Surrounded by Science

Learning Paths towards Science Proficiency

Research and Innovation Action in the European Union's Horizon 2020 Programme

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Deliverable 4.1

Research Implementation Plan

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Legal Notices

Executive Summary

The current deliverable describes the actions made to achieve the first task of *Work Package 4 - Research Implementation (WP4).* The main aim of this deliverable is to describe and outline the procedures needed to implement the planned research activities in the 18 case studies that were selected in *Work Package 2 - Research Framework (WP2).*

As such, the development of this implementation plan is strictly intertwined with the work done in *WP2* concerning the selection of the case studies, but also with *WP5 - Impact Assessment,* for the development of the assessment tools to be used during the implementation to analyse the case studies from different points of view (*T5.1 Impact Assessment Methodology & Tools*).

The plan considers the selected case studies (more details in *D2.3 Inventory of Activities*) and defines the overall steps, guidelines, and prerequisites that need to be met to start the onsite assessment of the various activities, as well as how to collect and store the data.

Therefore, this deliverable represents a roadmap for the members of the *Surrounded by Science* consortium that details the operational implementation of the assessment of the educational impact of the 18 case studies, according to the conceptual framework of the *Surrounded by Science* project.

Furthermore, a set of operational tools aimed to support the implementation of the assessment of each case study has been developed. Below these tools are listed and their features are described in detail in Chapter 3 of this deliverable:

- The **Scenario,** an activity's description, reports step-by-step the contents and the educational purposes of each case study, in both narrative and schematic ways.
- The **Case study table,** a template used to collect all the details needed to define, plan and schedule the implementation and the assessment of each activity case.
- The **Activity planning and monitoring scheme**, a Gantt chart to plan and monitor the implementation of the research, with a look at specific aspects of each case study.
- The **Data collection protocol and checklists** represent the procedure to be followed to implement the research of a case study from a given research perspective. Therefore, three different checklists were created, one for each research perspective.
- The **Decision tree,** to drive the partners in the choice of the best assessment tools for each case study, within all the research perspectives. In fact more than one path can be chosen.

Table of Contents

1 Introduction

The *Surrounded by Science* project aims to contribute to the exploration of the nature and effects of science education outside the classroom, as part of the wider science learning ecosystem, focusing on the analysis and assessment of learners' development of the six strands of Science Proficiency through their individual learning paths within diverse science learning contexts.

The main aim of this deliverable is to describe and outline the procedures needed to implement the planned research activities. In total, 18 case studies were selected in the context of WP2, which are input for the research. After this introduction, Chapter 2 gives an overview of the key characteristics, selection criteria, and the selected case studies. This is based on the work carried out in D2.2 and D2.3 of WP2 which led to the creation of an inventory of iSTEM (informal STEM) activities and programmes that are representative of those currently available in EU and which led to the selection of the case studies. The second part of this chapter describes factors that can affect the research implementation.

Chapter 3 presents in detail five tools to support the project partners in their research implementation: (a) the Scenarios are used to describe in detail the contents and educational purposes of each case study, (b) the Case study tables collect general and specific information needed to plan and schedule the implementation and assessment of the activities, (c) the Activity planning and monitoring scheme is developed to schedule the best period for implementing each case study and to monitor the implementation progress, (d) the Data collection protocol and checklist tool guide project partners to prepare and execute the actual implementation, and (e) the Decision tree, which can be used to select the most appropriate assessment instrument(s) for each case study.

The deliverable ends with the concluding Chapter 4.

2 The selected case studies

Within WP2 (*Research framework*) the project partners identified the out-of-school activities and programmes at the European and local level by interviewing representatives of informal STEM (iSTEM) activity providers operating in their countries (T2.2, Scanning the Horizon, more details in D2.2 *Surrounded by Science Key Characteristics and Matrices*, section 2. *Methods to identify key design characteristics*).

Through the interviews and checking existing repositories of learning activities in Europe, 76 iSTEM activities were identified and subsequently collected in the inventory (T2.4, more details in D2.3 *Inventory of activities*, page 10, section 2.3. *Inventory of activities*).

All the interviews were based on standard templates that used the guiding questions developed in the context of T2.1 (Developing the Research Methodology), reported in D2.1 (Research Methodology and Plan) and provided in the results, leading to the identification of the key characteristics and the development of the related matrices (D2.2 *Key Characteristics and Matrices*, section 5. *Matrices with success criteria*).

Finally, the procedures to choose the case studies to be implemented and their partition per typology are described in detail in D2.3 (Inventory of Activities and Selected Case Studies).

In particular, the design characteristics of the activities that emerged from the interviews with providers in the context of T2.2 (Scanning the Horizon) were analysed and validated by referring to the available scientific literature. The design characteristics for each learning context are reported in Table 1.

Table 1. *Design characteristics for each learning context (from D2.3, Inventory of Activities and Selected Case Studies)*

Outreach programmes	**Designed environments**	**Technology and media products**
1.Connection to real life	1. Connection to real life	1. Accessible/ easy to use
2. Choice of topic	2. Choice of topic	2. Connection/relevance to real life
3. Encouraging curiosity/ questioning/ inquiry	3. Encouraging curiosity/ questioning/ inquiry	3. Encouraging curiosity/ questioning/ inquiry
4. Personal experience/ interest-based	4. Combining visual, audial and kinaesthetic information and activities	4. Visually attractive (design)
5. Interactivity	5. Active involvement/ interactivity	5. The way of presenting information (for media products)
6. Collaboration/ dialogue with peers	6. Visually attractive materials	6. Interaction with the audience/ active engagement (for media products)
7. Age- and ability-appropriate language and tasks	7. Authentic materials	
	8. Collaboration/ family learning	
	9. Age- and ability-appropriate language	

From the inventory of 76 iSTEM activities, 18 case studies were selected to be assessed by the research. See D2.3 for the selection criteria that were used. Table 2 presents some general features of the case studies.

Table 2. *Amount of case studies for different criteria*

Context	STEM areas	Target group	Duration	Provider
Outreach programmes – 6 Designed environments – 6 Technology and media products - 6	Astronomy – 4, biology – 8, physics – 1, math – 1, chemistry -1, all areas – 3 OR Science -15 Technology and engineering – 2 Math - 1	Primary school children – 4 Secondary school children – 6 General public – 8	Short – 13 Medium – 3 Long - 2	Internal – 8, External - 10

In Table 3, the 18 case studies are presented, in the different research perspectives in which they will be assessed. Some activities are mentioned in more than one research perspective. Some activities (noted with an asterisk *) are part of a learning pathway.

