




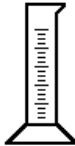
# *Science Menu: “à la carte” experiments among pans and test tubes*

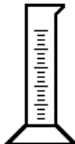

*a recipe book by Giulia Realdon & Immacolata Ercolino*

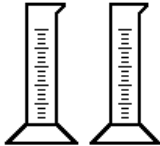
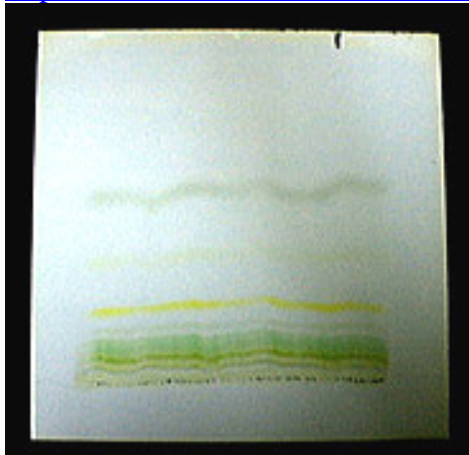
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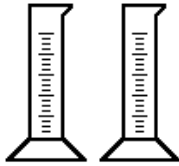
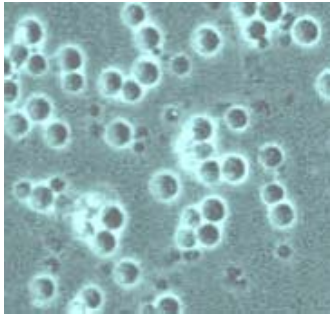
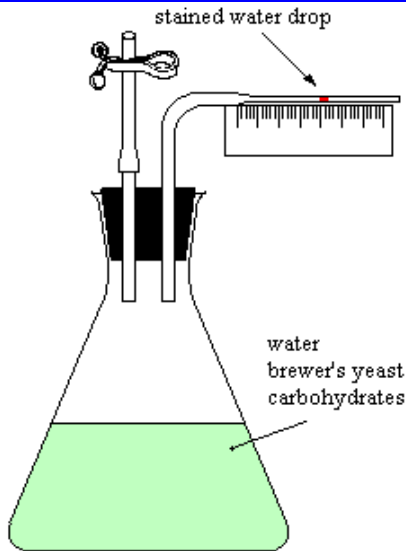
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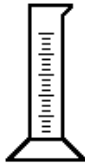

Name of the experiment	<b>Onions in brine</b>
Subject/s	Biology, physical chemistry
Topic	Osmosis
Students age	10-16
Time required	1 hour unit
Difficulty	
Equipments and materials	<p>Microscopy (preferably linked to video-camera and computer or TV set), knife or cutter, tweezers, slides and cover slips, glasses (beakers), droppers (Pasteur pipettes with rubber bulb), filter paper (or kitchen paper like Scottex®).</p> <p>Red onions (Tropea type), water, salt (NaCl).</p>
Protocol	<ol style="list-style-type: none"> <li>1) peel the onion's epidermis (on the external red side of the "leaves")</li> <li>2) place a small epidermis piece on the slide, 3) add a drop of water with the dropper or pipette</li> <li>4) top the specimen with a cover slip</li> <li>5) observe through the microscope beginning from the least magnification and draw a picture of the observed specimen</li> <li>6) prepare <math>\frac{1}{4}</math> of a beaker of NaCl saturated solution (dissolve some spoonfuls of salt in water until a small amount remains undissolved at the bottom)</li> <li>7) add a drop of NaCl saturated solution on the edge of the cover glass and place a piece of filter paper on the opposite edge so that the paper will draw the solution across the specimen</li> <li>8) wait for 5 minutes, then absorb the solution in excess with the filter paper (on the opposite edge as written at point 7)</li> <li>9) observe again through the microscope beginning from the least magnification and draw a picture of the observed specimen</li> </ol>
Didactical materials	<p>Work-sheet with test questions</p> <p>Website with pictures related to the proposed experiment:  <a href="http://www.microscopy-uk.org.uk/mag/indexmag.html?http://www.microscopy-uk.org.uk/mag/art97/maysnp2.html">http://www.microscopy-uk.org.uk/mag/indexmag.html?http://www.microscopy-uk.org.uk/mag/art97/maysnp2.html</a></p> <p>Website with many micro-photographs of onion's epidermis:  <a href="http://www.microscopy-uk.org.uk/mag/indexmag.html?http://www.microscopy-uk.org.uk/mag/artnov03/wdonion.html">http://www.microscopy-uk.org.uk/mag/indexmag.html?http://www.microscopy-uk.org.uk/mag/artnov03/wdonion.html</a></p> <div style="display: flex; justify-content: space-around;">   </div>

