educational community[2] and to science education.

Approaching the design process

- Briefly read the general template for an overview of the process and to see how it can be linked with your current practice design processes. You might notice many common aspects.
- Start analising your context (students' age, subject/s, curricula) and how this new practice is going to be linked and/or embedded in your past, current and/or future activities.
- Consider potential collaboration with other teachers or stakeholders and reflect on timing and on an approach to contact and involve them, both for designing and implementing the activities.
- Think about practices and content you may already have and have a look at the list of inspiring practices and resources we suggest at the end of each activity template (Getting started with RRI, Experiments and labs activities, Reflection and dissemination). Take notes on the ones you would like to further use.
- Select the template activity closer to your idea for the new practice.

Drafting the key aspects of the practice

- Choose a template and start taking notes into each section.
- Keep the third section of the template (Reflecting and Adapting) in a separate sheet and use it to take notes on your process while you design, get in contact with others, reflect on a method, etc.
- Jot down a brief description of the main activities, content and methods.

[2] How to integrate RRI in secondary education - http://www.rri-tools.eu/how-to-stk-ec-integrate-rri-in-secondary-education -How to Introduce RRI at school through project- and inquiry-based learning in STEM - www.rri-tools.eu/how-to-stk-ec-introduce-rri-at-school-through-project-and-inquiry-based-learning-in-stem

- Think of previous knowledge and learning outcomes both for you (other colleagues or stakeholders) and for your students. Refine the content and activities to match this reflection.
- Start describing how your activities, methods and content relate to RRI dimensions.
- Describe how the learning outcomes relate to RRI dimensions.

Refining and revising in cycles

At this point, you may have an outline of your new practice. Therefore, it is suggested to:

- Start adding notes in all the other sections of the template, such as resources, materials, timings, etc.
- Revise all sections in cycles, as you go refining each aspect in each section.
- Describe the RRI processes involved in your practice in the introductory section, step by step, anytime you add a new element of the aspects of the practice.

C. How to use the templates?

The general template is not a rigid framework. Instead, **its aim is to document the creation process in its dynamicity,** in particular to support a further revision of the practice and the opportunity to share it with other educators. In that sense:

- Templates are not meant as static forms to be filled in;
- The order of the sections does not necesarily represent the workflow to be followed;
- Not all sections need to be completed (it depends on the users' context);
- Different sections can be written at different times;
- In order to encourage collaborative work with other teachers, the practice is intended to be designed and revised in cycles.

An educational practice can be inspired by existing good practices and the design process might aim at linking existing resources in a way that implements RRI principles and dimensions. Therefore, in each activity template, a list of existing projects, tools and practices is provided as sources of inspiration. Many of the materials suggested are available online in the form of OER – Open Educational Resources[3] and/or with a variety of Creative Commons' licenses[4].

Moreover, **in each practice, it is important to identify and describe a number of key aspects,** such as age group, learning outcomes, subjects/s, operational details (like timing)

[3] What is OER? - https://wiki.creativecommons.org/wiki/What_is_OER%3F

[4] Creative Commons website - http://creativecommons.org/

or content and methodologies, and to reflect and explain how each of these items is related to RRI dimensions[5]. For each of these key elements, guidelines are provided in the general template as well as specific prompts, examples and a list of existing resources.

The last section of the template contains **three steps that inspire a further reflection and a revision process:** Obstacles and opportunities, Testing and Adjustments and Tips to implement.

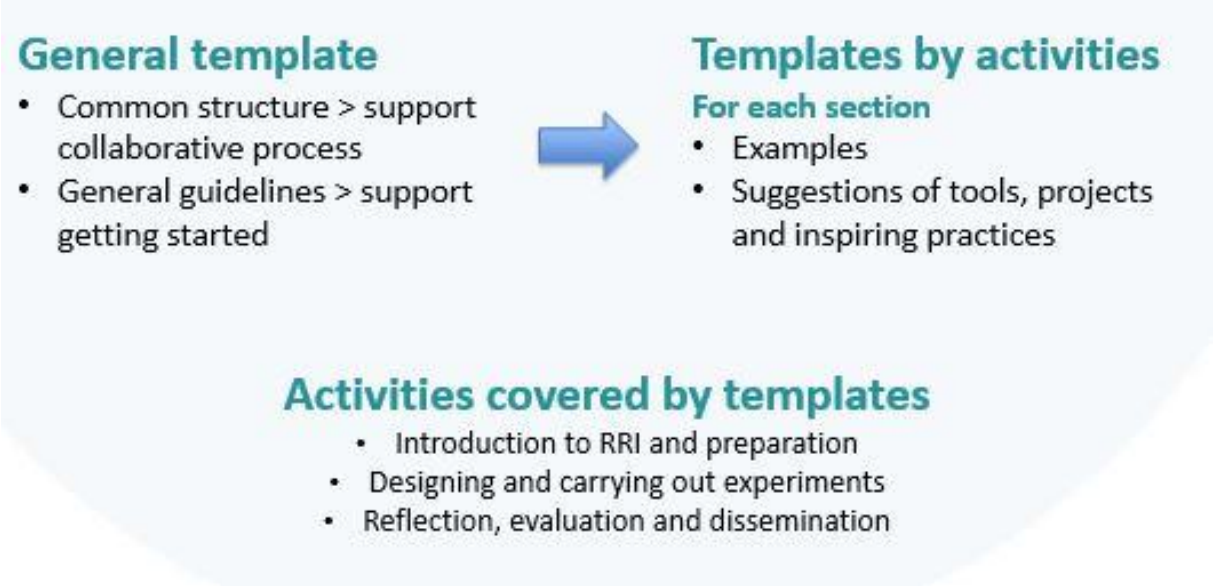

Figure 5: Framework of use for the general template and the templates by activity

D. Tips and suggestions to design practices

The content of these tips has been collected from several sources and with the support of experts and teachers participating in a STEM-related training organised by European Schoolnet.[6]

Practice design

Engagement and participation of a variety of stakeholders

- ***Tip:*** *Think of practices and projects that can be implemented not only at school level. Include external collaboration with families, local policy makers, citizen science associations, other schools (at local, national and international level), research centres, researchers, etc.*

Time estimation and balance

[5] RRI Tools Process dimensions - http://www.rri-tools.eu/about-rri

[6] Comments provided by E.Tasiopoulou (Science Project manager, EU Space Awareness project), V. Pinzi (Science Projects Officer, RRI Tools project) and M. Oubella (contributor).

- ***Tip:*** *Provide realistic estimations of the time educators will need in order to carry out the suggested activity, including any "preparatory time".*
- ***Tip:*** *In terms of balance between length of the activity and quantity of factual and conceptual knowledge provided, try to focus on 1 or 2 concepts for each activity and avoid introducing too many concepts in one lesson.*

Clarify and make explicit scope and requirements for each practice

- ***Tip:*** *Describe the aim and the learning outcomes at the beginning of the practice.*
- ***Tip:*** *Include information about previous knowledge required for students. When previous knowledge is needed, consider adding links and references to external resources, too.*
- ***Tip:*** *Consider any possible constraints and make them explicit.*

Practice implementation

Link to context and other initiatives

- ***Tip:*** *Think of links to frame or include the practice in existing events at local or wider level, such as ''day of…'' initiatives, students' contests, local open days, etc.*

Link across curricula and subjects

- ***Tip:*** *Contemplate multi-disciplinarity and how any educational practices can connect a variety of subjects with other scientific ones. For example: music and ICT; science and art; coding and physics; language and science communication, etc.*

Methods and contents

Integration of tools and ICT tools

- ***Tip:*** *Include the use of technology, for example, to collaborate with other schools, to support inclusion and diversity in planning activities and on giving feedback (through online questionnaires for parents/schools or through other online feedback tools) and make use of apps and online games for science activities.*
- ***Tip:*** *Consider using a mix of ICT resources, mobile apps and real models, as alternatives to choose from during the implementation of your practices.*

Sources of information

- ***Tip:*** *Provide students with key guidelines on how to search and select information, online and offline.*
- ***Tip:*** *Try to avoid using unknown online resources or resources you haven't checked in advance, since not all content is always reliable.*

E. Educational practice design – General template

Introductory information about your practice	
Description for distribution	This section has to be completed once the design process is finished and it is ready to use externally, to share it with colleagues or to distribute online through open education tools. This basic information will help others find and select materials easily and according to their needs. • Title: • Authors: • Organisation: • Brief description: what, main context and objective, for whom, etc. • License: please, see references to OER and Creative Commons.
Activities dependency	Describe potential dependencies of this activity with others. Explain who is involved in the previous activities and how they contribute to this one, focusing -in particular- on sinergies between activities, classes or teachers. If relevant, add links to other materials or content modules that present and describe competences and activities.
RRI processes involved	Please, describe how this practice relates to each set of RRI dimensions. • Inclusion and Diversity • Anticipation and Reflection • Responsiveness and adaptive change • Openness and Transparency See description of the dimensions in Section 1 – What is RRI?
Age group **School level** **Curricula**	Describe the age group(s) the practice is designed for. You can provide suggestions on how it can be used and/or adapted for activities with other age groups. If relevant, describe the types of curricula the practice is designed for, based on the education system in your country as well as the links to the main curriculum modules and subjects, focusing on the

	multidisciplinary aspects. You can provide with suggestions or notes on how it can be adapted to be implemented in other curricula.
Previous knowledge for teachers	Describe previous knowledge, skills and competences required for teachers (you, your colleagues etc.) to carry out the proposed activity, focusing on RRI-related aspects.
Learning outcomes for teachers	Detail any learning outcomes of activities for teachers developed using the practice, also referring to specific steps and modules. You could also refer to the section above and to expected improvements in our or more of those areas.
Previous knowledge for students	Describe previous knowledge, skills and competences required for students to be able to carry out the proposed activity, focusing on aspects related to RRI principles: critical thinking and reflection, collaborative skills etc.
Learning outcomes for students	Detail learning outcomes of the activities developed for students using the practice, also referring to specific steps and modules. You could also refer to the above section and to expected improvements in our or more of those areas.
When and with whom to use this template	Indicate in which phase of your school planning the practice should be designed and implemented. Describe the stakeholders to be involved in the process and how to involve them (other teachers, school staff, students, parents, science museums or other civil society organisation, national and local authorities, research centres and individual researchers, industry partners etc.).
Inspiring practices and Attribution	List and provide links to practices and materials your activity is built upon or inspired by. Describe how these practices relate to RRI principles and/or how you introduce RRI aspects into these existing activities. Explain the licensing and copyright information (attribution) and how your practice uses those materials (modifications). Many educational resources are open and shared within different types of Creative Commons. See references about Creative Commons and Open Educational Resources.

<table>
<tr><th colspan="3">Content of the practice</th></tr>
<tr><td colspan="2">Activities

List and describe each activity the practice is composed by and identify the link with the RRI processes involved as described above.</td><td>Methods to apply

Describe which methods are used to carry out the activities listed above.

It is useful to include specific reference and links to theories, methods and other practices using similar methods and to the RRI dimensions explained above. For example, you could link each methods to one or more of those principles.</td></tr>
<tr><td rowspan="4">How?</td><td colspan="2">Time to design the practice

At the end of the process, add here a note about the time you spent to design the practice and the time for testing and adapting the practice before finalizing it (estimation).