Table 3. *The 18 case studies will be assessed according to different research perspectives. Some activities (noted with an asterisk *) are part of a learning pathway.*

	Context-oriented perspective	Person-in-context perspective	Person-oriented perspective
Outreach Programs	1. Maker space 2. Master class	1. Chemistry escape room 2. The community of the beach 3. Maker space 4. Master class 5. Observation nights * 6. We came back to look at the stars	1. Chemistry escape room 2. The community of the beach 3. Observation nights * 4. We came back to look at the stars 5. *SEM*
Designed Environments	1. Corporea 2. Nordhorn zoo 3. Pedra do Sal Environmental Interpretation Centre 4. Vlinderfabriek	1. Corporea 2. Nordhorn zoo 3. Touch tank and " A parte que Fica" Exhibition 4. Tutti insieme! (All together!) 5. Vlinderfabriek	1. Touch tank and " A parte que Fica" Exhibition 2. Tutti insieme! (All together!)
Technology and media products	1. Davidson Institute's website 2. MOOC about recreational math	1. Galileo museum * 2. MOOC about recreational math 3. Roger Penrose's models *	1. Galileo museum * 2. The mystery in the forest of Østmarka 3. VIRGO experiment *

As can be seen from Table 3, a single case study can be evaluated under one or more research perspectives depending on its structural characteristics. For example, in the case of a Designed Environment, assessments according to context-oriented and/or person-in-context perspectives are actually implicit. In the case of an Outreach Programme, the context-oriented assessment will be carried out or not depending on the context in which the various stages of the programme take place: for example, in the case that an stage must necessarily take place in a specific environment (e.g., an exhibition space with specific contents) the context-oriented evaluation would be appropriate and desirable; if instead the internship could take place in a generic environment (e.g., a classroom; a conference room) this type of evaluation would be superfluous.

Therefore, the tools developed to support the implementation of the research were conceived with the aim of optimally defining the structural characteristics of the case studies, and therefore identifying the most appropriate evaluation perspectives for each individual case.

2.1 Factors affecting the planning of the research implementation

When planning the research implementation, there are different features of the case studies that need to be taken into account: (a) the learning context in which the activity takes place, (b) the target group for which the activity has been designed, and (c) whether there are seasonal constraints.

2.1.1 Learning context

The proposal describes three learning contexts: outreach programmes, designed environments, and technology and media products. Each case study is part of one of these three learning contexts. Case studies were selected in such a way that each of the three learning contexts would be equally represented.

The intrinsic characteristics of the different learning contexts condition the methods of approach by their users, and consequently also the methods of planning and implementing the research.

For example, in the case of a designed environment, such as a scientific exhibition or a science centre, visitors use to access these spaces sporadically (think of families with children who see this type of experience as a recreational way to spend their Sunday).

An outreach programme often entails the involvement of a group of users identified and involved by someone who organizes the programme and schedules the various stages (in this case the users could be represented by the member of a school class as well as the attendees of a science club, while the organizer could be represented by a teacher or by an out-of-school activities provider).

Finally the users of technology and media products act in further modalities completely free from both interpersonal relationships and strictly scheduled events (they can access a website to watch a documentary or listen to an online seminar, neither more nor less than they can read a book when they have the time and desire).

2.1.2 Target groups

The target groups can be divided into two main categories: school students (in primary and secondary schools) and the general public (family groups and adults).

Regarding the school audience, the academic grade of the classes involved and/or the type of school should be considered substantially, with particular reference to high schools, where the choice by teachers to participate with their classes in certain extracurricular educational experiences is strongly conditioned by the type of high schools in which they operate, whether these are high schools or vocational schools.

Regarding the general public, it must be considered that this varies greatly in relation to various factors, such as socio-economic conditions, the level of education, and one's occupation.

Particularly significant is the motivation that drives an adult to benefit from an informal educational activity: for example, an adult who occasionally visits a science museum or a zoo is mainly driven by recreational reasons, while a parent is often driven by intent to involve his/her children in a fun but educational experience (edutainment). Also, a participant in a science club often but not always has a high level of education and practices this activity with near-professional skills.

Considerations such as those outlined above have influenced the choice of case studies carried out in WP2 and will influence the methods of implementation of the research. In particular, the reasons that push different types of public to benefit from extra-curricular educational proposals will condition the identification of the strands of science proficiency to be evaluated according to the cases. Referring to the two previous examples, in the case of families with children it would be more appropriate to evaluate the strands most closely related to an emotional fruition (e.g., being interested in and excited by science), while in the case of science club goers the attention should focus on the more strictly cognitive implications of the experience (e.g., understanding science knowledge; using tools and language of science).

2.1.3 Seasonal constraints

Seasonal constraints represent an aspect that will strongly affect the scheduling of the research implementation phase. These constraints are as much related to the type of target groups as they are to intrinsic characteristics of the educational contents and contexts of the case studies.

With regard to target groups, in the case of school students, this is bound to the specific times of the school activity: length of the school year, holiday periods, periods of prevalent extra-curricular educational activities, etc. By way of example, in Italy the summer holidays that separate one school year from the next generally last from June to September, while the Christmas and Easter holidays are shorter than in other European countries.

Furthermore, schools tend to schedule extra-curricular activities in certain periods. For example, in Italy, they occur in the spring months, so this aspect must be considered when planning the research implementation.

Families and adults in general choose to enjoy educational-recreational activities on particular days (e.g., weekends) preferring certain periods of the year (e.g., spring or autumn, Christmas holidays, etc.).

Science club goers follow calendars of activities planned in accordance with the associative life of the clubs themselves. As an example, let's consider a science club among the providers contacted during the "Scanning the Horizon" phase of WP2: the Unione Astrofili Napoletani. Their social activity is organized according to a conventional calendar which preferably includes the autumn, winter and spring periods, but almost completely excludes the summer months. With regard to the seasonal constraints due to the intrinsic characteristics of the case studies, we consider the example of some activities aimed at deepening an understanding of natural phenomena that can only be carried out at certain times of the year (e.g., observation of astronomical phenomena or wild animals in natural environments, or temporary closures of the

designed environments). In accordance with the project proposal, the research implementation will take place from Month 16 to 32 (January 2023 – May 2024), covering a period longer than one year, both school and solar, thus allowing the project partners carrying out all the activities without impediments.

3 Implementation tools

The 18 selected case studies take place in different countries. Some of the case studies are offered by internal providers (i.e., consortium members), whereas others are offered by external providers (i.e., not part of the consortium). Implementation of the research can only take place if there is good communication and collaboration with the activity provider and when the research work is well prepared and targeted to the specific case study environment. In order to reach this goal and to simplify this task, several implementation tools have been developed: (a) a template for activity scenarios, (b) a template for case study tables, (c) a scheme to plan and monitor the implementation activities, (d) three data collection protocols and checklists to prepare the research, and (e) a decision tree. For each tool, its purpose and a description will be presented. The templates (and in some cases, examples) of each tool can be found in the appendices of this deliverable.

3.1 Scenarios

The *Scenario* is a tool aimed at describing the expected experiences and educational content of a case study. It provides the overall view of the activity, reporting step-by-step what participants or visitors do or see during the activity. In this way, each scenario is like a movie script that all project partners can use to better understand what the case study looks like, what its aims are, and what would be the best way to assess it.

Since these scenarios will report the most significant contents and purposes of each case study, in both narrative and schematic way, they can promote the assessment of the case studies (*WP5*) and the creation of potential extra contents for the *Science Chaser (WP3 - Digital Toolbox*). In addition, it assists the planning of the implementation (*WP4*), as it provides the WP4 team knowledge about the length and, if applicable, the stages of a case study, making it easier to schedule them in the project's timeline (see also Section 3.3).