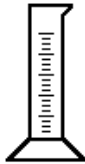
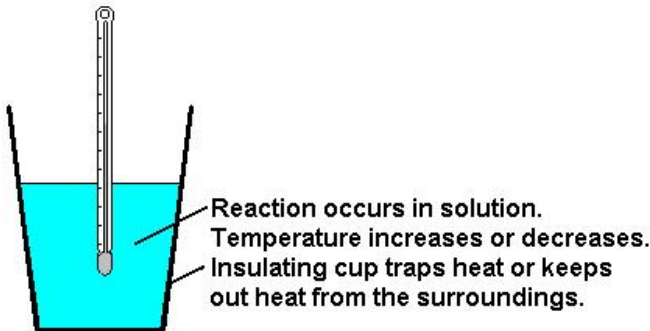
Name of the experiment	<b>Waiter, there is a fly in my glass!</b>
Subject/s	Physical chemistry
Topic	Water properties: surface tension, surfactants
Students age	10-16
Time required	1 hour unit
Difficulty	
Equipments and materials	One 100 ml beaker, a fake fly (taken from a hook; safety advice: cut the tip of the hook with the help of a pair of pincers before giving the “fly” to the students), water, washing up liquid
Protocol	<ol style="list-style-type: none"> <li>1) fill the beaker with water up to the rim</li> <li>2) carefully place the “fly” on the water surface</li> <li>3) observe the surface of the liquid around the fly (you can show some pictures of insects “walking” on the water, e.g. the pond skater)</li> <li>4) add to the water some drops of washing up liquid</li> <li>5) observe again what happens (the “fly” sinks) and add your comments, explaining the action of surfactants</li> <li>6) you can repeat the experience using a small thin coin, for instance 1 cent)</li> </ol>
Didactical materials	<p>Lab sheet, pictures and videos</p> <p>Website with interactive animation:  <a href="http://citt.ufl.edu/Marcela/Sepulveda/media/en_tension.swf">http://citt.ufl.edu/Marcela/Sepulveda/media/en_tension.swf</a></p> 

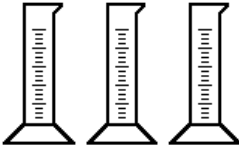
Name of the experiment	<b>Chromatography with Smarties® candies</b>
Subject/s	Chemistry
Topic	<p><b>Chromatography</b> was born as a separation technique and was later implemented as an analytical method. It is based on the fact that the various components of a mixture tend to distribute among two phases in a different way, depending on the affinity with each one of them.</p> <p>The invention of chromatography was ascribed to the Russian biochemist Mikhail Cvet (to be pronounced <i>Tswett</i>) in 1906 when he was able to separate chlorophyll from a plant extract by means of this technique. While one phase - generally a solid or a gel - stays still (<i>the stationary phase</i>), another phase (<i>the mobile phase</i>), which is liquid or gaseous, flows through it dragging along at higher rate the components of the mixture that are more similar to it.</p>
Students age	10-16 anni
Time required	1 hour unit
Difficulty	
Equipments and materials	A small bowl or a soup plate, a 100 ml graduated cylinder, a dropper (or Pasteur pipette with rubber bulb), a strip of filter paper 5 cm wide and 2-3 cm higher than the cylinder, Smarties® candies, water
Protocol	<ol style="list-style-type: none"> <li>1) put 10 red Smarties , 10 green ones and 10 blue ones in the small bowl or soup plate</li> <li>2) add a <u>small</u> amount of water in order to dissolve the candy pigments without diluting them excessively and soak for a few minutes mixing from time to time until the water is intensely dyed</li> <li>3) using a dropper make a dark spot at a distance of 4 cm from the end of the paper strip</li> <li>4) wait until the spot dries</li> <li>5) pour some water ( a 2 cm layer) into the cylinder</li> <li>6) insert the paper strip into the cylinder: the dye spot has to be a bit <u>higher</u> than the water level and turn the opposite end around the rim of the cylinder</li> <li>7) observe the ascent and separation of the pigments</li> </ol>
Didactical materials	<p>Lab sheet</p> <p>Website with interactive animation:  <a href="http://www.sambal.co.uk/chromatography.html">http://www.sambal.co.uk/chromatography.html</a></p> 