This information will be very useful once you will need to revise it and for others teacher who would like to adapt it to their contexts and needs.

Time to carry out the practice

Explain in days and hours, module by module and activity by activity, the time estimated to carry out the practice.</td></tr>
<tr><td colspan="2">Stakeholders involved

As already done for the designing phase, explain the stakeholders involved in the practice and how to involve them.</td></tr>
<tr><td colspan="2">Resources and equipment

Briefly describe which resources and materials are needed, by activities or by method.

If relevant, provide external links or files as appendix to the practice.

If relevant, reflect and add a note on how the choice of resources and equipment is sustainable and support RRI dimension, such as Diversity, Inclusiveness and Openness, for example.</td></tr>
<tr><td colspan="2">Teaching and learning materials</td></tr>
</table>

	Briefly describe teaching/learning materials used during the practices and indicate if they were created specifically for this practice. If relevant, explain how RRI principles were integrated in the content of the learning materials. If relevant, reflect and add a note on how the choice of materials is sustainable and support RRI dimension, such as Diversity, Inclusiveness and Openness, for example. If relevant, provide external links or files as appendix to the practice. If you used other resources and/or modified them, please, list the originals with the appropriate attribution and your modifications, as done for inspiring practices.

Reflecting and adapting **This section can be filled in more than one step:** • **while designing and working with other stakeholders;** • **while experimenting the practice in class;** • **as a final reflection and before distributing it, to support further sharing, re-using and adaptation by other educators.** **Ideally, this is an ongoing documentation process.**	
Opportunities and Obstacles	This section is meant to collect your reflections on the opportunities and obstacles of the implementation of this practice and its RRI-oriented approach in relation to wider aspects, such as curricula design, educational contexts, resources availability, etc. These reflections may tackle also more conceptual aspects, such as resistance to change and process improvement in an organisation.
Testing and adjustments	This section is meant to collect reflections on the usage of the practices to support its revision and enhancement.
Tips to implement	This section is designed to provide other educators with your insight on how this practice can be implemented in school activities as well as any other practical aspects to consider.

3.2 Educational practices

3.2.1 Getting started with RRI

Introductory information about your practice	
Description for distribution	**This section has to be completed once you have finished your design process and you are ready to use it externally, to share it with colleagues or to distribute online through open education tools.** **These are the basic information that will help others to find your material and to select it quickly, if it matches their needs.** • *Title:* RRI and ethical dilemmas • *Authors:* Viola Pinzi, Demetra Hadjichambi, Marina Jiménez Iglesias. • *Organisation:* European Schoolnet. • *Brief description:* Module designed to be implemented in a subject titled "Human and Health", included within a didactic unit on the topic of DNA-Molecular Biology, addressed to 16-17 years old students. The course is supposed to be centered around the discussion of an ethical dilemma developed as an Inquiry Based Activity. In this case, the dilemma is related to the issue of "to what extent should scientists be allowed to alter and create living things". • *License:* See references about Creative Commons and Open Educational Resources.
Activities dependency	**Describe potential dependencies of this activity with others. Explain who is involved in the previous activities and how they contribute to this one, focusing in particular on synergy between the activities, classes, teachers, etc.** The activity is based in the integration of RRI principles in the subject of Biology and specifically in a didactic unit on DNA and Molecular Biology. Educators and students are expected to form synergies and to work together in the academic process that will lead to a debate activity, in a student-centred environment. Teachers and the school principal should be involved in the implementation of the debate. Students and teachers are encouraged to

	share their findings and/or open up the course activities to other members of the educational community, such as NGOs, politicians, scientists, journalists, etc. **If relevant, add links to other materials or content modules that present and describe competences and activities.**
RRI processes involved	**Please, describe how this practice relates to each set of RRI dimensions. See description of the dimensions in Chapter 1 – What is RRI?** • **Anticipation and Reflection** • **Inclusion and Diversity** • **Responsiveness and adaptive change** • **Openness and Transparency** This activity tackles the dimensions of (1) Anticipation and reflection, (2) Inclusion and Diversity, (3) Responsiveness and Adaptive Change and (4) Openness and transparency. • <u>Anticipation and reflection:</u> - Reflection on a number of Socio-Scientific Issues (SSI) while increasing students' abilities to take account of ethical considerations in current or future scientific endeavours. - Inclusion of deontological considerations applied to current or future scientific investigations. - Identification of students' interest and knowledge through initial dialogue on the topic of choice. • <u>Inclusion and Diversity:</u> - Participatory research, online collaboration, decision making processes and assignment of different tasks and roles. - Identification of research questions and working hypothesis through exploration processes, including collaborative games and classroom discussions. • <u>Responsiveness and Adaptive Change:</u> - Inclusion of pre and post analysis of scientific ideas and perspectives as well as self-reflection of own work routines.

	- Introduction of reflective practices related to emerging scientific concerns to increase students' societal sensitivity. • <u>Openness and transparency:</u> - Through the activities' interactive nature, increased receptiveness to the involvement of different stakeholders in scientific processes and R+I practice.
Age group **School level** **Curricula**	**Describe the age/s group the practice is designed for.** **You may provide suggestions on how it can be used and/or adapted for activities with other age groups, also partially.** The activity is designed to be developed with secondary school students, preferable within the ages from 16 to 17. **If relevant, describe the types of curricula the practice is designed for, based on the education system of your country, and the links to the main curriculum/a modules and subjects and to other relevant subjects, focusing on multidisciplinary aspects.** **You may provide suggestions or notes on how it can be adapted to be implemented in other curricula.** The practice is thought to be implemented in the unit of DNA-Molecular Biology, according to the Cypriot national curricula (http://www.moec.gov.cy/dme/en/gymnasium.html). ✓ *N.B. Originally, the activity was thought to be implemented in 3 secondary education classes from a same education centre, in Cyprus. However, through a suggestion from the Ministry of Education, the practice has been implemented all over the country, in more than 50 classes.*
Previous knowledge for teachers	**Describe previous knowledge, skills and competences required for teachers (you, your colleagues etc.) to carry out the proposed activity, focusing on RRI-related aspects.** • <u>Pedagogical skills:</u> - Educators should be reasonably acquainted with debating practices, including the leading and moderation of speeches and discussions as well as with the format of the practice itself. - They should equally be able to implement classroom core values such as respect for one another and for others' opinions, fairness and objectivity etc.

	- Capacity to support team activities and to differentiate the roles and needs of each student will also be an asset.
Learning outcomes for teachers	**Detail learning outcomes of activities developed using the practice, also referring to specific steps and modules. You could also refer to the above section and to expected improvements in our or more of those areas.** • <u>Pedagogical skills:</u> - *Improved skills:* Teachers should have improved, through practice, their skills on leading and moderation of speeches and discussions. In particular, regarding paraphrasing, clarifying points, encouraging open discussions, leading to open-ended questions, balancing students dynamics, identifying bad behaviors, etc.). o *E.g. related to the "ethical dilemma" activity*: Through experience in structured (e.g. debate) and non-structured (e.g. classroom deliberation) discussions with students. - *Improved skills:* Enhanced understanding on how to transmit students core values through a number of different activities in the classroom. o *E.g. related to the "ethical dilemma" activity:* Especially relevant when conducting activities where pupils are supposed to collaborate with each other. - *Improved skills:* Enhanced capacity to differentiate pupils' needs, capacities and burdens, to interpret individual students' thinking and to promote collaborative learning. o *E.g. related to the "ethical dilemma" activity:* Acquired through observation of student's dissimilar behaviors and roles in different academic situations. • <u>Communication skills:</u> - *New skills:* Effective spoken communication with other members of the educational community, such as parents or other teachers. o *E.g. related to the "ethical dilemma" activity:* Through the planning and implementation of an RRI debate, educators

	get more acquainted with including other further relevant actors in pure academic activities.
Previous knowledge for students	**Describe previous knowledge, skills and competences required for students to be able to carry out the proposed activity, focusing on aspects related to RRI principles: critical thinking and reflection, collaborative skills etc.** • <u>Collaborative skills:</u> - Commitment to accept discussion outcomes and group decisions and to a continuous communication among peers as well as to promote core classroom values such as fairness and respect. • <u>Reflection skills:</u> - General problem-solving and critical thinking abilities, including tolerance of others' ideas and impartibility. - Basic capacity to understand abstract concepts, to relate theoretical with practical concepts and to understand how different work fields are related. • <u>Content skills:</u> - Students should have been previously taught concepts related to: Structure of DNA / stem cells / genetic modification / different applications of biotechnology. - Students should have been previously taught concepts related to Responsible Research and Innovation, in the field of human health, specifically in DNA experimentation.
Learning outcomes for students	**Detail learning outcomes of the activities developed using the practice, also referring to specific steps and modules. You could also refer to the above section and to expected improvements in our or more of those areas.** • <u>Collaborative skills:</u>

	- *Improved skills:* Increased commitment to accept discussion outcomes and group decisions and to a continuous communication among peers.
	  o *E.g. related to the "ethical dilemma" activity:* By enacting any discussion or debating assignment, students learn to communicate, reflect and compare others opinions, to critique other viewpoints in a constructive manner, etc.
	
	• <u>Reflection skills:</u>
	- *Improved skills:* Enhanced general problem-solving and critical thinking skills.
	  o *E.g. related to the "ethical dilemma" activity:* Understanding of different perspectives through games and debates helps students to think outside of the box and to have an open mind.
	- *New skills:* Capacity to make informed and evidence-based choices about the social implications of STEM disciplines.
	  o *E.g. related to the "ethical dilemma" activity:* Reflection processes on DNA modification and related issues will encourage students to reflect on the many ethical dimensions of this and other current scientific debates, while improving their capability to make better informed decisions.
	
	• <u>Content skills:</u>
	- *Improved skills:* Development of scientific knowledge and greater understanding of the links between STEM disciplines and its social outcomes.
	  o *E.g. related to the "ethical dilemma" activity:* In particular, increase in their social awareness in the field of molecular biology and alteration of DNA.
	- *New skills:* Identification of emerging needs through reflection on the ethical sustainability and social desirability of scientific outcomes related to the ethical debates on alteration and creation of living things.