Each activity provider would be in charge of writing a scenario for the case study they offer. In the case of an internal provider, the activity provider will get the required information by asking its own staff. In the case of an external provider, the writing will require an accurate interaction between the partners and these external activity providers. In order to help the activity providers in writing a complete scenario, they get the following guidelines:

- The scenario should start with the description of the environment in which the activity takes place. In case of a technology or media product, the description concerns what the learners see immediately before the activity begins.
- If there is a person who will conduct the activity, this should be described as well as what s/he is going to do.
- Every change of topic/activity should be underlined (e.g., children first have to watch something and then make a drawing; or visitors have to move independently from one exhibit to another).
- What is expected from the participants/visitors has to be described too (e.g., "They will try the experiment on their own at this point").
- The description should be given in chronological order.
- The educational purposes of the different actions/exhibits/activities of each case study should be highlighted wherever is possible.
- Pictures can be added if the writer thinks they could help.

The guidelines are also given in *Appendix I* of this deliverable. In addition, two examples of scenarios, with different levels of details, are given in *Appendix II*.

3.2 Case study tables

All the needed information to plan and schedule the implementation and the assessment of a given case study will be collected in a *Case study table* (see *Appendix III* for the template). This template helps the partners in categorising the different activities with an organized and unique format.

The detailed description provided by this section of the table will be used to better organize the implementation of the activity, as it helps the planners to relate to each part of it. Furthermore, the detailed description simplifies the work of WP5, since the target audience between the different stages might change, leading to a change of the assessment tools to be used.

The *Case study table* is divided into three sections: (a) the upper section in which general information about the activity is given, (b) the middle section in which the specifics of the stages of each activity are described, and (c) the lower section in which the assessment of the activity is described. More information about the sections is described below.

General information

The upper section of the table contains the information of the case study that is used to categorize each respective iSTEM activity or programme according to the criteria used for its selection. Most of them were presented in Table 2 of this deliverable (see D2.3 for more information). The information included is:

- Learning context: This is either a Designed Environment, an Outreach Programme, or a Technology and Media product. The learning contexts have been introduced and fully described in *D2.1 Research Methodology and Plan.*
- Activity type: Examples are a Guided Tour, Workshop, Website. For each learning context, activity types have been identified based on interviews with activity providers and an analysis of repositories of iSTEM activities carried out in the context of *WP2*. All activity types are listed and described in *D2.2 Surrounded by Science Key Characteristics and Matrices.*
- Target group: This refers to the people for whom the activity has been designed. Target groups are indicated by educational levels (e.g., upper primary school children, lower secondary school pupils) or by type of audience (e.g., families, attendees of a science club).
- Reference partner: This refers to the consortium member who interviewed the activity provider and suggested the case study for selection. For instance, Fondazione IDIS-Città della Scienza or Weizmann Institute.
- Provider: This refers to the organisation that provides the activity.
- STEM topics: This refers to the STEM areas, which include Science, Technology, Engineering and Math, and that are presented at the level that was mentioned by the activity providers, which means that they can either be general (e.g., science) or more specific (e.g., physics, neuroscience).
- Contribution to SP strands: This refers to the strands of Science Proficiency as described in D2.1. In the interviews, all activity providers were asked to indicate to which extent their activity contributed to the different strands (with 1 – no contribution to 5 – contribution to a very large degree).
- Description: Here, a general description of the activity must be given.

- Number of stages: This refers to the number of meetings, visits, lessons, etc. in which the activity is organised.

Stages of the activity

The middle section of the table represents the core of the tool and describes the different stages of each case study. Each *stage* is intended as a single action of the entire activity and has a specific task. For example, for Science Projects (one of the activity types for the Outreach Programmes), each lesson or meeting would be a *stage.* For each stage, the following information should be provided:

- Stage description: A detailed description of what participants/visitors are expected to do.
- Type: Refers to the type of activity of this stage.
- Duration: Refers to how long this stage takes.
- Stage replicable: Refers to whether the activity can be repeated as it was, when the audience is changed.
- Seasonal constraints and reason for this: Whether and why there are any seasonal constraints. See Section 2.1.3 for more information.
- Start and end date of the actual implementation: Refers to the period in which the case study will be implemented and assessed.

Assessment of the activity

The lower section of the table contains the information about assessment:

- Type: This refers to which research perspective is taken. There are three research perspectives: the context-oriented perspective, the person-in-context perspective, and the person-oriented perspective. The research perspectives are described in detail in D2.1.
- Assessment tool: This refers to the type of assessment tool that will be used to evaluate the case study. The assessment tools are described in D5.1.
- Involved people in the assessment: This refers to the number of users that will participate.
- Use of Science Chaser: This determines whether the Science Chaser is used for assessment or not. The possibilities of the Science Chaser are described in D3.3.
- Consent required: This indicates whether consent is required or not. More information is provided in D8.2.
- Notes: Additional notes about the assessment can be written here.

As with the scenarios, each partner organization will be in charge of filling in a Case study table for each of the case studies it proposed, while differentiating between the “internal” and the “external” proposals to provide all the needed information.

Two examples of tables for case studies are presented in *Appendix IV.*

3.3 Activity planning and monitoring scheme

In order to plan and monitor the implementation of all case studies, the Activity planning and monitoring scheme has been developed (see Appendix V for the template).

This scheme is set up as a Gantt chart and consists of a spreadsheet in which each row corresponds to a case study consisting of one or more stages. The first columns report relevant information for planning the implementation, which will be taken from the Case study table (i.e., referring partner, provider, country, learning context and activity type, number of stages, and stage types). Depending on the specifics of each case study, the corresponding row could be further subdivided in order to report more detailed information. In particular, this should be done if the case study is divided into multiple stages that differ from each other in a temporal or typological way.

In the columns after this information, the months are given. The corresponding partners indicate here in which months the implementation of the respective case study takes place. The cells in yellow indicate the periods when a stage of a case study is expected to be implemented (according to issues like seasonal constraints). Once the exact dates for data collection of a stage are known and scheduled, the date(s) will be added to the yellow bars. Once the data collection of a stage has been completed, the yellow bar will be changed into green.

The Activity planning and monitoring scheme will be shared among the partners in a common space (i.e., the Surrounded by Science Teams environment), and each partner is in charge to fill its contents and to keep it updated as planning and implementation progresses. In accordance with the project proposal, the first round of research implementation will take place between January 2023 and June 2023, and the second round of research implementation will take place from September 2023 to May 2024.

3.4 Data collection protocol and checklist tools

When data collection has been planned, there are several steps to take in order to arrive at a successful implementation. In order to assist project partners and activity providers, the Data collection protocol and checklist tools were developed. These tools describe all steps to follow before, during, and after data collection. By providing these steps, the tools is a data collection protocol that has to be followed, and by providing check boxes to all the steps, the project partners and activity providers can use them as checklists.