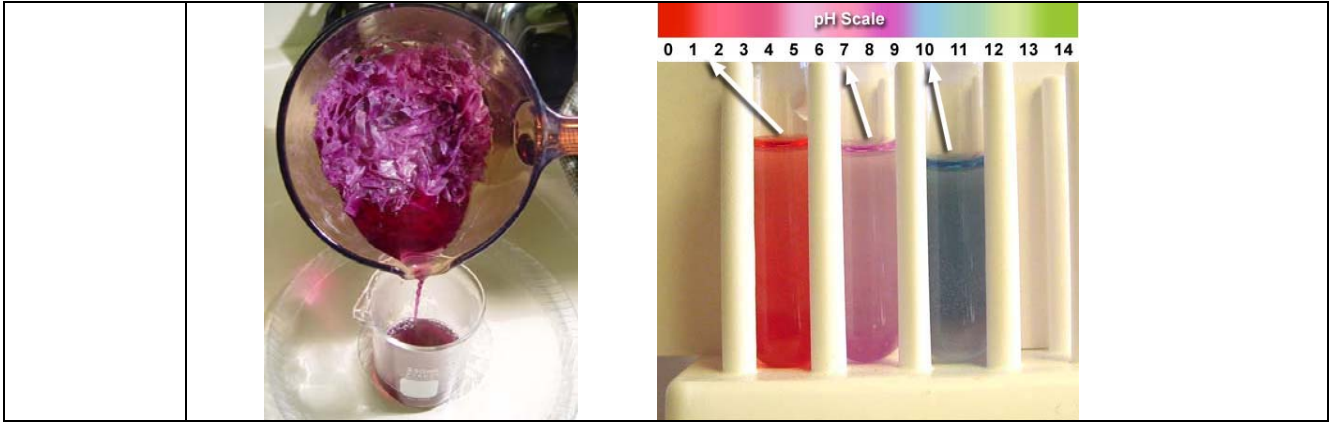
Name of the experiment	<b>Chromatography with spinach</b>
Subject/s	Chemistry
Topic	Separation of leaf pigments
Students age	12-18
Time required	2 hour units
Difficulty	
Equipments and materials	Leaf spinach, scissors, one 200 ml beaker, a hotplate (or Bunsen burner + trivet and wire gauze), mortar and pestle, a dropper, a large test tube or a 100 ml graduated cylinder, aluminium foil, acetone (nail polish remover), solvent mix (92% petroleum ether, 8% acetone), a filter paper strip wide enough to fit the test tube (or cylinder) and 2 cm longer than it.
Protocol	<ol style="list-style-type: none"> <li>1) put some spinach into the beaker with boiling water and wait for 5 minutes</li> <li>2) switch off the hotplate or burner</li> <li>3) remove the spinach and get them dry</li> <li>4) grind the spinach in the mortar adding 2ml acetone until a dark green (very dark!) liquid is obtained (WARNING! Work in a ventilated room. Make sure that the hot plate or burner is off and operate far from it when using acetone or solvent!)</li> <li>5) using a dropper make a dark spot at a distance of 4 cm from one end of the paper strip</li> <li>6) repeat point 5) until a very dark spot is obtained (pigment charge)</li> <li>7) pour a 2 cm layer of solvent mixture into the large test tube or cylinder</li> <li>8) insert the paper strip into test tube/cylinder: the spot has to be a bit <u>higher</u> than the solvent level; turn the upper end of the strip around the rim of the test tube/cylinder and cover it with a piece of aluminium foil</li> <li>9) wait until the solvent has nearly reached the rim of the test tube/cylinder</li> <li>10) observe the ascent and separation of the pigments</li> <li>11) add some comments on the chemical composition and role of the pigments in photosynthesis</li> </ol>
Didactical materials	<p>Biology textbook, lab sheet,          Animations on photosynthesis on the websites:  <a href="http://www.web.virginia.edu/gg_demo/movies/figure18_12b.html">http://www.web.virginia.edu/gg_demo/movies/figure18_12b.html</a>  <a href="http://www.fw.vt.edu/dendro/forestbiology/photosynthesis.swf">http://www.fw.vt.edu/dendro/forestbiology/photosynthesis.swf</a></p> 




Name of the experiment	<b>Alcoholic fermentation 1st part</b>
Subject/s	Biochemistry
Topic	Metabolism, CO <sub>2</sub> gas production
Students age	13-16
Time required	1 hour unit + 15 minutes
Difficulty	
Equipments and materials	2 g baker's yeast, 28 g sugar (sucrose), water, 0.2 g sodium mono-hydrogen phosphate (optional), barium hydroxide, two 200 ml beakers, a filtering flask (with side arm), a rubber stopper, rubber tubing fitting the "arm" of the flask, a Pasteur pipette without bulb.
Protocol	<ol style="list-style-type: none"> <li>1) dissolve the baker's yeast in 200 ml of lukewarm water (about 45°C) into a beaker, add the sugar and sodium mono-hydrogen phosphate (optional)</li> <li>2) prepare a saturated barium hydroxide solution (gradually dissolve barium hydroxide in water until a small amount remains undissolved at the bottom, then pour the solution into a beaker)</li> <li>3) pour the mixture into the flask, cork it and connect the "tail" with the tubing</li> <li>4) insert the pipette into the opposite end of the tubing and immerse the tip of the pipette into the beaker containing barium hydroxide solution</li> <li>5) wait (from 3 hours up to 1 day according to your teaching schedule) until a white precipitate (barium carbonate BaCO<sub>3</sub>) is visible at the bottom of the beaker: this is the sign of CO<sub>2</sub> production</li> <li>6) add some comments explaining the chemical reaction involved in the experiment</li> </ol>
Didactical materials	<p>Lab sheet with questions</p> <p>Website with audio/video animation for older students:  <a href="http://trc.ucdavis.edu/biosci10v/bis10v/media/ch06/fermentation.html">http://trc.ucdavis.edu/biosci10v/bis10v/media/ch06/fermentation.html</a></p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div>