	○ *E.g. related to the "ethical dilemma" activity:* Specifically, understanding of how Research and Innovation processes can be directly related to current social debates. • <u>Oral and public speaking skills:</u> - *New skills:* Ability to deliver complex messages effectively, appropriate structuring of speeches and logical organization of ideas, rebating of opinions, summarizing of concepts and development of argumentative skills. ○ *E.g. related to the "ethical dilemma" activity:* The more a student reflects on a subject, the easier to understand, summary, transmit or rebate its key messages. • <u>Responsiveness skills</u> - *New skills:* Increased familiarity with RRI dynamics and iterative processes by which all stakeholders involved in the R+I practice become mutually responsive and responsible in its processes and outcomes. Better understanding of how different stakeholders are able to influence decision-making processes related to Socio-Scientific Issues and how they can engage within the scientific community by becoming active citizens. ○ *E.g. related to the "ethical dilemma" activity:* By participating in R+I and SSI debates, students become active, instructed students and understand how different actors become engages in participatory decision-making processes.
When and with whom to use this template	**Indicate in which phase of your school planning the practice should be designed and implemented.** The practice will be programmed at the beginning of the year in order to be able to appropriately integrate the course within the school curriculum. **Describe the stakeholders to be involved in the process and how to involve them (other teachers, school staff, students, parents, science museums or other civil society organisation, national and local authorities, research centres and individual researchers, industry partners etc.).**
Inspiring practices	**List and provide links to the practices and materials your activity built upon or is inspired by.**

and Attribution	**Describe how these practices relates to RRI principles and/or how you introduce RRI aspects into these existing activities.** Existing practices to build upon and/or inspirational for RRI implementation: <u>Resources repositories:</u> • *Resource name:* Engage • *What is it?* Website of the Engage project, containing a number of materials, including lesson plans and classrooms activities. • *How does it relate to RRI?* Diversity and Inclusion, Anticipation and Reflection www.engagingscience.eu/en • *Resource name:* Inspiring Science Education • *What is it?* The webpage of the Inspiring Science Education contains a complete digital tools repository including teaching scenarios and lesson plans. • *How does it relate to RRI?* Diversity and Inclusion, Anticipation and Reflection http://portal.opendiscoveryspace.eu/repository-tool <u>RRI Resources:</u> • *Resource name:* RRI Tools – 20 Tips for High-school Students Engaging in Research with Scientists. • *What is it?* This resource involves an article providing a list of 20 tips for high school students interested in taking part in research processes. • *How does it relate to RRI?* Anticipation and Reflection http://www.rri-tools.eu/-/tips_high_school_tools • *Resource name:* SiS Catalyst. Diversity and Inclusion Map • *What is it?* Self-assessment tool developed in the form of a Diversity and Inclusion map for organisations and practitioners who are involved in science engagement programmes with children.

	• *How does it relate to RRI?* Diversity and Inclusion http://www.siscatalyst.eu/dimap <u>Debate/discussion resources:</u> • *Resource name:* NanOpinion project. Discussion game • *What is it?* Games to help students engage in a discussion about a specific topic. • *How does it relate to RRI?* Anticipation and Reflection, Responsiveness and Adaptive change http://nanopinion.eu/en/dialogue-activity-kit/nanopinion-theatrical-discussion-game.html • *Resource name:* Xplore Health. Games to engage in debates • *What is it?* Games to engage in a discussion about a specific topic. • *How does it relate to RRI?* Anticipation and Reflection, Responsiveness and Adaptive change http://www.xplorehealth.eu/en/resources-for-educators (Search keyword: Discussion game) • *Resource name:* PlayDecide. Discussion game • *What is it?* Games to help students engage in a discussion about a specific topic. • *How does it relate to RRI?* Anticipation and Reflection, Diversity and Inclusion. www.playdecide.eu • *Resource name:* Padlet • *What is it?* A virtual wall that lets users share their thoughts on a common topic. It is displayed as an online sheet of paper that accepts different types of content (such as images, videos, documents, text, etc.).

	• *How does it relate to RRI?* Anticipation and Reflection, Diversity and Inclusion. https://padlet.com/ • *Resource name:* Tricider • *What is it?* Online tool for that helps in brainstorming and voting tasks. It is especially useful in decision making processes or crowdsourcing activities. • *How does it relate to RRI?* Anticipation and Reflection, Diversity and Inclusion. http://www.tricider.com/ • *Resource name:* Kahoot! • *What is it?* Learning game based on question rounds and designed to be played in a group setting, such as a classroom. • *How does it relate to RRI?* Anticipation and Reflection, Diversity and Inclusion. https://getkahoot.com/how-it-works <u>Exploration resources</u> • *Resource name:* Wolfram • *What is it?* Engine designed to provide with knowledge. It integrates an immense store of expert-level knowledge and algorithms to automatically answer questions, do analysis, and generate reports. • *How does it relate to RRI?* Anticipation and Reflection, Responsiveness and Adaptive Change http://www.wolframalpha.com/tour/what-is-wolframalpha.html • *Resource name:* Study Blue • *What is it?* Collaborative learning ecosystem that empowers its users to master any subject. Students can connect with others who

	are on similar learning environment through a shared library of user-generated content. • *How does it relate to RRI?* Anticipation and Reflection, Responsiveness and Adaptive Change http://www.studyblue.com/about/ • *Resource name:* Wikipedia • *What is it?* A free encyclopaedia, written collaboratively by its users. It is organized through a wiki, a special type of website designed to make collaboration easy. • *How does it relate to RRI?* Anticipation and Reflection, Responsiveness and Adaptive Change https://en.wikipedia.org/wiki/Wikipedia:Introduction Information sharing and dissemination resources • *Resource name:* Google docs • *What is it?* Web-based editing program that allows users to create, share and edit documents through a secure networked system. • *How does it relate to RRI?* Responsiveness and Adaptive Change https://www.google.com/docs/about/ • *Resource name:* Dropbox • *What is it?* Online storage service to organize photos, docs, videos, and files. • *How does it relate to RRI?* Responsiveness and Adaptive Change https://www.dropbox.com/tour/ • *Resource name:* Apache Open Office • *What is it?* Open-source office software suited for word processing, spreadsheets, presentations, graphics, databases, among others. • *How does it relate to RRI?* Responsiveness and Adaptive Change

	https://www.openoffice.org/why/ • *Resource name:* Popplet • *What is it?* Tool that allows users to visualize ideas by creating graphic organizers, timelines, as well as other forms of visual organization. It can be used both as a brainstorming tool and a presentation tool. • *How does it relate to RRI?* Responsiveness and Adaptive Change http://popplet.com/ **Explain also the licensing and copyright information (attribution) and how your practice uses those materials (modifications). Many educational resources are open and shared within different types of Creative Commons.** See references about Creative Commons and Open Educational Resources.

Content of the practice

Activities	**Methods to apply**
List and describe each activity the practice is composed by and identify the link with the RRI processes involved as described above. • The initial course exploration of the ethical dilemma should be organized with the aim of posing an ethical dilemma; It is recommended to organize it in different phases. 1. Exploration and collection of students' arguments. The exploration phase should be understood as a systemic way to study (or even to manipulate) data with the aim of finding relations between	**Describe which methods are used to carry out the activities listed above.** • Methods related to the initial exploration of the ethical dilemma. 1. Methods related to the collection of students' arguments - As guidance for brainstorming ideas and to gather and organize concepts, students should be presented with an array of tools: a) Exploratory engines such as Wikipedia or Wolfram (e.g. wolfram)

different variables and eventually, to formulate an ethical dilemma. - Students should first gather all information necessary to conceptualize the dilemma, including exploring and retrieving information from different sources. - Educators should lead students in the collection process. In particular, they should encourage them to utilise online search engines as a way to gather information and to conceptualize ideas. - Educators are encouraged to incorporate role or game playing activities during this phase. 2. <u>Formulation of the ethical dilemma</u> - It is useful to formulate the ethical dilemma as a question. *E.g.:* The phrasing "To what extent should scientists be allowed to alter and create living things?" poses a STEM related quandary that can make students reflect about ethical concerns while tackling sustainability and responsiveness topics. - Nonetheless, the dilemma can also be formulated as a scientific or working hypothesis, so students are introduced to scientific research terms and methodologies. 3. <u>The ethical dilemma debate</u> - A debate can inspire students to engage and become more passionate about the topic previously explored. - It can be integrated as a part of the exploration phase, in order to create	b) "Question and Answer" online games to evaluate students' interest and knowledge on the topic (e.g. Kahoot) c) Online collaboration documents and shared spaces, as tools to exchange concepts (e.g. dropbox) d) Online resources to conceptualize and link ideas, to create concept maps, etc. (e.g. padlet). 2. <u>Methods related to the formulation of the ethical dilemma</u> - Students should be able to refer back to their hypothesis and questions throughout the whole activity. The use of virtual classroom walls and study cards is highly recommended. - For further investigation, students can be encouraged to manipulate data at a basic level. Some resources to help during this step could be: Educational games, tools to create graphics or modeling simulation software. - During this process, teachers are discouraged to point out any students' mistakes, giving them space to discover any mistakes by themselves and to be able to correct them. False hypothesis are a way to contribute to their leaning process. 3. <u>Methods related to the ethical dilemma debate.</u> The debate can be organized in different formats: a) A common debate format is to organize two teams of debaters (one in favour and another one against the topic of

further hypothesis and through the exchange of information between students. - It can also be carried out in the classroom or as a public debate, inviting an audience. - There are several debating games that can help educators carry on this activity. Some of these are available through the following platforms: a) The Playdecide platform. b) The Nanopinion projects. c) The Xplore Health website. *E.g.* The "Discussion Continuum Game" within the Xplore Health platform.[7] *Example: How to play the "Discussion Continuum Game" from the Xplore Health project.* - Students will copy some of the ethical, legal and socio-economic questions available in the Discussion Continuum game onto the board and answer them individually. - The game should be played as explained in the mentioned instructions. It is recommended to (a) start off with just 6 cards, as playing with all of them can complicate game play and (b) to play in groups of 5 or 6 students. - The groups should compare their order of cards with the other groups.	discussion) who will take turns in posing and rebating discussion points, while a moderator organizes the turns. This type of debate usually incorporates time limits and a final verdict by the moderator. b) Another option is to substitute the discussion teams for a single person debate. c) Other formats include the moderator suggesting questions previously drafted by the audience, or letting the mentioned audience to ask them directly to the debaters. - If working in teams, students should always be organized in an heterogeneous way to ensure equity. - The educator should encourage students to assume challenging roles and must ensure that the leadership positions do not always lay on the same student or group of students. *Example: How to moderate a debate?* - In any debate, ground rules should be established from the start. The moderator should start by asking a question to an initial debater, who has a set amount of time to respond. Once the first debator has finished, a debator from the opposing team will give a rebuttal. Some moderators allow for a good back-and-forth to keep going. Other formats are stricter.

[7] All URLs are available and accessible in the previous section

- Each group should find arguments both for and against each of the cards. This video can help finding some ideas: http://www.xplorehealth.eu/en/media/biotechnology-and-ethics - Finally, all groups should return to the questions they started off with on the board and decide whether they have changed their opinions after the debate. 4. Discussion post-debate After the debate/game, the teacher should introduce key aspects in RRI, by presenting several questions. In the case of this ethical debate, some example questions could be: - RRI's aim to create a society in which research and innovation practices work towards sustainable, ethically acceptable, and socially desirable outcomes and - RRI as a dynamic, iterative process by which all stakeholders involved in the R+I practice become mutually responsive and share responsibility regarding both the outcomes and processes involved.	- During the final debate judgement, it is typical for the moderator to assign a winner. The moderator should ensure a total objectivity in this decision and give a number of reasons for this decision. 4. Methods related to the discussion post-debate - In any discussion activity, educators should take into account group activity processes. In particular: a) Allow the presentation of multiple opinions and perspectives. b) Be sensitive for cultural differences in presenting styles, recognizing that different standards can be applicable. c) Be aware of any particular problems and of the experiences of visibly underrepresented students in the classroom.
How	**Time to design the practice.** **At the end of the process, add here a note about the time you spent to design the practice and the time for testing and adapting the practice before finalizing it (estimation).** **This information will be very useful once you will need to revise it and for others teacher who would like to adapt it to their contexts and needs.** • Design of the module - around 8 hours. • Design of the leaflet (simultaneous to the development of the leaflet) – around 2 hours.