The tool is divided into three phases: (a) preparation for the data collection, (b) the data collection itself, which is subdivided into steps to be taken before, during, and after the activity, and (c) steps to be taken after data collection. An example of preparing for data collection is acquiring ethical approval for the research according to the national standards. An example of preparing for data collection itself is making sure that all participants have created an account in the Science Chaser. An example of a step to be taken after data collection is uploading prepared data to the shared folder on the Surrounded by Science server.

As different research perspectives ask for different steps to be taken, three different Data collection protocol and checklist tools were created, one for the context-oriented perspective, one for the person-in-context perspective, and one for the person-oriented perspective. They can be found in *Appendix VI, VII, VIII* of this deliverable.

3.5 Decision tree for assessment instruments

In the three different research perspectives, different assessment instruments are used (more information about these instruments is given in D5.1). Moreover, within each research perspective, it depends on the goals of the activity, which strands of Science Proficiency are assessed. The Decision tree guides the project partners in choosing the appropriate assessment tools for the research implementation. Partners start this process by identifying the research perspective in which their case study takes place and answering additional questions (e.g., about the learning context, the target audience, or the strands of Science Proficiency) to arrive at the appropriate assessment instrument(s). The bottom lines of the Decision tree point the user to the specific appendix of D5.1, in which all assessment instruments are presented. The Decision tree is presented in *Appendix IX* of this deliverable.

4 Conclusions

The aim of this deliverable was to outline and establish the relevant operating procedures for all the activity providers involved in the implementation of the research, as well as to define the assessment tools for planning the implementation of each case study. The writing of the deliverable therefore involved the partners of the Idis Foundation with the support of researchers from the University of Twente and the Weizmann Institute of Science, the first being in charge of the research framework and selection of the case studies (WP2) and the latter being in charge of developing the methodology for evaluating the case studies and the related support tools (WP5).

The result of the work performed in the context of this work package is a set of five operational tools that aim to support the implementation of the assessment of each case study. These tools are:

- The **Scenario,** an activity's description, reports step-by-step the contents and the educational purposes of each case study, in both narrative and schematic ways.
- The **Case study table,** a template used to collect all the details needed to define, plan and schedule the implementation and the assessment of each activity case.
- The **Activity planning and monitoring scheme**, a Gantt chart to plan and monitor the implementation of the research, with a look at specific aspects of each case study.
- The **Data collection protocol and checklists** represent the procedure to be followed to implement the research of a case study from a given research perspective. Therefore, three different checklists were created, one for each research perspective.
- The **Decision tree,** to drive the partners in the choice of the best assessment tools for each case study, within all the research perspectives. In fact more than one path can be chosen.

What is outlined in this deliverable will guide the next steps of the project, with particular reference to the implementation of the research. From the delivery of this document (Month 15) the preparation of the onsite research activities of the case studies (T4.2) and their implementation (T4.3) will start.

5 List of appendices

Appendix I Guidelines for writing a Scenario

Appendix II Two examples of scenarios

Appendix III Case study table template

Appendix IV Two examples of Case study tables

Appendix V Activity planning and monitoring scheme

Appendix VI Data collection protocol and checklist tool for the Context-Oriented perspective

Appendix VII Data collection protocol and checklist tool for the Person.in-Context perspective

Appendix VIII Data collection protocol and checklist tool for the Person-Oriented perspective

Appendix IX Decision tree

Appendix I

Guidelines for writing a Scenario

Guidelines for writing a Scenario

- The scenario should start with the description of the environment in which the activity takes place. In case of a technology or media product, the description concerns what the learners see immediately before the activity begins.
- If there is a person who will conduct the activity, this should be described as well as what s/he is going to do.
- Every change of topic/activity should be underlined (e.g., children first have to watch something and then make a drawing; or visitors have to move independently from one exhibit to another).
- What is expected from the participants/visitors has to be described too (e.g., “They will try the experiment on their own at this point”).
- The description should be given in chronological order.
- The educational purposes of the different actions/exhibits/activities of each case study should be highlighted wherever is possible.
- Pictures can be added if the writer thinks they could help.

Appendix II

Two examples of Scenarios

An unguided tour in Corporea exhibition

Scenario

The section of the Corporea exhibition described below is dedicated to the brain and nervous system.

This section of the exhibition does not claim to provide the visitor with an exhaustive discourse about neuroscience, but rather to reveal some special aspects of the functioning of the brain and nervous system, aspects which can be traced back to their structural characteristics.

In particular, the section offers 6 main exhibits characterized by different levels of interactivity and ways of involving the visitor:

- a "push the button" mode, mainly used to highlight some structural elements of models of anatomical organs;
- a "hands-on" mode, which provides for different levels of interactivity:
- the real physical involvement of the visitor, more in line with the exhibition methods typical of science centres; and
- a more “technological” involvement like the participation in simple logical and/or skill tests, or the exploration of human bodies, always through digital devices (touch screens).

The 6 exhibits that make up this section of Corporea are listed below and their physical characteristics and educational purposes are described.

The sequence in which the exhibits are presented in this scenario considers both their physical location in the exhibition and a possible narrative path. However, it should be remembered that as part of the implementation, tour goal is to evaluate a free and unguided visit to the exhibition, and visitors could favour visit exhibits for other reasons such as, for example, their spatial location and/or visual appeal.

THE EQUILIBRIST

Going up the stairs to the second floor of the Corporea exhibition, you will immediately notice three hanging balls with a yellow wooden bar on the ground below. The panel accompanying the exhibit invites the visitors to walk in balance on the bar two times, the first with the hanging balls stopped, the second while they are oscillating. The visitors experiment that such an easy task like walking in balance on a small bar becomes more difficult in the second condition. The educational purpose of the exhibit is to show how our brain is not able to manage at the same time two stimuli that require a full attention. A screen provides the visitor with some additional information on the physiology of balance.

SUPERSIZED NEURON

Next to the previous exhibit there is a showcase with a neuron model inside. The panel invites the visitors to push different buttons to highlight special anatomical areas of the neuron and to read some information about each area. For example, visitors learn that the synapse is where the one neuron “communicates” with another neuron.

To understand how neuronal connection works, you need to move to the

TABLE OF NEURONS

This exhibit is a large touch screen that shows a neuronal web. Tapping on the screen, a neuron will be generated and will start to navigate on this web. Generating two or more different neurons at the same time, without remove your fingers from the table, you can see a sprinkled path which represents the synapse and the “communication” between the neurons. On the panel the visitor can find that the main purpose of this exhibit is to show how the different intensity of the users’ interactions influence the connections between the cells.

To get a larger-scale view of brain functioning, move to

YOUR BRAIN

This exhibit displays a brain transversely sectioned into several parts suspended on a platform. Around the brain are four touch screen stations that provide the visitors with skills tests, conceived to let the participant asses one’s memory, reaction time, concentration and logical skills. While the visitor is taking a test, the part of the brain involved in performing that specific skill lights up on the platform. Each test starts when the visitor taps on the “Start” button on the display of the touch screen. Each skill test begins with a warm-up phase followed by three trials and then the actual test.