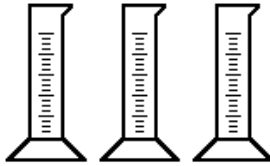

Name of the experiment	<b>Alcoholic fermentation 1st part simplified</b>
Subject/s	Biochemistry
Topic	Metabolism, CO <sub>2</sub> gas production
Students age	10-16
Time required	½ hour + 15 minutes
Difficulty	
Equipments and materials	10 g baker's yeast, 50 g sugar (sucrose), water, a beaker, a glass bottle, a balloon, a rubber band (office type)
Protocol	<ol style="list-style-type: none"> <li>1) dissolve the baker's yeast in 200 ml of lukewarm water (about 45°C) into a beaker and add the sugar</li> <li>2) pour the mixture into the bottle, seal the bottle with the balloon fastening it to the bottle neck with the rubber band</li> <li>3) wait for 1-2 hours until the balloon is inflated by gas: this is the sign of CO<sub>2</sub> production</li> </ol>
Didactical materials	<p>Lab sheet with questions</p> 



Name of the experiment	<b>Alcoholic fermentation 2nd part</b>
Subject/s	Biochemistry
Topic	Metabolism, heat production
Students age	10-16
Time required	1 hour unit
Difficulty	
Equipments and materials	10 g baker's yeast, 50 g sugar (sucrose), water <u>at room temperature</u> , a calorimeter or a thermos flask (or an expanded polystyrene container of 200-300 ml capacity) with a thermometer inserted in the cover (use a piece of expanded polystyrene to build the cover) Attention: the thermometer must have the scale with Celsius degrees divided into tenths
Protocol	1) dissolve the baker's yeast in 200 ml of water ( <u>at room temperature</u> ) into a beaker and add the sugar 2) pour the mixture into the calorimeter or thermos flask (or polystyrene container), cork it with the polystyrene cover with thermometer and check the temperature every 10 minutes 3) the increasing temperature is the proof of energy production by means of alcoholic fermentation 4) add some comments on the different ways of energy production in living organisms (fermentations, without oxygen and respiration with oxygen)
Didactical materials	Lab sheet with questions Website with audio/video animation for older students: <a href="http://trc.ucdavis.edu/biosci10v/bis10v/media/ch06/fermentation.html">http://trc.ucdavis.edu/biosci10v/bis10v/media/ch06/fermentation.html</a>  <p>Reaction occurs in solution. Temperature increases or decreases. Insulating cup traps heat or keeps out heat from the surroundings.</p>

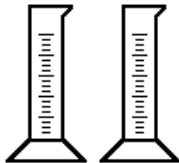
Name of the experiment	<b>Flowers, fruit and cabbage indicators</b>
Subject/s	Chemistry, pH, indicators
Topic	Preparation of indicators with pigments of natural origin extracted from flowers, fruit and vegetables
Students age	13-18
Time required	1 hour unit + 1 hour to prepare the indicator
Difficulty	
Equipments and materials	A hotplate (or Bunsen burner + trivet and wire gauze), a 200 ml beaker, mortar and pestle, a funnel, filter paper, distilled water, a Pasteur pipette with rubber bulb (or a dropper), red fruit (cherries or raspberries, blackberries, ...) or red/purple flowers (roses, tulips, irises, ...) or red vegetables (cabbage), HCl and NaCl dilute solutions (or common use liquids as vinegar, lemon juice, beer, white wine, mineral water, ammonia, baking soda solution, washing or washing-up detergents solutions, ...)
Protocol	<p>1) Cut the fruit or flower or vegetable into small pieces and grind it carefully with mortar and pestle</p> <p>2) according to the amount of fruit/flowers/vegetable used, add some spoonfuls of water to the mixture, mix carefully and put the mush into a beaker, then simmer it on the hotplate for 5-10 minutes until it shows an intense colour</p> <p>3) wait until the mixture is cold, filter in a funnel covered with filter paper and keep the indicator liquid in a small bottle sheltered from light by means of aluminium foil. Use it before one week.</p> <p>3a) an alternative method is to make an infusion of the ground mixture with 20-30 ml ethanol for 2-3 days in a sealed bottle covered with aluminium foil (WARNING: DO NOT heat the mixture: ethanol is highly flammable!) then proceed as written at point 3</p> <p>4) pour 0,5-1 ml of indicator into a test tube, then add HCL dilute solution drop by drop observing if the colour changes</p> <p>5) repeat point 4) using NaCl dilute solution (and another pipette), observing again the colour changes</p> <p>6) you can test also common use liquids (as vinegar, lemon juice, beer, white wine, mineral water, ammonia, baking soda solution, washing or washing-up detergents solutions, ...) proceeding as before (point 4)</p> <p>7) Once proved that the vegetal indicator changes its colour depending on the acidity/basicity of the solution, you can test the indicator range using a series of solutions of known pH (from 0 to 6 with progressive dilution of HCl 1M, from 14 to 8 with progressive dilution of NaOH 1M).</p>
Didactical materials	Lab sheet Another protocol on the website: <a href="http://www.chemistryland.com/CHM107Lab/Lab1/Lab1PreparingCabbageExtract.htm">http://www.chemistryland.com/CHM107Lab/Lab1/Lab1PreparingCabbageExtract.htm</a>