	N.B. All time orientations are indicative. It is recommendable to keep a flexible approach during the preparation and execution of all activities. **Time to carry out the practice.** **Explain in days and hours, module by module and activity by activity, the time estimated to carry out the practice.** The implementation of the activity is designed to last around 3 x 1.5 hours, integrated in a whole year subject entitled "Human and Health". The time allocated for each of the activities is shown below: - Exploration phase, which can include a range of different activities: - Introduction and collection of information about the ethical dilemma "To what extent should scientists be allowed to alter and create living things?" - Game playing activity - Formulation of questions or hypothesis in relation to the ethical dilemma - around 1.5 hour (x2 classes) - Ethical dilemma open debate - around 1.5 hour (x1 class) - Post-debate classroom discussion - around 0,5 hours (optional) *N.B. All time orientations are indicative. It is recommendable to keep a flexible approach during the preparation and execution of all activities.*
	Stakeholders involved As already done for the designing phase, explain the stakeholders involved in the practice and how to involve them. *Key stakeholder 1:* Students. *Why?* Activity main end-user. *When?* During all activity phases. *Key stakeholder 2:* Teachers. *Why?* Main providers of knowledge and responsible for planning and execution of the activity *When?* During all activity phases. *Desirable stakeholder 1:* Members of the educational community (other teachers and students) *Why?* Bringing the topic to a wider audience and sharing experiences with peers. *When?* During the Openness and Reflection phase (Debate activity) *Desirable stakeholder 2:* Representatives of civil society (promoters of cultural and scientific activities for the wider audience). *Why?* Bringing

	the topic to a wider audience and involving different actors in academic STEM ventures *When?* During the Openness and Reflection phase (Debate activity) *Desirable stakeholder 3*: Researchers and other STEM professionals *Why?* Create links between students and the professional and research STEM community *When?* During the Openness and Reflection phase (Debate activity) *Other stakeholders:* Students' parents and families Why? Involve students personal and academic environment to encourage students to pursue educational activities outside the educational center *When?* During the Openness and Reflection phase (Debate activity)
	Resources and equipment **Briefly describe which resources and materials are needed, by activities or by method.** **If relevant, provide external links or files as appendix to the practice.** **If relevant, reflect and add a note on how the choice of resources and equipment is sustainable and support RRI dimension, such as Diversity, Inclusiveness and Openness, for example.** The equipment required for this practice is, at least, one electronic devise (laptop, tablet, etc.) to show the multimedia content necessary for the activity. Nonetheless, to ensure the maximum interaction of students during the exploration process, it would be helpful if -at least- one electronic devise could available per small group of students. A specific venue might also be necessary in order to accommodate the debating activities.
	Teaching and learning materials **Briefly describe teaching/learning materials used during the practices and indicate if they were created specifically for this practice.** **If relevant, explain how RRI principles were integrated in the content of the learning materials.** **If relevant, reflect and add a note on how the choice of materials is sustainable and support RRI dimension, such as Diversity, Inclusiveness and Openness, for example.** **If relevant, provide external links or files as appendix to the practice.** • *Resource name:* Xplore Health

	• *What is it?* Webpage to carry out advanced searches among all the educational resources offered by the Xplore Health project. • *How does it relate to RRI?* Anticipation and Reflection http://www.xplorehealth.eu/en/resources-for-educators • *Resource name:* Xplore Health - Biotechnology and ethics • *What is it?* In this video, different experts from around the globe share their opinions about the limits of science, whether it is ethical to create artificial life or to select embryos to improve quality of life. • *How does it relate to RRI?* Anticipation and Reflection • http://www.xplorehealth.eu/en/media/biotechnology-and-ethics • *Resource name:* Xplore Health: Biotechnology revolution • *What is it?* Discussion game to discuss whether it is right to allow scientists to alter and create organisms, its limits and impact. The following resource offers a way to incorporate these discussion questions (as a game) in the classroom. • *How does it relate to RRI?* Anticipation and Reflection http://www.xplorehealth.eu/en/discussion-games-biotechnology-revolution?arg0=node&arg1=92 If you used other resources and/or modified them, please, list the originals with the appropriate attribution and your modifications, as done for inspiring practices.

Reflecting and adapting

This section may be filled in more than one step:

- **while designing and working with other stakeholders**
- **while experimenting the practice in class**
- **as final reflection, before distributing, to support further share, re-use and adaptation by other educators**

This is ideally an ongoing documentation process.

Opportunities and Obstacle	**This section is meant to collect your reflections on opportunities and obstacles of the implementation of this practice and its RRI-oriented**

	approach in relation to wider aspects, such as curricula design, educational contexts, resources availability etc. **These reflections may tackle also more conceptual aspects, such as resistance to change and process improvement in an organisation.** <u>Opportunities</u> This activity approaches scientific concepts in a social and ethical manner, which translates in critical reflection processes on a number of social aspects. This makes it easier to incorporate it in activities and reflective practices outside the classroom. <u>Obstacles</u> Educators might encounter difficulties in addressing different students' skills. However, these should be solved through the assignment of different tasks and the recognition of different student experiences. **Add a reflection also on the implementation of RRI principles in general.**
Testing and adjustments	**This section is meant to collect reflections on the usage of the practices to support its revision and enhancement.** It is recommendable to encourage students to reflect on their group experiences during different project phases, in a regular manner. This will help them develop critical teamwork skills and strengthen their self-reflection skills. ○ *E.g. related to the "ethical dilemma" activity:* The educator can set up student questions, based on group project objectives. This will encourage pupils to further reflect on their own activities, to adapt them or to make any necessary changes to their work routines.
Tips to implement	**This section is to provide other educators with your insight on how this practice can be implemented in school activities, practical aspects to consider and to look out for.**

3.2.2 Educational practice: Experiments and labs activities

Introductory information about your practice	
Description for distribution	**This section has to be completed once you have finished your design process and you are ready to use it externally, to share it with colleagues or to distribute online through open education tools.** **These are the basic information that will help others to find your material and to select it quickly, if it matches their needs.** • *Title:* Experiments: Design and implementation of simple machines • *Authors:* Viola Pinzi, Tiina Kahara, Marina Jiménez Iglesias. • *Organisation:* European Schoolnet • *Brief description:* This practice involves the construction of simple machines (inclined plane, pulley, lever, wheel, wedge and screw) after a theoretical introduction on the topic. The activity finalizes with a classroom reflection of the students' project. • *License:* See references about Creative Commons and Open Educational Resources.
Activities dependency	**Describe potential dependencies of this activity with others. Explain who is involved in the previous activities and how they contribute to this one, focusing in particular on synergy between the activities, classes, teachers etc.** The activity is based on the topic of simple machines and it can be integrated in any technology related subject. Educators and students are expected to form synergies and to work together in a student-centred academic environment. **If relevant, add links to other materials or content modules that present and describe competences and activities.**
RRI processes involved	**Please, describe how this practice relates to each set of RRI dimensions. See description of the dimensions in Chapter 1 – What is RRI?** • **Anticipation and Reflection** • **Inclusion and Diversity** • **Responsiveness and adaptive change** • **Openness and Transparency**

	This activity tackles the dimensions of (1)Inclusion and Diversity, (2)Openness and transparency, (3) Anticipation and Reflection and (4) Responsiveness and Adaptive Change Inclusion and Diversity: • Production of knowledge on construction and usage of simple machines (including specific technology and technique behind it) to enrich students' technology literacy. • Critical reflection of group processes, values, routines and outcomes followed by inclusive and participative decision making through teamwork routines. Openness and transparency: • Improvement and sharing of available resources for other educators and students in the R+I system. Anticipation and Reflection: • Identification of students' interest and knowledge through initial dialogue on the topic of choice. Responsiveness and Adaptive Change: • Students' enhancement of their reflection and interpretation skills through the accomplishment of different work phases.
Age group **School level** **Curricula**	**Describe the age/s group the practice is designed for.** **You may provide suggestions on how it can be used and/or adapted for activities with other age groups, also partially.** The activity is designed to be developed with either primary or lower secondary school students. **If relevant, describe the types of curricula the practice is designed for, based on the education system of your country, and the links to the main curriculum/a modules and subjects and to other relevant subjects, focusing on multidisciplinary aspects.** **You may provide suggestions or notes on how it can be adapted to be implemented in other curricula.** The activity is adapted to the Finnish curricula. Accessible in Finnish National Board of Education website: http://www.oph.fi/english/education_development/current_reforms/curriculum_reform_2016

Previous knowledge for teachers	**Describe previous knowledge, skills and competences required for teachers (you, your colleagues etc.) to carry out the proposed activity, focusing on RRI-related aspects.** Pedagogical skills: • Educators should be reasonably acquainted with Inquiry Based practices and should have the capacity to ignite self-directed inquiry and curiosity-driven action in students. Especially, since teachers are advised to incorporate reflective and inquiry questions throughout the whole course. • Having a sound knowledge of Interactive learning processes is advisable, in order to be able to incorporate the usage of digital technology in the classroom.
Learning outcomes for teachers	**Detail learning outcomes of activities developed using the practice, also referring to specific steps and modules. You could also refer to the above section and to expected improvements in our or more of those areas.** • Pedagogical skills: - *Improved skills:* Improved familiarity with Inquiry Based practices to ignite self-directed inquiry and curiosity-driven action in students. o *E.g. related to the "Design and implementation of simple machines" activity:* By introducing IBSE activities in the classroom, educators will undergo trial and error processes that will enable them to acquire experience in this specific pedagogical approach. - *Improved skills:* Enhanced capacity to differentiate and act in regard to students' needs and to interpret individual student thinking. This is especially significant concerning younger pupils, as it is an opportunity to identify weaker/stronger learning areas from a very early age. o *E.g. related to the "Design and implementation of simple machines" activity:* If students work individually, educators will be able to distinguish different work methodologies when developing a similar project as well as any setbacks or particular abilities they might experience. • Anticipation and Reflection skills: - *New skills:* Ability to look back, reflect and –if necessary- make changes in different activity stages in order to adapt them to future works. o *E.g. related to the "Design and implementation of simple machines" activity:* Developing the "building of simple machines" activity in

	different stages (plan-design-construct, etc.) allows educators to scheme a plan and to distinguish between different tasks and the skills necessary to develop them.
Previous knowledge for students	**Describe previous knowledge, skills and competences required for students to be able to carry out the proposed activity, focusing on aspects related to RRI principles: critical thinking and reflection, collaborative skills etc.** • Collaborative skills: Commitment to the promotion of common goals, group decisions and to continuous communication among peers while challenging each other's ideas. • Reflection skills: Basic capacity to generate inquiry questions and to carry on problem solving activities while reflecting on owns work. • Content skills: Basic understanding of technology and engineering terms and how these are applied in basic construction activities.
Learning outcomes for students	**Detail learning outcomes of the activities developed using the practice, also referring to specific steps and modules. You could also refer to the above section and to expected improvements in our or more of those areas.** • Collaborative skills: - *Improved skills:* Increased commitment to achievement of shared goals and group decisions and to fostering continuous communication. Eagerness to giving and receiving feedback from peers, expanding on others ideas and in assisting in solving problems and achieving results. o *E.g. related to the "Design and implementation of simple machines":* Through the final evaluation activity, students will be able to share results. Besides, throughout the whole activity, pupils will be encouraged to give/receive feedback to each other in a constructive way. • Reflection skills: - *Improved skills:* Reflection of own work and improvement in problem-solving and critical thinking skills o *E.g. related to the "Design and implementation of simple machines":* By carrying out a project with several stages, students learn to reflect on how different phases have an impact on a particular end result. Students will also be able to compare and contrast multiple conceivable solutions, methods and technical systems and to give an opinion about it, according to definite criteria. • Content skills:

