Common aspects of all scenarios

All different scenarios for microMOOCs are laboratory-based experiences and should have a high degree of interactivity. Their duration must be limited approximately to 20-30 minutes, inclusive of the exploitation of the remote/virtual labs. The key role in making successful the proposed teaching strategy is played by the choice of the topic and of the learning environment in the microMOOC. What piques student's curiosity will depend on the student's interests, experience and prior knowledge. A "good" microMOOC topic for the implementation in a classroom, should:

1. provide affective engagement to the students;
2. generate curiosity and leads to questions;
3. generate a cognitive conflict;
4. be scientifically investigated and explained within the competence of the students involved;
5. create scientific knowledge;
6. require the students to use inquiry skills to explain the involved phenomena;
7. be faced in a limited span of time (1–2 lessons for the presentation and use of remote/virtual labs).

The pedagogical approach used in the MOOCs design should take into account the 5E cycle. In particular:

(i) **Engage** state involves the setting of the learning environment in a way that piques student interest and generates curiosity in the topic under study. It get students personally involved in the lesson, while pre-assessing prior understanding. During the ENGAGE stage, students first encounter and identify the instructional task, make connections between past and present learning experiences, setting the organizational ground work for upcoming activities. The video format should arouse students' curiosity and encourage them to ask their own questions;

(ii) in the **Exploration** stage, by means of the remote/virtual labs, the students have the opportunity to get directly involved with phenomena and materials. The teacher acts as a facilitator, providing materials and guiding the students' focus. **Explore** is the beginning of student involvement in inquiry. They search for information, raise questions, develop hypotheses to test, collect data;

(iii) **Explanation** involves the process of data acquisition and evidence processing techniques for the individual groups or entire class (depending on the nature of investigation) from the information collected during the exploration. **Explain** is the stage at which students build models (descriptive or explicative), discuss their data with peers and the teacher and begin to communicate what they have learned;

(iv) **Extend** is the stage in which students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways, building possible generalizations;

(v) **Evaluate** is an on-going diagnostic process for both students and teachers. It involves students' capacity to make judgments, analyses, and evaluations of their work, also in comparison with the work of their colleagues. It also allows teachers to determine how much learning and understanding has taken place.

In order to develop scientific knowledge and stimulate the strengthening of reasoning skills, the students will be engaged into inquiry-based learning environments in identifying scientifically relevant questions, planning investigations, gathering data and evidences in laboratory and/or real life situations, building

descriptions and explicative models, sharing their findings and eventually addressing new questions that may arise. All phases of the 5E cycle model should be included into the microMOOC, but with different amount of support provided by the teacher. Moreover, the five phases of the learning process should be well separated within the microMOOC in such a way that their administration, could also be delayed in time.

In the following we present the templates for different pedagogical scenarios.