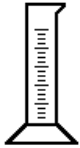
Name of the experiment	<b>DNA juice (DNA extraction from kiwi or peach)</b>
Subject/s	Biochemistry
Topic	Making visible DNA from food
Students age	10-16
Time required	1 hour unit
Difficulty	
Equipments and materials	A mixer (like MiniPimer® type), a funnel, filter paper, two 400 ml beakers, 3 large test tubes, an inoculation loop (or a piece of wire coiled as a loop), a knife, 10 ml washing-up liquid, 3 g table salt, 100 ml distilled water, half peach or kiwi, 20 ml 95% ethanol (= pure alcohol, very cold, straight from the freezer),
Protocol	<ol style="list-style-type: none"> <li>1) cut the half peach or kiwi into small pieces</li> <li>2) add the salt, the washing-up liquid and mix well</li> <li>3) add the chopped kiwi</li> <li>4) wait for 10 minutes</li> <li>5) blend the mixture with the mixer for exactly 5 seconds</li> <li>6) filter the mixture (with funnel + filter paper) into a second beaker</li> <li>7) pour 20 ml of the filtrate into a large test tube</li> <li>8) very carefully pour ice cold ethanol down the side of the tube, to form a layer on top of the kiwi extract</li> <li>9) collect the filaments of DNA wrapping them around the inoculation loop</li> <li>10) observe the appearance of DNA precipitate, adding a comment on the difference between the macroscopic aspect and the molecular structure of DNA</li> </ol>
Didactical materials	<p>Lab sheet with questions</p> <p>Other protocols on DNA extraction can be found on the website:  <a href="http://learn.genetics.utah.edu/units/activities/extraction/">http://learn.genetics.utah.edu/units/activities/extraction/</a></p> <p>DNA models to be built by the students ( cardboard, origami, marshmallow and liquorice models)</p> <div style="display: flex; justify-content: space-around;">   </div>

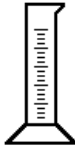

Name of the experiment	<b>Jellies, bacteria and clean hands</b>
Subject/s	Microbiology, hygiene
Topic	Bacteria dwelling in the skin
Students age	10-16
Time required	1 hour unit + 15 minutes
Difficulty	
Equipments and materials	A hotplate (or Bunsen burner + trivet and wire gauze), 12 plastic Petri dishes (you can ask to a medical lab in your area), a small saucepan, a vegetable stock-cube, a spoonful of sugar, a jelly mix pack, water (according to the instructions on the jelly mix pack)
Protocol	<ol style="list-style-type: none"> <li>1) carefully wash your hands before starting</li> <li>2) boil the water in the saucepan, then dissolve the sugar, the stock-cube and the jelly mix according to the instructions on the jelly mix pack</li> <li>3) simmer for 30 minutes</li> <li>4) pour the liquid into a jug and then into the Petri dishes (a layer about 3 mm deep)</li> <li>5) cover the dishes with their lids and wait until the jelly is solid</li> <li>6) keep the dishes upside down until you use them</li> <li>7) open one of the dishes and press an UNWASHED finger on the jelly</li> <li>8) cover the dish fastening the lid with a piece of adhesive tape and label it</li> <li>9) repeat points 7) e 8) but this time press a WASHED (with water and soap) finger on the jelly</li> <li>10) keep the dishes at room temperature for some days (check them every day)</li> <li>11) observe the bacterial growth in the two (closed) dishes holding them against the light or, better, through the microscope</li> <li>12) dispose of the dishes without opening after having sealed them in a plastic bag, following the current procedure of waste disposal used in your town</li> </ol>
Didactical materials	<p>Another protocol can be found on the website:  <a href="http://education.denniskunkel.com/catalog/index.php?cPath=3">http://education.denniskunkel.com/catalog/index.php?cPath=3</a></p> 

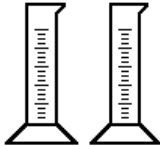

Name of the experiment	<b>Jellies for every taste 1<sup>st</sup> part</b>
Subject/s	Biology, enzymes
Topic	Protease action and specificity
Students age	10-16
Time required	½ hour to prepare the jelly + 15 minutes x 2 after 2-4 hours
Difficulty	
Equipments and materials	a cup (or small bowl), a knife, refrigerator, 1 fresh and ripe pineapple, a jelly mix pack (animal gelatine, the type used to prepare aspics), water
Protocol	<ol style="list-style-type: none"> <li>1) prepare the jelly according to the package directions</li> <li>2) pour the jelly into the cup or bowl</li> <li>3) keep the cup into the fridge for 1 day or until it solidifies</li> <li>4) cut a piece of ripe pineapple that fits easily in the cup and place it on the solid jelly</li> <li>5) store the cup in a cool place or, better, in the fridge for 2-4 hours</li> <li>6) observe and record the results of the experiment</li> </ol>
Didactical materials	<p>Worksheet with explanations, suggestions and questions</p> 