	- *New skills:* Development on the knowledge of simple technology and engineering terms and how these are applied in basic construction activities (e.g. simple/compound machines, wheel, inclined plane, gears, gravity, effort, distance, level pulley, wedge, motion, friction etc.)
	  o *E.g. related to the "Design and implementation of simple machines* – Students will learn to identify different types of simple machines along a number of physics principles and even to understand how technological processes are developed, as a whole.
	- *New skills:* Sensitization of future generations on the role that science and technology has in shaping our world and of their potential role as responsible users of technology, while encouraging them to become active citizens and to develop an entrepreneurial mind-set.
	  o *E.g. related to the "Design and implementation of simple machines"* – By carrying out an activity that produces a tangible usable object, students learn how they can work as creators and how they can cause an impact not only as technology users but also as technology creators.
	- *New skills:* Development of ingenious and innovative skills while understanding the possible constrains and challenges in different creative activities.
	  o *E.g. related to the "Design and implementation of simple machines"* – Through the construction of a simple machine, students will develop their innate creative skills, as they seek for tangible applications of engineering and physics concepts.

When and with whom to use this template	**Indicate in which phase of your school planning the practice should be designed and implemented.** The practice should be designed during the yearly school activities planning phase (usually carried out at the beginning of the year) in order to be able to appropriately integrate it within the course curricula. **Describe the stakeholders to be involved in the process and how to involve them (other teachers, school staff, students, parents, science museums or other civil society organisation, national and local authorities, research centres and individual researchers, industry partners etc.).**
Inspiring practices	**List and provide links to the practices and materials your activity built upon or is inspired by.**

and Attribution	**Describe how these practices relates to RRI principles and/or how you introduce RRI aspects into these existing activities.** Existing practices to build upon and/or inspirational for RRI implementation: <u>Debate/discussion resources:</u> • *Resource name:* NanOpinion project. Discussion game • *What is it?* Games to engage in a discussion about a particular topic. It supports the development of scientific literacy and the acquisition of key skills for STEM, such as inquiry and critical thinking skills. • *Relation to RRI principles:* Anticipation and Reflection, Inclusion and Diversity http://nanopinion.eu/en/dialogue-activity-kit/nanopinion-theatrical-discussion-game.html • *Resource name:* Xplore Health project. Activity: Games to engage in debates • *What is it?* Games to engage in a discussion about a particular topic. It supports the development of scientific literacy and the acquisition of key skills for STEM, such as inquiry and critical thinking skills. • *Relation to RRI principles:* Anticipation and Reflection, Inclusion and Diversity http://www.xplorehealth.eu/en/resources-for-educators - (Search keyword: Discussion game) • *Resource name:* PlayDecide. Discussion game • *What is it?* Games to engage in a discussion about a particular topic. It supports the development of teamwork skills and reflection of owns' work. • *Relation to RRI principles:* Anticipation and Reflection, Inclusion and Diversity www.playdecide.eu <u>Topic related activities:</u> (On construction of simple machines and other machinery): • *Resource name:* Design and Build a Rube Goldberg

	• *What is it?* Activity to design simple machines and to show that designs are meant to show the unnecessary complexities in machines, which sometimes result from modern technology. • *Relation to RRI principles:* Anticipation and Reflection https://www.teachengineering.org/activities/view/cub_simp_machines_lesson05_activity1 https://www.teachengineering.org/lessons/view/cub_simple_lesson01 • *Resource name:* Activity pack for simple machines – LEGO Teacher's guide • *What is it?* Activity pack and guide for the construction of simple machines using LEGO materials. • *Relation to RRI principles:* Anticipation and Reflection https://le-www-live-s.legocdn.com/sc/media/files/curriculum-previews/machines-and-mechanisms/9689-curriculum-preview-enus-d7064dc438d9eb4661a7db23e57c189d.pdf • *Resource name:* Handisciences –Float or sink • *What is it?* Pupils learn to distinguish what floats and what sinks, to highlight that the buoyancy of an object depends on the homogeneous material which constitutes it. Then they try to make a boat from a piece of putty. • *Relation to RRI principles:* Anticipation and Reflection http://www.scientix.eu/web/guest/resources/details?resourceId=8557 • *Resource name:* Handisciences – Electric carousel • *What is it?* A model electric carousel is presented to the class for students to discover how its different elements work and how to manufacture it. • *Relation to RRI principles:* Anticipation and Reflection http://www.scientix.eu/web/guest/resources/details?resourceId=8560 • *Resource name:* Building water rocket cars and water rockets • *What is it?* A Moodle course to take different ideas on how to build rocket cars and water rockets with children. - *Relation to RRI principles:* Anticipation and Reflection http://www.scientix.eu/web/guest/resources/details?resourceId=9471 • *Resource name:* Building an aqueduct

	• *What is it?* The resource provides information on the technical and historical aspects of aqueducts and contains numerous tips on setting up an experiment of the type. • *Relation to RRI principles:* Anticipation and Reflection http://www.scientix.eu/web/guest/resources/details?resourceId=9006 Entrepreneurship resources: • *Resource name:* Get your own business started • *What is it?* This resources guides students through an entire technological process in which they learn how to start their own technology business • *Relation to RRI principles:* Openness and Transparency http://www.scientix.eu/web/guest/resources/details?resourceId=9044 **Explain also the licensing and copyright information (attribution) and how your practice uses those materials (modifications). Many educational resources are open and shared within different types of Creative Commons.** See references about Creative Commons and Open Educational Resources.

Content of the practice		
What	**Activities** **List and describe each activity the practice is composed by and identify the link with the RRI processes involved as described above.** 1. Theoretical introduction to the topic: - In order to get pupils acquainted and interested on	**Methods to apply** **Describe which methods are used to carry out the activities listed above.** 1. Methods used in the introduction to the topic: - Students should make initial use of the scientific method, including observation,

	the project, educators could introduce the topic through one of these initial activities: - Showing students videos on ready-made projects (these are easily available on YouTube E.g.: search through the "simple machines projects" concept). This will allow students to see the end product achievable. - Asking students to find examples and take pictures of simple machines around them in order to use as inspiration to build their own. Students can also be asked to search for examples of simple machines they can find at home. - Educators must ensure that a minimum theoretic basis has been laid for students to understand the concepts of simple machines, its components and functionality. 2. <u>Simple machines building process:</u> a) Planning and designing - Teachers should decide whether pupils work individually, in pairs or in small groups. - Students will plan, design and draw a potential	reasoning, prediction and critical thinking methodologies. 2. <u>Methods used in the machine building process:</u> a) Planning and designing - Given the pyramidal structure of the activity (meaning that all phases are subject to the success and knowledge acquired in the previous one), reflection tasks can be inserted in between phases to make sure the student has acquired the appropriate skills and knowledge. - If students are working in groups, it is important for the educator to pay attention to the length of time students remain in a group, particularly if the group is not working well. - Tutoring activities or pair learnening can also be encouraged as students help each other within groups, especially during the construction process. - Educators should make an effort to create a cooperative environment within each group and among groups. b) Construction - Teachers should be monitoring the construction process as well as assessing self-performance and team performance and taking corrective actions if needed.

	machine for the educators' review. ○ The first step will be to design and draw a construction/machine that includes three different simple machines. While the design process of this activity is initially thought to be done on paper, teachers can also incorporate software that helps students develop the design while improving their technology skills. ○ The next step would be for students to think which materials are needed to create their simple machine. The educator can accompany this step with further content on the usage of certain construction materials. b) Construction - Pupils should proceed to the construction of each of their machines. For that, teachers can provide students with a set of specific practical guidelines that would help them in the construction process or can allow and encourage students to create their own, through a self-inquiry process.	4. <u>Evaluation and usage of simple machines:</u> - The implementation of the students' constructions in everyday situations can give students a sense of entrepreneurship. - It is useful to include specific reference and links to theories, methods and other practices using similar methods and to the RRI dimensions explained above. For example, you could link each method to one or more of those principles.

	3. <u>Evaluation and usage of simple machines:</u> - As a final activity, teachers should encourage students to evaluate their creations and to think of possible usages of the machines in different contexts such as the school, the household, etc. - As another final activity, teachers could show the usage of simple machines in relation to different STEM jobs and careers.	
How	**Time to design the practice** **At the end of the process, add here a note about the time you spent to design the practice and the time for testing and adapting the practice before finalizing it (estimation).** **This information will be very useful once you will need to revise it and for others teacher who would like to adapt it to their contexts and needs.** For the design of this practice, educators should dedicate about 8 hours. *N.B. All time orientations are indicative. It is recommendable to keep a flexible approach during the preparation and execution of all activities.* **Time to carry out the practice** **Explain in days and hours, module by module and activity by activity, the time estimated to carry out the practice.**	

This is an activity that should can be carried out during a number of lessons. In particular:

- For the theoretical introduction to the topic. 1 or 2 lessons of 60' each.
- For the planning and design of the simple machine. 1 or 2 lessons of 60' each.
- For the construction process of the simple machine. 3 or 4 lessons of 60' each.
- For the evaluation of the simple machine. 1 lesson of 60'.

N.B. All time orientations are indicative. It is recommendable to keep a flexible approach during the preparation and execution of all activities.

Stakeholders involved

As already done for the designing phase, explain the stakeholders involved in the practice and how to involve them.

- *Key stakeholder 1:* Students. *Why?* Activity main end-user. *When?* During all activity phases.
- *Key stakeholder 2:* Teachers. *Why?* Main providers of knowledge and responsible for planning and execution of the activity *When?* During all activity phases.
- *Desirable stakeholder 1:* Parents, as member of the educational community *Why?* In order to involve them in educational environments and to encourage them to participate in similar household activities with their children. In that matter, kids are kept in an instructive and educational environment at all times. *When?* After the activity is completed.
- *Desirable stakeholder 2:* STEM professionals (engineers, in particular) *Why?* As a way, for students, to understand the applicability of their projects in the professional world *When?* At any stage of the project.