TURN OFF THE LIGHTS

Still talking about memory, this exhibit will help you to understand the role of the working memory, a particular short-term memory. In fact, the goal is to identify which buttons turn off the corresponding light. The visitor has 60 seconds to perform the task and, due to difficulty, some people can't even complete it. However, the more you repeat the game, the quicker you will be able to complete it, because the working memory gradually begins to associate each button with the corresponding light.

CHIMPANZEE VS. HUMAN

At the back of the previous exhibit you will find this one which consists of a skill test to be performed on a touch screen station aimed at assessing your visual memory. When the test starts, numbers from 1 to 9 appear randomly on the screen. The visitor has little time to memorise the location of all numbers before they are covered with coloured squares. At this point, the visitor must touch the squares in sequence identifying each number from 1 to 9. The test can be performed four times: the first one as warm-up phase, the remaining three times as real test.

Once the test is finished, the screen shows a short video in which a chimpanzee performs the same task in an incredibly short time and without making any mistake! Obviously, the chimpanzee was previously trained to order visual signs (numbers) in sequence, even without knowing their logical meaning.

Pictures and Panel texts can be added to this description.

All Together! An outreach programme on the world of ants

Scenario

This visit includes a section inside the exhibition of Insects and another part in the garden. If for the latter the weather conditions do not allow it – or if the period in which it takes place does not allow the observation of ants in nature, it is replaced with a short laboratory activity after children completed the cards.

The activity consists of 3 moments:

1. Previous knowledge about ants
2. Observation and discussion in front of the showcases
3. Field observation and/or laboratory activity

PREVIOUS KNOWLEDGE ABOUT ANTS

The visit begins with a short chat with students about their knowledge of ants. The guide will write down or keep in mind the most interesting things (true or false) heard by the students' voice. He will ask if they have seen documentaries about ants on TV and what they remember about those documentaries. Sometimes ants are also topic of the news. The guide will take notes of those news that will then allow him to build (or destroy) on those statements his own speech at the appropriate time. For example, if the children say:

Student affirmation	→	Topic to be explored
Ants are annoying	→	Argentine ants, polygynous colonies, man-made problems
Ants can lift objects 100 times their weight	→	Anatomical structure of the ant, special examples
Ants have a hierarchical structure	→	Structure of the ant colony and their respective roles
Ants sting	→	Evolution of ants from wasps
I really like ants	→	The inclusion of all elements of the colony and the distribution of tasks

It is important that we can capture those beliefs and / or information, true or false that allow us to deepen the themes of the evolution of ant societies, the differences with other insects, the communication between the individuals of a colony and the advantages of group work. If these questions are not asked by the children, it will be up to the guide to introduce them starting from simple questions. I find it very useful to compare human societies with those of ants because even with the obvious differences due to our reasoning, the evolution of societies has many similarities, to which we will return later.

OBSERVATION AND DISCUSSION IN FRONT OF THE SHOWCASES

In this section we want to address the issue of communication and collective behaviour, especially in those categories of insects defined as social. It will be shown how the development of sociability has allowed to greatly increase the potential of ants, wasps, bees.

Ants represent a group of insects that appeared for a long time on Earth's history, about 90 or 100 million years ago, but the peculiar characteristic of this group, eusociality, is much more recent, it is thought to be about 20 million years ago. Eusociality has allowed ants to dominate the world of terrestrial invertebrates, so much so that both in numerical size and biomass, ants surpass any other group of invertebrates. Even the biomass of ants is higher than that obtained by weighing all humans.

What is eusociality? It is the highest level of social organization that is realized by some animal species, and that meets the following conditions: cooperative care of the offspring, overlapping of adult generations and division of labour between the fertile queen and sterile workers (known as workers) This type of intraspecific interaction can give rise to real "cities" of insects, all linked by a family bond, with a remarkably complex social structure and an extraordinary diversification and specialization of tasks.

Such a complex social structure is regulated and kept under control by the queen thanks to pheromones, which also have the function of inducing sterility in the workers (in hymenoptera all sterile individuals are females). The other great achievement of ants is their self-organization: in an anthill there is no ant that commands, but the actions that the colony performs are the result of the interactions of many individual behaviours that are regulated by positive feedback mechanisms; that is the ants recruit their mates whenever there is a task to be carried out (search for food, construction and maintenance of nest, defence of the colony)

The first stop of the visit is at the anthill of Formica rufa. The thing to point out immediately to the students is the architecture of the acervo. Given that the ants made it and that our colony is about 4 years old, the next questions for the students will be: "how was it built, in your opinion? What materials and instructions are needed to make such a structure?"

The second stop is the Camponotus fulvopilosus anthill of South Africa. The fake skull and the desert rose in the arenaci help to predict the type of environment in which they live. Once we have established that they are desert ants, we make students think about the adaptations of ants to life in torrid environments. The morphology and behaviour of these ants are direct derivation of the environment in which they live. We note that like most ants, we are faced with hunter-gatherer societies. In this location it is also possible to illustrate (and observe live) the life cycle of ants.

The next installation is that of harvester ants, Messor capitatus. Contrary to the previous, the Messor collect seeds of cereals and other plants, and once collected they bring them to the nest, where they will be opened, crushed, and reduced to flour, The flour then mixed with water, allows the ants to knead the so-called "ant bread", food for the larvae, which can also be observed in the lower part of the nest. We are faced with a kind of ant with a more complex organization as they transform a natural element to obtain another with different characteristics. Even here you can show the similarity with the first human societies when the hunting and harvesting of fruits were flanked by the cultivation and processing of cereals.

The other two anthills, that of Camponotus vagus and that of Liometopum microcephalum allow us to talk about communication between ants. In fact, both species mark with pheromones the path for food so as to leave an olfactory trace that subsequent ants can follow. The first ones have a long acrylic tube that they can travel, the latter, smaller, make up beautiful black lines from the nest to the food, which intensify with the passage of time.

FIELD OBSERVATION AND/OR LABORATORY ACTIVITY

Weather permitting, the guide accompanies the students to the garden where in two specific locations it is possible to observe two wild colonies, the Messor minor and the Tapinoma magnum. These ants are excellent species to study because they have high numbers and very different behaviours. The Messor have a very orderly course, collect seeds and have a marked intra-colony dimorphism. While Tapinoma are fond of sugars, they move chaotically and are very fast.

The students, divided into small groups of 4 will first observe their behaviour in the absence of external stimuli, then give different foods (seeds, cooked chicken, dead insects and water with sugar) and observe the different reactions to the respective foods given.

They will then individually fill in a field form as per the attached model.

If the weather conditions or the season do not allow to observe the colonies in nature, we end the path with the compilation of a small notebook in the laboratory space, which serves to fix the ideas on what has been observed and discussed.

Pictures, panel texts and cards can be added to this description.

