This project has received funding from the European Union's Seventh Framework Programme Capacity, Collaborative Project under grant agreement no 321428

# On-the-fly Feedback teaching plan UK

**Title: Reaction Rates**

**Background**

The Reaction rates inquiry was taken from the SAILS project (www.sails-project.eu). It uses effervescent vitamin C tablets to introduce students to the concepts of gas production in the reaction of acid with carbonate, and rates of reaction and factors influencing reaction rate. This lesson plan is an adaptation of one of the lessons in this unit. It was designed and trialled with an upper secondary chemistry class (Y11, mixed attainment).
More information on Reaction rates SAILS unit can be found at http://www.sails-project.eu/units/reaction-rates.html

**Learning aims/Summary of the lesson focus**

- Select one factor that is expected to affect reaction rate
- Design an investigation that enables the collection of valid data

**Inquiry skills**

Predictions; planning an investigation; variable control; data collection; explanation; drawing evidence based conclusions

**Assessed skills**

Planning an investigation and data collection-*This investigation provides an excellent opportunity for students to revise their plans as they go.*

**Overview:** using vitamin C tablets as an example of an acid-carbonate reaction from which to collect data on carbon dioxide production as a method for measuring rate of reaction.

**Equipment required:**

Soluble vitamin C tablets, conical flasks, small beakers, water bottles (commercial).
Methods of gas collection/loss of mass: balloons (possibly with a tape measure); measuring cylinders; gas syringes; scales; water trough, delivery tube and inverted measuring cylinder; any others that you or your students may plan for.
Methods for changing factors: temperature e.g. water bath / kettle; surface area; concentration; agitation

**Group composition**

Teacher grouped four students of similar abilities, breaking up usual partners to develop original dialogue.

**Lesson plan**

Duration of the lesson: 90 min.

1. Teacher elicits students' ideas on what is a chemical reaction, what do we mean by reaction rate, and the methods to measure reaction rates. *Optional: discussion of factors that affect the rate of reaction (RoR) or gathering ideas from the students of factors that they think might affect the rate of a reaction without further discussion (*duration 20 min).
2. Teacher introduces the inquiry activity: to measure a reaction rate. Teacher makes a demonstration by dropping a tablet of VitC in water. The teacher starts a classroom discussion on how to measure the reaction rate. *Optional: teacher tells students that there are two ways of doing this, measuring the speed of product formation or the speed of reagent consumption gives them the formula to calculate this* (duration 10 min).
3. Teacher groups the students. In each group, students choose a factor to investigate. This will involve a discussion as students choose a variable that they believe will affect the rate of reaction and also for which they will be able to record values. Groups write a brief outline of their investigation method (duration 10 min). (teacher walks around and talks to the different groups)
4. Teacher stops the class and addresses the whole class by giving students some feedback on procedures and suggestions to improve their experiments (duration 10 min).
5. Students revise their investigation methods and carry out the investigation. During this time the groups will start to carry out their methods. *Optional: You may choose to show the students the available equipment, or allow the students to order/provide their own equipment.* Students will encounter problems with their methods and adapt them as they go. See feedback below for possible questions to ask students during this stage.
6. Students' home work is to present their data and evaluate their investigation and suggest improvements to it.

**Feedback**

Questions to ask groups during the investigation:

- How will you measure/define your independent variable?
- How will you measure/define your dependent variable?
- Why are you *insert your observation of what they are doing*?
- How much ... did you use? Is it important how much you use? Why?
- Is there a better way to measure ...?
- How does ... affect the ...?
- How do you know that ... affects ...?
- What in your procedure might have caused errors?
- How could you control for these errors?
- How could you improve your method to avoid these uncertainties?

The purpose of these questions is to encourage students to think about and justify why they are doing what they are doing, the decisions they have made in developing their method and how they can adjust their plan.