	Resources and equipment **Briefly describe which resources and materials are needed, by activities or by method.** **If relevant, provide external links or files as appendix to the practice.** **If relevant, reflect and add a note on how the choice of resources and equipment is sustainable and support RRI dimension, such as Diversity, Inclusiveness and Openness, for example.** For this activity, a series of construction materials will be necessary: - For the design of the simple machine: Pens/pencils/crayons/markers, measured paper, rulers, etc. In the case that online software is incorporated, devises such as computers or tablets will be necessary. - For the construction of the simple machine: Hot glue, rubber bands, construction paper, cardboard, rubber bands, string, scissors, tape, boards, simple objects to lift etc. *N.B. In this section, only the basic resources and equipment requirements are covered. Others might be needed depending on specific demands that might arise.*
	Teaching and learning materials **Briefly describe teaching/learning materials used during the practices and indicate if they were created specifically for this practice.**

	If relevant, explain how RRI principles were integrated in the content of the learning materials. **If relevant, reflect and add a note on how the choice of materials is sustainable and support RRI dimension, such as Diversity, Inclusiveness and Openness, for example.** **If relevant, provide external links or files as appendix to the practice.** • *Resource name:* Simple Machines Types & Functions Kindergarten, pre-schoolers, kids • *What is it?* Animated video on simple machines. The video shows 6 basic types of simple machines: pulley, lever, wheel and axle, wedge, inclined plane and screw. The video is mainly addressed to primary education students. • *Relation to RRI principles:* Anticipation and reflection https://www.youtube.com/watch?v=ByLXZCP4ixc • *Resource name:* Simple machines Game • *What is it?* Through the website of the Museum of Science and Industry, in Chicago, we are offered with an online animated game that uses simple machine concepts in order to advance game platforms. • *Relation to RRI principles:* Anticipation and reflection http://www.msichicago.org/play/simplemachines/ • *Resource name:* What is an Inclined Plane? - Simple Machines | Mocomi Kids • *What is it?* Animated tutorial about the inclined plane, including its definition and usage. It includes an example to illustrate how the mechanical advantage of inclined planes. • *Relation to RRI principles:* Anticipation and reflection

	https://www.youtube.com/watch?v=igrMlzHL-qg • *Resource name:* What is a pulley? - Simple Machines | Mocomi Kids • *What is it?* Animated video on the pulley. It includes a definition of the parts of the pulley, the concepts of "load" and "effort" and of a "lifting machine" and its mechanical advantage in different pulleys systems. • *Relation to RRI principles:* Anticipation and reflection https://www.youtube.com/watch?v=LiBcur1aqcg • *Resource name:* What is a lever? - Simple Machines | Mocomi Kids • *What is it?* Animated video on the lever. It includes a definition of the essential terms related to a lever (load, fulcrum and effort), its usage and the different types of level available. • *Relation to RRI principles:* Anticipation and reflection https://www.youtube.com/watch?v=E8RA9Kw_IaE • *Resource name:* Wheel and axle - Simple Machines | Mocomi Kids • *What is it?* Animated video about the wheel and the axle. It includes definitions and examples of friction, gravitational force and frictional force. In which day to day activities do we see the wheel and the axle in our day to day activities. • *Relation to RRI principles:* Anticipation and reflection https://www.youtube.com/watch?v=ndT35aqDfAQ • *Resource name:* What is a wedge? - Simple Machines | Mocomi Kids • *What is it?* Animated video about the wedge. It includes its definition and usages. It also includes an explanation on the inclined angle. • *Relation to RRI principles:* Anticipation and reflection

	https://www.youtube.com/watch?v=LAAwZird80kn • *Resource name:* What is a screw? (With narration) - Simple Machines | Mocomi Kids • *What is it?* Animated video about the screw, its parts and how these affect its mechanical advantage and everyday usages of it. • *Relation to RRI principles:* Anticipation and reflection https://www.youtube.com/watch?v=dDEhrpFb1BU • *Resource name:* Six Simple Machine Project Using All Six Machines - Rube Goldberg • *What is it?* The video consists on the recording of a fourth grade American student who has made a construction including six simple machines in action. • *Relation to RRI principles:* Openness and transparency https://www.youtube.com/watch?v=VunNpfdw68g&feature=youtu.be **If you used other resources and/or modified them, please, list the originals with the appropriate attribution and your modifications, as done for inspiring practices.**

Reflecting and adapting

This section may be filled in more than one step:

- **while designing and working with other stakeholders**
- **while experimenting the practice in class**
- **as final reflection, before distributing, to support further share, re-use and adaptation by other educators**

This is ideally an ongoing documentation process.

Opportunities and Obstacle	**This section is meant to collect your reflections on opportunities and obstacles of the implementation of this practice and its RRI-oriented approach in relation to wider aspects, such as curricula design, educational contexts, resources availability etc.** **These reflections may tackle also more conceptual aspects, such as resistance to change and process improvement in an organisation.** **Add a reflection also on the implementation of RRI principles in general.** <u>Opportunities</u> - As a transversal topic, there is a relative ease in its integration within different fields/subjects and curriculum systems, especially considering that most primary education curriculums tend to be a lot less specialized than those in secondary education. Indeed, the activity includes concepts related to science, physics, engineering and mathematics. - While the course incorporates a construction activity, it is designed so it only requires the usage of easy-to-find materials. <u>Obstacles</u> - Difficulties might arise when addressing different students' skills, which can be solved through the assignment of different tasks (if working in groups) or by reinforcing particular skills by assigning specific responsibilities to each student (if working individually). - As the activity as a whole can entail a relatively long process, teachers should be able to transmit students, values of perseverance, stimulus and the skill to overcome dissatisfaction.
Testing and adjustments	**This section is meant to collect reflections on the usage of the practices to support its revision and enhancement.**

	• It is recommendable to encourage students to reflect on their group experiences in between project phases. This can help them develop critical teamwork skills and strengthen their self-reflection abilities. ○ *E.g. related to the "Design and implementation of simple machines"* – Educators can set up questions, based on the group project objectives. This will encourage students to further reflect on their own activities while encouraging them to adapt or make any necessary changes to their work.
Tips to implement	**This section is to provide other educators with your insight on how this practice can be implemented in school activities, practical aspects to consider and to look out for.** In order to implement the activity throughout different sessions, it is recommendable that students keep a record of previous tasks. The creation of worksheets where they can note any problems encountered or milestones achieved can be a useful idea. Another suggested activity can be taking pictures of students' progress or, at the beginning of the project, ask them to find examples of simple machines around them and to take pictures of them in order to use as inspiration.

3.2.3. Educational practice: Reflection and dissemination

Introductory information about your practice	
Description for distribution	**This section has to be completed once you have finished your design process and you are ready to use it externally, to share it with colleagues or to distribute online through open education tools.**

	These are the basic information that will help others to find your material and to select it quickly, if it matches their needs. • *Title:* Dissemination workshop in school fair: "Climate change awareness". • *Authors:* Viola Pinzi, Mohammed Oubella, Marina Jiménez Iglesias. • *Organisation:* European Schoolnet • *Brief description:* Students will carry on a dissemination activity focused on the area of "Climate change awareness" and will share content and/or recreate activities previously developed during a short school course on the same topic. The objective of the dissemination activity will be that of increasing awareness on climate change and other environmental concerns. • *License:* See references about Creative Commons and Open Educational Resources.
Activities dependency	**Describe potential dependencies of this activity with others. Explain who is involved in the previous activities and how they contribute to this one, focusing in particular on synergy between the activities, classes, teachers, etc.** The activity is based on the topic of climate change. Being this a multidisciplinary field, it can be integrated in different curriculum subjects (such as Mathematics, geography, ICT, physics etc.). While the final dissemination activity is mainly addressed to the educational community (students, teachers and families) it is still designed with the potential to approach civil society organizations (such as representatives of museums or NGOs) and other relevant actors in STEM education. Educators and students are expected to form synergies and to work together in the academic process that will lead to the dissemination activity on climate change in a student-centred environment. Similarly, students are supposed to collaborate heavily and rely on each other to pursue the course's objectives. Finally, parents are also supposed to inspire students -from home- by providing with an educationally stimulating environment that will encourage youngsters to explore how academic activities can be incorporated in out of school activities and non-formal contexts.

	If relevant, add links to other materials or content modules that present and describe competences and activities.
RRI processes involved	**Please, describe how this practice relates to each set of RRI dimensions. See description of the dimensions in Chapter 1 – What is RRI?** • **Anticipation and Reflection** • **Inclusion and Diversity** • **Responsiveness and adaptive change** • **Openness and Transparency** This activity tackles the dimensions of (1)Anticipation and reflection, (2)Inclusion and Diversity, (3)Responsiveness and Adaptive Change and (4)Openness and transparency. • *Anticipation and reflection:* - Students reflection on a number of societal problems (ethical considerations, social and environmental sustainability and responsibility etc.), particularly on their daily actions and consumer choices in relation to the environment. • *Inclusion and Diversity:* - Production of scientific knowledge on sustainability and climate change awareness, presented in an interdisciplinary manner. - Critical reflection of groups processes and results, values and routines as a way to encourage students to think about their work and study methodologies. - Promotion of inclusive and participative decision making through teamwork activities. • *Responsiveness and Adaptive Change:* - Involvement of a wider audience through the dissemination of the climate change activity in an educational event. - Students active societal involvement as responsible citizens is strongly encouraged throughout the whole course while students are taught about values, needs and expectations of society and about the sharing of responsibilities in relation to processes and outcomes of R+I practices. • *Openness and transparency:*

	- Improvement and distribution of available resources and methodologies for other educators and students in the R+I system in order to facilitate constructive collaboration and a productive dialogue among colleagues. - Increased receptiveness to others assessments and points of view.
Age group **School level** **Curricula**	**Describe the age/s group the practice is designed for.** **You may provide suggestions on how it can be used and/or adapted for activities with other age groups, also partially.** The activity is designed to be developed with secondary school students, preferable within the ages from 14 to 16. **If relevant, describe the types of curricula the practice is designed for, based on the education system of your country, and the links to the main curriculum/a modules and subjects and to other relevant subjects, focusing on multidisciplinary aspects.** **You may provide suggestions or notes on how it can be adapted to be implemented in other curricula.** The activity is adapted to the French curricula for collège (Intermediate school. Ages 11/12 to 14/15), to be specifically integrated in the "Sciences de la vie et de la Terre" subject. « http://www.education.gouv.fr/cid81/les-programmes.html#Sciences de la vie et de la Terre ». The activity can be easily incorporated in the troisième anne level (14-15 years old) as concepts on the topic of Earth history and environmental human responsibility are taught. It can also be integrated in sixième anne level (11-12 years old) where they tackle the topic of human intervention in their environment to ensure their alimentary needs.
Previous knowledge for teachers	**Describe previous knowledge, skills and competences required for teachers (you, your colleagues etc.) to carry out the proposed activity, focusing on RRI-related aspects.** • *Pedagogical skills:* - Educators should be reasonably acquainted with IBSE practices, including the leading of group discussions, the formulation of research questions, the reflection on students' experimental processes, etc. - Being familiar with Interactive learning processes (in order to incorporate the usage of digital technology) is highly recommended.