Appendix III

Case study table template

Template for the Case study tables

<table>
<tr><td>Case Study</td><td colspan="6">Activity title</td></tr>
<tr><td>Learning context</td><td colspan="2">Designed, Outreach…</td><td>Activity type</td><td colspan="2">See D2.2 Chapter 3 e.g. Workshop</td></tr>
<tr><td>Target group</td><td colspan="6">Write category and age of the users e.g. Primary School children; Science Club attenders; children form 6 y.o.</td></tr>
<tr><td>Reference partner</td><td colspan="3">e.g. Fondazione IDIS-Città della Scienza</td><td>Country</td><td>e.g. Italy</td></tr>
<tr><td>Provider</td><td colspan="3">Write it down even if it’s the same of the partner</td><td>Country</td><td></td></tr>
<tr><td>STEM topics</td><td colspan="6">e.g. Life sciences (botany, plant physiology)</td></tr>
<tr><td rowspan="2">Contribution to SP strands</td><td colspan="2">High</td><td colspan="2">Medium</td><td colspan="2">Low</td></tr>
<tr><td colspan="2">Insert here all the strands evaluated with 4 or 5</td><td colspan="2">Insert here all the strands evaluated with 3</td><td colspan="2">Insert here all the strands evaluated with 1 or 2</td></tr>
<tr><td>Description</td><td colspan="6">Describe the activity in general. What are its purposes, how people are involved, duration, tasks and so on…</td></tr>
<tr><td>N. of stages</td><td colspan="6">Number of meetings, visits, lessons, etc. in which the activities of the case study is organised e.g. 2 (preparatory training + experiment)</td></tr>
<tr><td rowspan="4">Stage 01</td><td colspan="2">Stage description</td><td colspan="4">Go in depth. What are people asked to do during this Stage?</td></tr>
<tr><td>Type</td><td>e.g. Teacher training</td><td>Duration (hours)</td><td>Only of this Stage</td><td>Stage replicable</td><td>By changing the audience, can the activity be repeated as it was? Yes/No</td></tr>
<tr><td colspan="2">Seasonal constraints</td><td>Yes/No</td><td>Reason</td><td colspan="2">Why? Write down also if there is a period that is preferable</td></tr>
<tr><td colspan="2">Actual implementation</td><td>Start date</td><td>Also a period e.g. March 2023 or Summer 2023</td><td>End date</td><td>e.g. April 2023 or the end of the school year</td></tr>
<tr><td rowspan="3">Stage …
add as many lines as there are planned stages</td><td colspan="2">Stage description</td><td colspan="4">Go in depth. What are people asked to do during this Stage?</td></tr>
<tr><td>Type</td><td>e.g. Teacher training</td><td>Duration (hours)</td><td>Only of this Stage</td><td>Stage replicable</td><td>By changing the audience, can the activity be repeated as it was? Yes/No</td></tr>
</table>

	Seasonal constraints	*Yes/No*	**Reason**	*Why? Write down also if there is a period that is preferable*	
	Actual implementation	**Start date**	*Also a period e.g. March 2023 or Summer 2023*	**End date**	*e.g. April 2023 or the end of the school year*
Research perspectives					
Type	*e.g. Context-oriented or Person-in-Context or Person-orientend*			*e.g. Context-oriented or Person-in-Context or Person-orientend*	
Assessment tool	*E.g. Questionnaires*			*e.g. Pre and post test*	
Involved people in the assessment	*Number of users that you intend to reach*			*Number of users that you intend to reach*	
Use of Science Chaser	*Yes / No*			*Yes / No*	
Consent required	*Yes / No*			*Yes / No*	
Notes	*Every detail about the assessment tool above. When it will be presented, how it will be used etc…*			*Every detail about the assessment tool above. When it will be presented, how it will be used etc…*	

Appendix IV

Two examples of Case study tables

Corporea

<table>
<tr><td>Case Study</td><td colspan="6">Corporea</td></tr>
<tr><td>Learning context</td><td colspan="2">Designed environment</td><td>Activity type</td><td colspan="2">Unguided tour</td></tr>
<tr><td>Target group</td><td colspan="6">Families; common citizens; Students of all ages</td></tr>
<tr><td>Reference partner</td><td colspan="3">Fondazione Idis – Città della Scienza</td><td>Country</td><td>Italy</td></tr>
<tr><td>Provider</td><td colspan="3">Fondazione Idis – Città della Scienza</td><td>Country</td><td>Italy</td></tr>
<tr><td rowspan="2">Contribution to SP strands</td><td>High</td><td colspan="3">Medium</td><td colspan="2">Low</td></tr>
<tr><td>Understanding
Interest</td><td colspan="3">Reasoning
Reflecting</td><td colspan="2">Using
Identifying</td></tr>
<tr><td>STEM topics</td><td colspan="6">Life sciences (biology, physiology, neurosciences)</td></tr>
<tr><td>N. of Stages</td><td colspan="6">1</td></tr>
<tr><td>Description</td><td colspan="6">Corporea exhibition is dedicated to the human body and its functions with a particular attention to the health. Visitors are invited to interact with stands in nine thematic islands arranged according to the different systems of the human body and to observe what happens and what consequences particular actions have. The activity contributes to developing interest in science and equipping participants with more knowledge.
In particular, the implementation of the research will be focused only on a branch of the exhibition dedicated to the brain and nervous system.</td></tr>
<tr><td rowspan="4">Stage 01</td><td>Stage description</td><td colspan="5">The implementation of this case study is divided into a single Stage which consists of monitoring the general public as they visit the exhibition and interact with the exhibits available.</td></tr>
<tr><td>Type</td><td>Unguided tour</td><td>Duration (hours)</td><td>< 1h</td><td>Stage replicable</td><td>yes</td></tr>
<tr><td>Seasonal constraints</td><td>yes</td><td>Reason</td><td colspan="3">In some periods of the year the exhibition is visited more than in others, however it works about all the weekends of the year except in the months of August and September when the science centre is closed.</td></tr>
<tr><td colspan="2">Actual implementation</td><td>Start date</td><td>January 2023</td><td>End date</td><td>July 2023</td></tr>
<tr><td colspan="7">Research perspectives</td></tr>
<tr><td colspan="2"></td><td colspan="2">Context-oriented</td><td colspan="3">Person-in-Context</td></tr>
<tr><td colspan="2">Assessment tool</td><td colspan="2">Observation grid</td><td colspan="3">Questionnaires</td></tr>
<tr><td colspan="2">Involved people in the assessment</td><td colspan="2">100</td><td colspan="3">40</td></tr>
<tr><td colspan="2">Use of Science Chaser</td><td colspan="2">No</td><td colspan="3">Yes</td></tr>
<tr><td colspan="2">Consent required</td><td colspan="2">No</td><td colspan="3">Yes</td></tr>
</table>