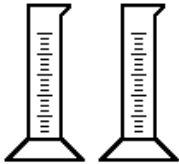

Name of the experiment	<b>Jellies for every taste 2<sup>nd</sup> part</b>
Subject/s	Biology, enzymes
Topic	Protease action and specificity
Students age	10-16
Time required	½ hour to prepare the jelly + 15 minutes x 2 after 2-4 hours
Difficulty	
Equipments and materials	a cup (or small bowl), a knife, refrigerator, 1 fresh and ripe pineapple, a cup of gelatine from meat stock (prepared boiling some meat rich of connective tissue or taken from canned meat), water
Protocol	<ol style="list-style-type: none"> <li>1) prepare a cup of gelatine melting the stock gelatine or the gelatine from canned meat</li> <li>2) pour the gelatine into a cup or bowl</li> <li>3) keep the cup into the fridge for 1 day or until it solidifies</li> <li>4) cut a piece of ripe pineapple that fits easily in the cup and place it on the surface of the solid gelatine</li> <li>5) store the cup in a cool place or, better, in the fridge for 2-4 hours</li> <li>6) observe and record the results of the experiment</li> </ol>
Didactical materials	Worksheet with explanations, suggestions and questions Website with another protocol: <a href="http://learn.genetics.utah.edu/units/activities/proteins/">http://learn.genetics.utah.edu/units/activities/proteins/</a>

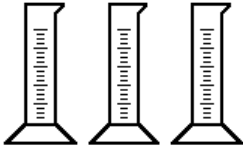
Name of the experiment	<b>Jellies for every taste 3<sup>rd</sup> part</b>
Subject/s	Biology, enzymes
Topic	Protease action and specificity
Students age	10-16
Time required	½ hour to prepare the jelly + 15 minutes x 2 after 2-4 hours
Difficulty	
Equipments and materials	a cup (or small bowl), a knife, refrigerator, 1 fresh and ripe pineapple, a jelly mix pack (vegetal jelly like Tortagel® Cameo), water
Protocol	<ol style="list-style-type: none"> <li>1) prepare the vegetal jelly according to the package directions</li> <li>2) pour the jelly into the cup or bowl</li> <li>3) keep the cup into the fridge for 1 day or until it solidifies</li> <li>4) cut a piece of ripe pineapple that fits easily in the cup and place it on the solid jelly</li> <li>5) store the cup in a cool place or, better, in the fridge for 2-4 hours</li> <li>6) observe and record the results of the experiment</li> </ol>
Didactical materials	<p>Worksheet with explanations, suggestions and questions</p> <p>Website with another protocol:  <a href="http://learn.genetics.utah.edu/units/activities/proteins/">http://learn.genetics.utah.edu/units/activities/proteins/</a></p> 

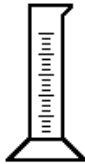


Name of the experiment	<b>Chemical geyser with Mentos® candies</b>
Subject/s	Physical Chemistry
Topic	Gas, pressure, solubility
Students age	10-16
Time required	30 minutes
Difficulty	
Equipments and materials	A pack of Mentos® candies, a bottle (1,5 o 2 L) of carbonated soda (a very carbonated one, like Coca Cola® or Diet Coke®), an index card or a post card, a test tube narrow enough to form a single column of candies (otherwise you can roll a sheet of paper into a tube just barely wide enough for a stack of candies)
Protocol	<ol style="list-style-type: none"> <li>1) stack the candies in the test tube or in the rolled paper</li> <li>2) Place the card over the opening of the test tube or end of the paper tube to hold the candies in the container. Invert the test tube.</li> <li>3) Open your bottle of diet soda. The eruption happens very quickly, so set things up: you want the open bottle - card - roll of candies so that as soon as you remove the index card, the candies will drop smoothly into the bottle. ATTENTION: it is advisable to operate outdoors or in a room with easily cleanable walls and floor.</li> <li>4) remove the card and let the candies into the bottle, then go (quickly!) at a certain distance from it</li> <li>5) observe what is happening</li> </ol>
Didactical materials	<p><b>Some clarifications</b></p> <p>The gas “explosion” is more a physical than a chemical reaction, due to the candies.</p> <p>The carbonated soda is a CO<sub>2</sub> supersaturated solution and, when the bottle is opened, it tends to reach an equilibrium with the atmosphere.</p> <p>Any objects dropped in a carbonated soda make the gas bubbles to develop more quickly because they provide them with a wider surface for forming, so they will separate from the liquid in a turbulent way, overcoming the resistance opposed by the surface tension.</p> <p>This phenomenon is called “nucleation”: adding a surface to a super-saturated solution triggers a physical reaction (CO<sub>2</sub> dissolved in the solution → gaseous CO<sub>2</sub>).</p> <p>The rougher the surface is, the quicker bubbles will form and the higher the “geyser” will explode.</p> <p>(Anyway the “Coke® and Mentos®” phenomenon is not yet fully understood, so if you discover more, please let us know!)</p> <p>Another protocol to make a “volcano” with baking soda and vinegar:  <a href="http://www.mbmng.mtech.edu/kids/make_a_volcano.htm">http://www.mbmng.mtech.edu/kids/make_a_volcano.htm</a>  A website with an incredible series of videos on the topic:  <a href="http://video.google.com/videoplay?docid=-1450915772177922792">http://video.google.com/videoplay?docid=-1450915772177922792</a></p>