	- Capacity to support team activities and to differentiate the roles and needs of students is equally desirable.
Learning outcomes for teachers	**Detail learning outcomes of activities developed using the practice, also referring to specific steps and modules. You could also refer to the above section and to expected improvements in our or more of those areas.** • <u>*Pedagogical skills:*</u> • *Improved skills:* Increased experience in integrating IBSE practices in student-centred activities. o *E.g. related to the "Climate change" activity* – Through the leading of group discussions, development of Q+A sessions, activities to analyze results, etc. - *Improved skills:* Better capacity to integrate interactive learning processes (in order to incorporate the usage of digital technology) in the classroom. o *E.g. related to the "Climate change" activity* – Through the screening of online videos, by giving students access to websites of interest, etc. - *Improved skills:* Enhanced capability to differentiate and act in regard to students' needs, to interpret their individual thinking and to promote collaborative learning. o *E.g. related to the "Climate change" activity* – Through observation of student's behaviors and work routines, teachers should learn to differentiate and understand students' roles and necessities and to take them into account for further activities. • <u>*Openness and transparency skills:*</u> - *New skills:* Experience in establishing inclusive participatory multi-actor dialogues between different members of the educational community. o *E.g. related to the "Climate change" activity* – Particularly through the development of a number of discussion activities and a dissemination activity.

Previous knowledge for students	**Describe previous knowledge, skills and competences required for students to be able to carry out the proposed activity, focusing on aspects related to RRI principles: critical thinking and reflection, collaborative skills, etc.** • *Collaborative skills:* Sense of commitment to the promotion of common goals and group decisions and to continuous communication among peers. • *Reflection skills:* Basic problem-solving and critical thinking skills (as well as general willingness to reflect on own work behaviors and routines).
Learning outcomes for students	**Detail learning outcomes of the activities developed using the practice, also referring to specific steps and modules. You could also refer to the above section and to expected improvements in our or more of those areas.** • *Collaborative skills:* - *Improved skills:* Sense of commitment to shared goals and group decisions and to fostering continuous communication. Likewise, fresh eagerness to giving and receiving feedback from peers, assisting others in solving problems and achieving common goals. o *E.g. related to the "Climate change" activity* – By committing to develop and finish a set of tasks in groups through previous discussions on the topic. - *New skills:* Improvement of critical values through collaborative work, including fairness, reliance, accountability and mutual respect. o *E.g. related to the "Climate change" activity* – By working in a cooperative environment, developing tasks in groups and reaching a common goal students will learn about specific shared values. • *Reflection skills:* - *Improved skills:* Enhanced problem-solving and critical thinking abilities (and reflection of own work behaviours and routines). o *E.g. related to the "Climate change" activity* – By supporting IBSE methodologies along the course, students will be encouraged to think critically.

	- *New skills:* Capacity to make informed and evidence-based choices about society's environmental future and to become better citizens with the necessary knowledge to participate in R+I debates.
	  ○ *E.g. related to the "Climate change" activity* – Through the acquisition and improvement of more scientific knowledge related to societal issues, students will be able to make properly informed choices concerning environmental issues.
	• *Openness and transparency skills:*
	- *New skills:* Effective communication skills including ability to deliver and synthetize complex scientific messages, appropriate structuring of speeches, logical organization of ideas and capacity to lead discussions paired with basic public speaking skills, including oral fluency, interactive presentation, engagement techniques etc.
	  ○ *E.g. related to the "Climate change" activity* – Developed through team activities, Q+A sessions, discussion activities etc. (which stimulate the constant exchange of ideas with other students) as well as through the presentation of these discussions to a multiple and diverse audience.
	• *Content skills:*
	- *New skills:* Development of scientific knowledge and better understanding of the links between STEM disciplines and its societal outcomes. In particular, increase in their social awareness in the environmental field by assisting them with consumer choices, particularly.
	  ○ *E.g. related to the "Climate change" activity* – By linking academic and scientific terms with real world complexities in a personal context.
	- *New skills:* Identification of emerging needs through reflection on the ethical acceptance, sustainability and social desirability of STEM outcomes.
	  ○ *E.g. related to the "Climate change" activity* – By identifying their own social print, students become aware of their impact in the world in environmental terms and start their process to become ethical citizens.
	- *Entrepreneurial skills:*

	- *New skills:* Newly incorporated sense of initiative and entrepreneurship, transformed in the capacity to turn ideas into action and promotion of scientific vocations, among students. ○ *E.g. related to the "Climate change" activity* – Developed through the dissemination activity and the interaction with other STEM actors. Also, by making students learn the linkages between research processes and current societal agendas and civil society concerns.
When and with whom to use this template	**Indicate in which phase of your school planning the practice should be designed and implemented**. The practice should be designed during the yearly school activities planning phase (usually carried out at the beginning of the year) in order to be able to appropriately integrate the course in the curriculum as well as to plan it according to the dissemination event timing. During this initial phase, it is advisable for the educator in charge to initiate an event planning scheme (if directly organized in the educative centre) or about relevant local STEM events (if the activity is to be presented in a local/regional event) organized by members of the education field, from civil society organizations or other relevant members of the local community. **Describe the stakeholders to be involved in the process and how to involve them (other teachers, school staff, students, parents, science museums or other civil society organisation, national and local authorities, research centres and individual researchers, industry partners etc.).**
Inspiring practices and Attribution	**List and provide links to the practices and materials your activity built upon or is inspired by.** **Describe how these practices relates to RRI principles and/or how you introduce RRI aspects into these existing activities.** **Existing practices to build upon and/or inspirational for the implementation of the Climate Change activity:** *Dissemination/exhibition resources:* • *Resource name:* DESIRE Toolkit. • *What is it?* Guidelines to disseminate science education projects results in order to increase public engagement in STEM research processes. Particularly focused on reaching science event's organisers and science museums. • *Relation to RRI principles:* Openness and transparency

	http://www.rri-tools.eu/-/desire_tools (Chapter 1 - Section 4) • *Resource name:* IRRESISTIBLE project. Exhibition Development Guide. • *What is it?* Guidelines to develop an exhibition plan. • *Relation to RRI principles:* Openness and transparency https://issuu.com/institutodeeducacao-universidadedel/docs/development_guide_-_v2.2_web *Presentation resources:* • *Resource name:* Power Point • *What is it?* Presentation graphics package. It includes word processing, outlining, drawing, graphing, and presentation management tools. • *Relation to RRI principles:* Openness and transparency https://office.live.com/start/PowerPoint.aspx • *Resource name:* Prezi • *What is it?* Visual storytelling tool combining an open canvas with spatial dimension and motion and with the aim of making presentations more engaging. • *Relation to RRI principles:* Openness and transparency https://prezi.com/ • *Resource name:* Animoto • *What is it?* Software resource including a number of professionally designed video styles, licensed songs and video creation sources to help users produce quality videos easily. • *Relation to RRI principles:* Openness and transparency https://animoto.com/ • *Resource name:* Storybirds • *What is it?* Online tool developed to help users make visual stories quickly and easily. • *Relation to RRI principles:* Openness and transparency https://storybird.com/ • *Resource name:* Google Photos

	• *What is it?* Photo and video sharing and storage service featuring unlimited photo and video storage. • *Relation to RRI principles:* Openness and transparency https://photos.google.com/ • *Resource name:* Flickr • *What is it?* Online resource that enables users to upload, access, organize, edit, and share photos from different devices. • *Relation to RRI principles:* Openness and transparency https://www.flickr.com/ • *Resource name:* Photobucket • *What is it?* Image and video hosting website, web services suite, and online community dedicated to preserving and sharing the entire photo and video lifecycle. • *Relation to RRI principles:* Openness and transparency http://s5.photobucket.com/ Topic related activities (climate change) • *Resource name:* The Systems Thinking Playbook for Climate Change - A Toolkit for Interactive Learning. • *What is it?* This Playbook aims to help experts, advocates and educators to be more effective in talking with groups about climate change and promoting interactive learning on the topic. For this purpose, twenty-two interactive games are offered and described to help increase the effect of workshops, speeches and conversations on the topic. • *Relation to RRI principles:* Anticipation and Reflection, diversity and inclusion http://www.rri-tools.eu/-/the-systems-thinking-playbook-for-climate-change-a-toolkit-for-interactive-learning • *Resource name:* What do we know about climate change? The evidence for climate change • *What is it?* Document including a number of facts about climate change • *Relation to RRI principles:* Anticipation and Reflection, Responsiveness and Adaptive change

	http://www.scientix.eu/web/guest/resources/details?resourceId=3603 • *Resource name:* Envkids response natural resources management pilot (my planet) • *What is it?* Pilot activity focusing on raising awareness on sustainable management of natural resources such as forests, biodiversity and water. It presents scientific data on forest coverage, deforestation rates, water resources per capita, emissions and species threatened by climate change and the consequences of the current practice in natural resource management. It is built upon the Google Earth platform. • *Relation to RRI principles:* Anticipation and Reflection, Responsiveness and Adaptive change http://www.scientix.eu/web/guest/resources/details?resourceId=3212 • *Resource name:* Footprint calculator • *What is it?* Different resources including information about ecological footprints and the resources to calculate it. • *Relation to RRI principles:* Anticipation and Reflection, Responsiveness and Adaptive change. http://footprint.wwf.org.uk/ - WWF http://www.footprintnetwork.org/en/index.php/GFN/page/calculators/ - Global Foodprint Network **Explain also the licensing and copyright information (attribution) and how your practice uses those materials (modifications). Many educational resources are open and shared within different types of Creative Commons**. See references about Creative Commons and Open Educational Resources.

Content of the practice		
What	**Activities** **List and describe each activity the practice is composed by and identify the link with the RRI processes involved as described above.**	**Methods to apply** **Describe which methods are used to carry out the activities listed above.**

	Creation of the "Climate change awareness" course. Although the original course is planned to last a month, divided in 2-hour sessions per week, a course of this type could follow different structures. Below an example:
	
	1. <u>Theoretical sessions within the "Climate change awareness" course</u>
	
	The theoretical part of the course is planned as the introductory basis for the courses' practical sessions and as the framework to implement the dissemination activity but is not the focus part of this activity.
	
	2. <u>Practical sessions within the "Climate change awareness" course</u>
	
	- Reflection on the concepts learned in the classroom and development of a decision-making process on what and how to include in a dissemination activity. This should include:
	  ○ Choice of content to be incorporated in the dissemination activity. It can be an overview of all the ideas presented throughout the course or an extension of a specific topic tackled beforehand. It can incorporate a practical activity, too. E.g.: Carbon Foot print calculator the practical
		1. <u>Methods related to the creation of the "Climate change awareness" course.</u>
		
		- Methods related to the theoretical sessions of the "Climate change awareness" course
		
		- To encourage students' engagement, the introduction to the topic can be done using audiovisual resources. E.g.: Through the screening of informative videos.
		
		- Following this introductory part, students should be familiarized with the content and thus able to reflect on it. This can be done through several activities:
		  ○ Q+A session on the subjects previously discussed and introduction of any other topics that might arise
		  ○ Development and implementation of a Mapper app type of activity to link and to fix the concepts previously learned.
		