All Together

<table>
<tr><td>Case Study</td><td colspan="6">All together!</td></tr>
<tr><td>Learning context</td><td colspan="2">Designed environment</td><td>Activity type</td><td colspan="2">Designed route with tasks</td></tr>
<tr><td>Target group</td><td colspan="6">Primary and secondary school pupils</td></tr>
<tr><td>Reference partner</td><td colspan="3">Fondazione Idis – Città della Scienza</td><td>Country</td><td>Italy</td></tr>
<tr><td>Provider</td><td colspan="3">Fondazione Idis – Città della Scienza</td><td>Country</td><td>Italy</td></tr>
<tr><td rowspan="2">Contribution to SP strands</td><td colspan="2">High</td><td colspan="2">Medium</td><td>Low</td></tr>
<tr><td colspan="2">Understanding
Interest</td><td colspan="2">Reasoning
Reflecting</td><td>Using
Identifying</td></tr>
<tr><td>STEM Topics</td><td colspan="6">Life sciences (biology, zoology, ethology, ecology, evolution)</td></tr>
<tr><td>N. of Stages</td><td colspan="6">3</td></tr>
<tr><td>Description</td><td colspan="6">The activity is meant for primary and middle school pupils visiting the exhibition about ants as social insects with their teachers. The experience is divided into two stages: the first involves a training meeting for teachers so that they are better informed of the experience that their pupils are going to carry out; the second is the actual activity that involves the pupils. During 75-90 minutes, pupils listen to the guide, observe and sometimes even touch the insects, observe models and watch videos. They also need to answer the questions and complete tasks in a special notebook. At the end of the activity, they talk about their experience with insects and what they have learned. Learning about the behaviour of social insects, pupils get introduced to topics from biology, zoology, ethology and ecology. Tasks and questions in the notebook are specially designed for the age range of the participants with some reference to the curriculum in natural science in school. This way the activity connects learning in formal and informal settings.
This activity mainly contributes to sparkle students' interest to science and developing their understanding of social animals, with a bit less contribution to developing scientific reasoning and reflection. This fits IDIS profile as a science museum with their priorities in terms of contribution to science proficiency being developing interest to science, engaging in scientific reasoning and understanding scientific content.</td></tr>
<tr><td rowspan="4">Stage 01</td><td>Stage description</td><td colspan="5">A training aimed to let the teachers would be aware about the proposal their pupils will attend</td></tr>
<tr><td>Type</td><td>Teacher training</td><td>Duration (hours)</td><td>2 h</td><td>Stage replicable</td><td>yes</td></tr>
<tr><td>Seasonal constraints</td><td colspan="2">no</td><td>Reason</td><td colspan="2">Just during school year, anyway it would be better if the training would take place short time before the Stage 02</td></tr>
<tr><td colspan="2">Actual implementation forecast</td><td>Start date</td><td>March 2023</td><td>End date</td><td>April 2023</td></tr>
<tr><td rowspan="2">Stage 02</td><td>Stage description</td><td colspan="5">This is the true activity where the pupils will carry out a guided exploration in an exhibition showing real anthills of different species of ants.</td></tr>
<tr><td>Type</td><td>Guided tour</td><td>Duration (hours)</td><td>1h 30'</td><td>Stage replicable</td><td>yes</td></tr>
</table>

	Seasonal constraints	*Yes*	**Reason**	*The ants are more active and more easily observable when the weather is warm, while the school years ends between the end of May and the beginning of June.*		
	Actual implementation forecast		**Start date**	*2nd half of April 2023*	**End date**	*End of May 2023*
Stage 03	**Stage description**	*Pupils will carry out a guided exploration in a garden to find real anthills to observe. After this they will organize their knowledge answering some questions.*				
	Type	*Guided tour*	**Duration (hours)**	*1h*	**Stage replicable**	*yes*
	Seasonal constraints	*Yes*	**Reason**	*The ants are more active and more easily observable when the weather is warm, while the school years ends between the end of May and the beginning of June. It must take place at the latest **one week after Stage 02***		
	Actual implementation forecast		**Start date**	*2nd half of April 2023*	**End date**	*End of May 2023*

Research perspectives		
Type	***Person-in-Context***	***Person-Oriented***
Assessment tool	*Questionnaires*	*Pre and post test*
Involved people in the assessment	*40*	*25*
Use of Science Chaser	*Yes*	*Yes*
Consent required	*Yes*	*Yes*
Notes	*During and immediately after the visit the pupils will answer the questions. To make this task more enjoyable for them, the questions should be proposed in the most playful way possible, for example, a specially written booklet, printed or in digital format on tables provided to pupils by the organizers.*	*The pre-test would be submitted to the pupils by their teachers some time before the visit to the exhibition, as well as the post test would be proposed to them some time later, once they return to school. This is to avoid overloading the children with too many tests in a short time since they will already have to answer the questionnaire during the visit to the exhibition.*

Appendix V

Activity planning and monitoring scheme

Activity planning and monitoring scheme

title	referring partner	provider	implementation contry	Learning Context/Activity type	number of Stages	Stage	Stage type	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23
Chemistry Escape Room	WIS	WIS	Israel	OP. scenario-based activity											
The Community of the Beach	Idis	ARDEA	Italy	OP, science project	3	?									
						?									
						?									
Maker Space	Nuclio	Nuclio	Portugal	OP, workshop											
Master Class	Twente	Twente	Netherland	OP, workshop	3	Stage 1	Workshop 1								
						Stage 2	Workshop 2								
						Stage 3	Workshop 3								
Observation night	EA	EA	Greece	OP											
We came back to look at the stars	Idis	UAN	Italy	OP, science club activities	3	Stage 1	Lecture								
						Stage 2	Observation in Planetarium								
						Stage 3	Observation of the sky								
Corporea, nervous system and brain	Idis	Idis	Italy	DE, unguided visit	1										
Nordhorn Zoo	Twente	Nordhorn Zoo	Germany	DE, unguided visit	1										
Touch tank, unguided visit	Nuclio	Pedra do Sal Environn	Portugal	DE, unguided visit	1										
Touch tank, guided visit	Nuclio	Pedra do Sal Environn	Portugal	DE, guided visit	1										
Tutti insieme!	Idis	Idis	Italy	DE, scenario-based activity	2	Stage 1	Teachers training								
						Stage 2	Guided tour for children								
Vlinder Fabriek (Butterfly factory)	Twente	Museum Fabriek, the	Netherlands	DE, unguided visit	1										
Virtual Visit in Galileo Museum	EA	Galileo Museum	Italy	T&M, virtual visit	?										
The Website of Davidson Institute	WIS	The Davidson Institut	Israel	T&M, website	?										
Website with "MOOCs about recreational m	WIS	The Davidson Institut	Israel	T&M, website	?										
online game "The mystery in the forest of Ø	?	Vitenparken	Norway	T&M, website	?										
website with videos about Roger Penrose's	?	Nobel Prize Foundatio	Sweden	T&M, website	?										
virtual visit to the VIRGO experiment	EA?	European Gravitational Observatory		T&M, virtual visit	?										

Appendix VI

Data collection protocol and checklist tool for the Context-Oriented perspective

Data collection protocol and checklist tool for the Context-Oriented perspective

Preparation for the data collection	**Check**
1. Acquire ethical approval according to the national standards (see D8.1 for more information on ethical principles and the procedure to follow). The average estimated time needed for ethical approval is 2-3 weeks. *	☐
2. Discuss the practicalities (e.g., time, place, specific point of interest) of data collection with the activity provider	☐
3. Familiarize yourself with the observation schemes for your study. Check them using the Decision Tree (see Appendix IV of D4.1).	☐
4. (Optional) Translate the observation scheme into the required language if that is more convenient for the observers.	☐
5. Pilot the instruments in the setting of the case study. Check aspects like best position to observe while being “invisible” to the audience, time to fill in the scheme, difficulty in assessing specific aspects, etc.	☐
6. Be sure that you have enough observers, considering the dimensions of the space where observation takes place.	☐
7. Train the observers in using the observation scheme and provide instructions of what is expected from them. Remember: this can influence the scheduling of your activity. **	☐

Notes:

*This step can be done in parallel with the other steps and should be completed before the data collection dates.