Name of the experiment	<b>Magic baking soda</b>
Subject/s	Chemistry
Topic	The states of matter, the burning process
Students age	8-16
Time required	30 minutes
Difficulty	
Equipments and materials	A glass (or beaker), baking soda (sodium bicarbonate), water, vinegar, a candle, a cigarette lighter
Protocol	<ol style="list-style-type: none"> <li>1) pour some water (a 3 cm layer) into the beaker</li> <li>2) add about 10 ml of vinegar</li> <li>3) add some (2-3) spoonfuls of baking soda</li> <li>4) the mix will soon fizz and foam: CO<sub>2</sub> is forming and the gas is released resulting in foam development.</li> <li>5) light the candle and put it near the rim of the beaker: carbon dioxide will blow out the flame</li> <li>6) add some comments on the chemical reaction (<math>\text{HCO}_3^- + \text{H}^+ = \text{H}_2\text{CO}_3 = \text{H}_2\text{O} + \text{CO}_2</math>), on the burning process and its need for oxygen</li> </ol>
Didactical materials	<p>Observation sheet</p> <p>Other activities with baking soda on the website:  <a href="http://entertainment.howstuffworks.com/uses-for-baking-soda-childrens-activities-ga.htm">http://entertainment.howstuffworks.com/uses-for-baking-soda-childrens-activities-ga.htm</a></p> 

Name of the experiment	<b>Viscous honey</b>	
Subject/s	Chemistry	
Topic	Viscosity measurement, measurement method	
Students age	10-15	
Time required	1 hour unit	
Difficulty		
Equipments and materials	4 plastic bottles (0,5L), 4 marbles passing through the bottles' neck, liquids of different viscosity, for instance water, oil, honey, hair gel, shampoo....., some chronometers (according to the number of student groups)	
Protocol	<ol style="list-style-type: none"> <li>1) divide the students into groups of 2-3 people each</li> <li>2) every group prepares a bottle filling it with one of the liquids to be tested and then introducing the marble in it</li> <li>3) after sealing the bottle one of the students turns it upside down while another student measures the time required for the marble to reach the bottom</li> <li>4) every group takes a measure for three times before exchanging the bottle with another group and testing another liquid</li> <li>5) repeat the measurement (3x) for every liquid</li> <li>6) finally every group fills in a sheet writing the 3 measures for all the tested substances, calculates the average values for each of them and then compares its data with those of the other groups discussing the results and giving an esteem of the viscosity of the various liquids</li> </ol> <p>P.S. you can use other substances like glycerine, foam bath, syrup, ... You can add other measurements and calculations (absolute error, relative error,...)</p>	
Didactical materials	<p>Worksheet</p> <p>Website with another protocol:  <a href="http://www.seed.slb.com/en/scictr/lab/viscosity/index.htm">http://www.seed.slb.com/en/scictr/lab/viscosity/index.htm</a>            Website on viscosity and motor oils:  <a href="http://www.smartsynthetics.com/motor-oil-viscosity.htm">http://www.smartsynthetics.com/motor-oil-viscosity.htm</a>            Website showing lavas with different viscosity:  <a href="http://www.learner.org/exhibits/volcanoes/movies/movies3.html">http://www.learner.org/exhibits/volcanoes/movies/movies3.html</a></p>	