		2. <u>Methods related to the practical sessions of the "Climate change awareness" course</u>
		
		- In order to increase students' abilities to make a proper and organized oral speech, they could be assigned to work on a report describing every step of the work process.

	activity in focus, followed by results' interpretation for critical reflection on the topic. ○ In regard to the content chosen, teachers and/or students should select a specific type of dissemination activity (Oral presentation, workshop, poster exhibition, interviews etc.) ○ Creation of supporting materials with key information on the content to be presented. - Students' rehearsal of the dissemination activity (taking into account a potential audience) 3. <u>Dissemination of the "Climate change awareness" course.</u> Students will have to apply the theoretical and practical content learned throughout the course in an academic event. *How (and what) to present?* - The dissemination activity on the Climate Change awareness topic can be developed in different formats: a) Presentation style, including speeches, interviews, a Questions and Answers (Q+A) session, etc.	- It is essential to encourage students to come up with creative ways to communicate their work. This could be facilitated through the provision of different resources: a) Recordings of previous presentations/workshops on the same topic. b) Previously developed materials that could be reused during the dissemination event. c) Tasks that provide with tips to improve students' oral communication (pronunciation lessons, etc.) - The resources provided should vary depending on the dissemination activity chosen. 3. <u>Methods linked to the dissemination of the "Climate change awareness" course</u> *What roles to assign?* - While a number of students would be assigned the main roles of presenting, other students can be in charge of any technical needs. - Another group of students could be in charge of recording the dissemination activity, to later reflect on it. - A third group could be in charge of taking pictures and even of sharing them through social media.

	b) Workshop about activities developed throughout the course, including experiments, educational games, etc. c) Formal/informal debate over particular ideas that might have controversial while learning the course' topics. *Where to present?* - There are different events where the course could be disseminated: a) School fair b) School open day c) STEM local/regional event etc. - If the dissemination activity will be held during an event directly organized by the school, it is advisable for teachers to be directly involved in the logistics.	- There should be, at least, one student responsible of taking minutes of the session. *What tools to use?* Different presentation tools can inspire creative and engaging presentations. These should be chosen depending on the dissemination format. - Presentation/Exhibition: From PowerPoint, Prezi or Open Office Impress for a simple presentation, to Windows Moviemaker, Animoto or Storybirds as a movie making tool. Students can also use Photo sharing and editing tools such as Picasa, Instragram, Snapchat, Flickr or Photobucket. - Debate: Social Media outlets such as Twitter can be incorporated to let a possible audience to pose questions. - Workshop: the tools used would have to be determined in relation to the type of experiment or activity that is performed. It is useful to include specific reference and links to theories, methods and other practices using similar methods and to the RRI dimensions explained above. For example, you could link each method to one or more of those principles.

How	**Time to design the practice** **At the end of the process, add here a note about the time you spent to design the practice and the time for testing and adapting the practice before finalizing it (estimation).** **This information will be very useful once you will need to revise it and for others teacher who would like to adapt it to their contexts and needs.** • Process of acquaintance with RRI principles – around 3 hours • Initial study, planning and design of the "Climate change awareness" course in relation to RRI principles – around 5 hours • Desk research for content and methodologies to develop the "Climate change awareness" course – around 4 hours • Additional reflection tasks (and testing activities) can be carried out at the end of the process or in between phases, as a way to enhance reflection processes. – Up to 2 or 3 hours *N.B. All time orientations are indicative. It is recommendable to keep a flexible approach during the preparation and execution of all activities.* **Time to carry out the practice** **Explain in days and hours, module by module and activity by activity, the time estimated to carry out the practice.** "Climate change awareness" course execution – 8 hours (2h per weekly session during a month) "Climate change awareness" dissemination activity execution – 30' to 45' minutes for its enactment. Showcase of static material during event – Depending on the length of the event but usually around 1 or 2 days. (optional, depending on the dissemination format) *N.B. All time orientations are indicative. It is recommendable to keep a flexible approach during the preparation and execution of all activities.*
	Stakeholders involved **As already done for the designing phase, explain the stakeholders involved in the practice and how to involve them.**

	• *Key stakeholder 1:* Students. *Why?* Activity main end-user that should be given skills to invigorate their employability and sensitized in relation to climate change topics. *When?* During all activity phases. • *Key stakeholder 2:* Teachers. *Why?* Main providers of knowledge and responsible for planning and execution of the activity. These should contribute to enhance teaching methodologies and curriculum materials for a better incorporation of RRI principles in school activities *When?* During all activity phases. • *Desirable stakeholder 1:* Member of the educational community (other teachers and students) *Why?* So students have the possibility to share, compare and contrast opinions, knowledge and experiences with other members of the educational community that might be involved in similar activities. *When?* During the Openness and Reflection phase. • *Desirable stakeholder 2:* Representatives of civil society (promoters of cultural and scientific activities for a wide audience). *Why?* To help and/or participate in the Dissemination event. Also, to bring the topic to a wider audience and to involve different actors in STEM research ventures. *When?* During the Openness and Reflection phase. • *Other stakeholders:* Parents. *Why?* Involving the parents always entails a positive outcome for students, as it helps parents understand the educational activities the kids are doing and it ignites them to participate in them. *When?* During the Openness and Reflection phase.
	Resources and equipment **Briefly describe which resources and materials are needed, by activities or by method.** **If relevant, provide external links or files as appendix to the practice.** **If relevant, reflect and add a note on how the choice of resources and equipment is sustainable and support RRI dimension, such as Diversity, Inclusiveness and Openness, for example.** • *For the implementation of the "Climate Change Awareness" course:*

	- Computer equipment to show interactive materials to students. If necessary, provide each student with a digital devise so they can work with course materials on their own. • *For the presentation of the "Climate Change Awareness" activity:* - Electronic equipment (laptop, tablet, projector, etc.) for the showcase of different interactive dissemination materials. - Different supplies to create any dissemination materials (e.g. posters) needed for the course dissemination activity. - Camera or video recorder - Any other specific resources needed for the enactment of a workshop. - Venue for rehearsals and to carry on the event itself (if the event is directly organized by the school)
	Teaching and learning materials **Briefly describe teaching/learning materials used during the practices and indicate if they were created specifically for this practice.** **If relevant, explain how RRI principles were integrated in the content of the learning materials.** **If relevant, reflect and add a note on how the choice of materials is sustainable and support RRI dimension, such as Diversity, Inclusiveness and Openness, for example.** **If relevant, provide external links or files as appendix to the practice.** • *Resource name:* Introductory videos - Natural and Human causes of global warming. • *What is it?* Animated videos with explanations on the topic of global warming and climate change. • *Relation to RRI principles:* Anticipation and Reflection, Responsiveness and Adaptive change, Openness and Transparency. - https://www.youtube.com/watch?v=ddu80ZFk5tk – Natural causes of Global Warming https://www.youtube.com/watch?v=pbBb-SvRFjM – How Do We Know Global Warming is Human-Caused? • *Resource name:* Foot print calculator.

	• *What is it?* A free source to use Carbon Footprint Calculator for individuals and households • *Relation to RRI principles:* Anticipation and Reflection, Responsiveness and Adaptive change, Openness and Transparency. http://www.carbonfootprint.com/calculator.aspx **If you used other resources and/or modified them, please, list the originals with the appropriate attribution and your modifications, as done for inspiring practices.**

Reflecting and adapting

This section may be filled in more than one step:

- **while designing and working with other stakeholders**
- **while experimenting the practice in class**
- **as final reflection, before distributing, to support further share, re-use and adaptation by other educators**

This is ideally an ongoing documentation process.

Opportunities and Obstacle	**This section is meant to collect your reflections on opportunities and obstacles of the implementation of this practice and its RRI-oriented approach in relation to wider aspects, such as curricula design, educational contexts, resources availability etc.** **These reflections may tackle also more conceptual aspects, such as resistance to change and process improvement in an organisation.** • Opportunities - As a transversal topic, there is a relative ease in its integration within different fields/subjects and curriculum systems and even in different school grades. - Likewise, the activity triggers critical reflection on further social aspects (not only through the content of the activities but through its design), which allows for it to be translated to other contexts (e.g. it enables parents to incorporate it to their daily activities at home with the kids, in an educational environment).

	- The activity introduces innovative and up-to-date scientific concepts in the science curriculum which will enhance the employability and entrepreneurship skills of the students. - The activity does not require the incorporation of many different materials or resources and it is easily adaptable. • Obstacles - Difficulties in addressing different students' skills, which can be solved through the assignment of different tasks. - Educators should acknowledge the potential existence of a digital divide among students (that is, possible inequalities in regard to access to ICT) that can affect their access to the activities' resources outside the classroom. **Add a reflection also on the implementation of RRI principles in general.**
Testing and adjustments	**This section is meant to collect reflections on the usage of the practices to support its revision and enhancement.** It is recommendable to encourage students to reflect on their group experiences during different project phases. This will help them develop teamwork skills and will strengthen their self-reflection capacities. o *E.g. related to the "Climate change" activity* – The educator can set up questions to ask students, based on group objectives. This will encourage students to further reflect on their own activities while inspiring them to adapt or make any necessary changes to their work.
Tips to implement	**This section is to provide other educators with your insight on how this practice can be implemented in school activities, practical aspects to consider and to look out for.** It is mandatory to think in advance about the dissemination event itself for several organization considerations. It is of special important to keep in mind the potential event's audience and which implications it might entail.

Useful vocabulary

- **STEM** is the acronym used to make reference to the disciplines of Science, Technology, Engineering and Mathematics. The term is often used in education policy and project development. One of the main aims in Responsible Research and Innovation is to promote continuous STEM education through RRI principles as well as through a transdisciplinary approach (linking it to other academic fields as well as to non-formal academic sources).[8]

- **Synergy** indicates the interaction or collaboration between two or more organizations or actors in order to produce a combined effect that is greater than the sum of its parts or its separate effects.[9]

- **Critical thinking** refers to the ability to engage in reflective and independent thinking, including the construction and evaluation of arguments, the identification of ideas and the capacity to understand logical connections between them.[10] The inclusion of soft skills -such as critical thinking- in informal and formal education activities has the potential to empower students to become active and responsible citizens as well as skillful in Responsible Research and Innovation.[11]

- **Collaborative learning** can be defined as a continuous cooperation between stakeholders, including the exchange of information among peers paired with project-based learning activities.[12]

- **Entrepreneurship education** (within RRI) englobes those activities encouraging and promoting entrepreneurial mind-sets to familiarize learners to a responsible approach to Research and Innovation.

- **IBSE (Inquiry Based Science Education)** is an approach to teaching and learning science derived from a specific understandement of students learning processses, paired with science inquiry concepts. IBSE acknowledges the importance of ensuring that students really understand what they are learning and encourages

[8] Rationale for Science Education Stakeholders, RRI Tools

[9] Oxford Dictionaries http://www.oxforddictionaries.com/definition/english/synergy

[10] http://philosophy.hku.hk/think/critical/ct.php

[11] Rationale for Science Education Stakeholders, RRI Tools

[12] Rationale for Science Education Stakeholders, RRI Tools

student satisfaction through having learned and understood contents and processes.[13]

- **ICT (Information and Communication Technologies)** englobes all those technical resources used to handle information and aid communication, including computer and network hardware and software.[14]

- **Digital divide** brings up the division between those with internet access (who are consequently able to make use of the services available through it) and those without it. The term digital divide not only refers to direct access to Information and Communication Technologies (ICT), but also to those skills that are needed to take part in the information society which will, in turn, allow further participation in it.[15]

[13]Designing and implementing Inquiry Based Science Units for Primary Education. Pollen (2009) http://www.fondation-lamap.org/sites/default/files/upload/media/Guide_Designing%20and%20implementing%20IBSE_final_light.pdf

[14]http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Information_and_communication_technology_(ICT)

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