**If you already have enough trained personnel, skip this step.

Data collection	**Check**
Before the activity:	
8. Prepare all the tools you will need during the activity’s observation: the observation scheme, a chronometer, a pen and something to write on (a sheet or a notebook).	☐
9. Determine with the other observers the observing positions or who observes what***	☐
During the activity:	
10. Conduct the observation using the observation scheme.	☐
After the activity:	
11. Immediately complete parts of the observation scheme that you were not able to complete during the activity to be sure that nothing will be missed.	☐

Notes:

***If there is only one observer, skip this step.

After the data collection	**Check**
12. Prepare data for the data analysis (i.e., code the learners' actions, calculate the average time next to an exhibit, etc.).	☐
13. Upload prepared data to the shared folder on the Surrounded by Science server. Use the naming convention described in D1.2.	☐
14. Update the status of data collection in the Monitoring tool in the Surrounded by Science Teams environment.	☐
15. Debrief the provider about the results at the general level.	☐
16. Keep all the observation schemes and notes according to the national research protocol.	☐

Appendix VII

Data collection protocol and checklist tool for the Person-in-Context perspective

Data collection protocol and checklist tool for the person-in-context perspective

Preparation for the data collection	**Check**
12. Acquire ethical approval according to the national standards (see D8.1 for more information on ethical principles and the procedure to follow). The average estimated time needed for ethical approval is 2-3 weeks. *	☐
13. Adjust the questions in the data collection instrument for the topic of your activity and the target group. Do so by using the Decision Tree (see Appendix IV of D4.1).	☐
14. Translate and validate the instrument into the required language by using back-and-forth translation.	☐
15. Insert the instrument into the Science Chaser. **	☐
16. Prepare a paper-and-pencil version of the questionnaire, including an active consent form (see D8.2 for more information on the procedure and a template) for people who are not able to use their own mobile devices.	☐
17. Pilot the instrument with representatives of the target population (but <u>not</u> the actual participants). Check aspects like right representation in the Science Chaser, time to complete the instrument, understanding, difficulty level, etc.	☐
18. Print the QR code of the questionnaire (generated in the Science Chaser) and put it in a good position to be scanned after the activity. **	☐
19. (optional) Insert additional information to use during the activity in the Science Chaser. **	☐

Notes:

*This step can be done in parallel to other steps but should be completed before the data collection dates.

**If the data collection is planned without using the Science Chaser, skip this step.

Data collection	**Check**
Before the activity:	
20. Make sure all participants create an account in the Science Chaser at their mobile devices. *	☐
21. Make sure you have a copy of paper test and a pen for all the participants that have to complete it. **	☐
After the activity:	
22. Arrange a moment for participants to complete the questionnaire (using either the Science Chaser or the paper-and-pencil version).	☐
23. Arrange a moment to interview children on their open-ended questions, taking note of their answers. ***	☐

Notes:

*If the data collection is planned without using the Science Chaser, skip this step.

** If all the participants are able to use the Science Chaser, skip this step.

***If the participants are not primary school children, skip this step.

After the data collection	**Check**
24. Prepare data for the data analysis (i.e., code the answers to the open questions, calculate the average scores for the Likert-scale questions).	☐
25. Upload prepared data to the shared folder on the Surrounded by Science server. Use the naming convention described in D1.2.	☐
26. Update the status of data collection in the Monitoring tool in the Surrounded by Science Teams environment.	☐
27. Keep the consent forms and questionnaire answers according to the national research protocol.	☐

Appendix VIII

Data collection protocol and checklist tool for the Person-Oriented perspective

Data collection protocol and checklist tool for the person-oriented perspective

Preparation for the data collection	**Check**
1. Acquire ethical approval according to the national standards (see D8.1 for more information on ethical principles and the procedure to follow). The average estimated time needed for ethical approval is 2-3 weeks.*	☐
2. Discuss the goals (i.e., strands of Science Proficiency) of data collection with the activity provider.	☐
3. Compose the data collection instrument(s) for your study, consisting of pre- and post-test versions. Do so by using the Decision Tree (see Appendix IV of D4.1).	☐
4. Prepare a coding scheme for open-ended questions in the tests.	☐
5. Translate and validate the instrument into the required language by using back-and-forth translation.	☐
6. Insert the instrument into the Science Chaser. **	☐
7. Pilot the instrument with representatives of the target population (but not the actual participants). Check aspects like right representation in the Science Chaser, time to complete the instrument, understanding, difficulty level, etc.	☐
8. Prepare an active consent form (see D8.2 for more information on the procedure and a template) and distribute it to the participants and, if applicable, their parents. The average estimated time needed to receive the consent form back is 1-2 weeks.	☐
9. (optional) Insert additional information to use during the activity in the Science Chaser.	☐

Notes:

*This step can be done in parallel to other steps but should be completed before the data collection dates.

**If the data collection is planned without using the Science Chaser, skip this step.

Data collection	**Check**
Before the activity:	
10. Make sure all participants create an account in the Science Chaser. *	☐
11. Create a master file with participants' usernames and real names to prevent loosing data in case participants forget their user names (it is not to be shared with the consortium but kept only for the duration of the data collection).	☐
12. Make sure all the participants have an appropriate (mobile) device to use before, during (if needed), and after the activity. *	☐
13. Instruct people administering the test (e.g., not to answer content-related questions).	☐
14. Arrange a moment for participants to complete the pre-test.	☐

During the activity:	
15. Ask participants to use the Science Chaser during the activity (only if Step 9 has been implemented).	☐
After the activity:	
16. Arrange a moment for participants to complete the post-test (use the master file from Step 11, if needed). Help the participants to log into the Science Chaser, if help is needed.	☐

Notes:

*If the data collection is planned without using the Science Chaser, skip this step.

After the data collection	**Check**
17. Prepare data for the data analysis (i.e., code the answers to the open questions of the pre- and post-tests, calculate the average scores for the Likert-scale questions).	☐
18. Upload prepared data to the shared folder on the Surrounded by Science server. Use the naming convention described in D1.2.	☐
19. Update the status of data collection in the Monitoring tool in the Surrounded by Science Teams environment.	☐
20. Debrief the participants about the results at the general level (via a teacher/contact person).	☐
21. Keep the consent forms and tests according to the national research protocol.	☐

Appendix IX

Decision Tree

The Decision Tree

This flowchart is designed to help the activity providers decide which tools to use for their respective case studies. Each case study will focus on 1-3 research perspectives. The respective tools are listed in lower-case bold lettering. These tools are located in the appendices of D5.1.