Name of the experiment	<b>Shrinkable potatoes</b>
Subject/s	Biology, physical chemistry
Topic	Osmosis
Students age	10-16
Time required	1 hour and ½
Difficulty	
Equipments and materials	Three 200 ml beakers (or glasses), a device for cutting potatoes into sticks or a knife, 1-2 potatoes, sugar (sucrose), water
Protocol	<ol style="list-style-type: none"> <li>1) prepare two sugar solutions about 1M and 0,5M concentration (dissolving either 340g or 170g of sugar in enough water to have 1L of each solution; if you are preparing ½ L of the solutions dissolve respectively 170g and 85g of sugar)</li> <li>2) cut the potato into sticks with the help of the cutting device or using the knife in order to have at least 3 parallelepipeds of the same size (about 5 x 0,5 x 0,5 cm or according to the “gauge” of the cutting device)</li> <li>3) put the potato sticks into 3 beakers labelled A, B and C</li> <li>4) fill beaker A with water, beaker B with sugar solution 0,5M (less concentrated) and beaker C with sugar solution 1M (more concentrated)</li> <li>5) wait for 30 minutes</li> <li>6) take the sticks out of the beakers and measure their length</li> <li>7) immerse again the sticks in their respective beakers (be careful not to exchange the place of the sticks)</li> <li>8) take the sticks out of the beakers and measure their length again</li> <li>9) compare the data and explain what has happened adding some comments on osmosis and cells</li> </ol>
Didactical materials	<p>Lab sheet with questions</p> <p>Website with another protocol:  <a href="http://www.starsandseas.com/SAS%20Cells/SAS%20cellphysiol/Osmosis.htm">http://www.starsandseas.com/SAS%20Cells/SAS%20cellphysiol/Osmosis.htm</a></p> <p>Website with animation on osmosis:  <a href="http://www.ac-creteil.fr/biotechnologies/doc_osmosis.htm">http://www.ac-creteil.fr/biotechnologies/doc_osmosis.htm</a></p> 

Name of the experiment	<b>Foamy meatballs</b> (contribution by R Sponza)
Subject/s	Biochemistry, enzymology
Topic	Factors affecting enzyme activity
Students age	14-19
Time required	1 hour unit + 1 hour to get the lab ready
Difficulty	
Equipments and materials	A hotplate (or Bunsen burner + trivet and wire gauze), scales (division 0,1g), 4 test tubes, a chronometer, four 200 ml beakers, a thermometer, a ruler (division 1 mm), one 5 ml pipette, two 2 ml graduated pipettes (or 0,5 ml volumetric pipettes), minced meat, hydrogen peroxide (H <sub>2</sub> O <sub>2</sub> ) 3,6%, washing up liquid, isotonic saline solution (you can prepare dissolving 9,8g NaCl in distilled water up to 1L solution), ice
Protocol	<p>The students must be divided into groups of 3 people each; every group performs the whole experiment</p> <ol style="list-style-type: none"> <li>1) boil some water in a beaker using the hotplate or Bunsen burner</li> <li>2) prepare four minced meat meatballs (3 g each)</li> <li>3) pour 5ml of isotonic saline solution in four test tubes</li> <li>4) put some ice in one beaker, pour some water (20°C) into a second one and some water (38°C) into another one. The beakers must be half filled. Mix hot and cold water to obtain the chosen temperatures.</li> <li>5) boil one meatball until it is cooled</li> <li>6) introduce the cooked meatball into a test tube and the remaining raw meatballs in three more test tubes</li> <li>7) mix the meatball in each test tube with the saline solution with the help of a glass rod</li> <li>8) introduce the three test tubes with raw meat respectively in the beaker containing ice, water (20°C) and water (38°C) Wait until the temperature of each test tube is the same as in the beaker</li> <li>9) gently add 5ml of washing up liquid in every test tube, mix carefully with the rod avoiding foam production, put again each test tube into its beaker</li> <li>10) control that the temperature in the beaker at 38°C remains the same; in case add more warm water</li> <li>11) gently add 0,5 ml of hydrogen peroxide in every test tube, start the chronometer <b>immediately</b> and put again each test tube into its beaker</li> <li>12) using the ruler measure the height of the foam layer in each test tube every minute for 7 minutes</li> <li>13) draw a graph with the recorded data</li> </ol>
Didactical materials	<p>Lab sheet with table for the data and graph paper</p> <p>Website with another protocol:  <a href="http://www.okc.cc.ok.us/biologylabs/Documents/Measurement/Catalase.htm">http://www.okc.cc.ok.us/biologylabs/Documents/Measurement/Catalase.htm</a></p> <p>Other website with further information and protocol on catalase:  <a href="http://www.science-projects.com/catalasekinetics.htm">http://www.science-projects.com/catalasekinetics.htm</a></p>

Name of the experiment	<b>Elastic egg</b> (contribution by A.Scaramuzza)
Subject/s	Biology, physical chemistry
Topic	Osmosis
Students age	10-16
Time required	15' in 3 different days + 1 hour unit on another day
Difficulty	
Equipments and materials	3 large glass (or 400 ml beakers), 1 raw egg, 0,3 L vinegar, 0,3 L sugar syrup, water The syrup can be the type used to prepare soft drinks or can be prepared dissolving 300g of sugar into 250 ml water and boiling the mixture for 3 minutes. Wait until the syrup is cooled before the use.
Protocol	<ol style="list-style-type: none"> <li>1) put the raw egg into the beaker filled with vinegar and wait for one day until the shell is dissolved</li> <li>2) take the egg out of vinegar observing what happened about the shell</li> <li>3) immerse the “naked” egg in a beaker filled with syrup</li> <li>4) wait for 24 hours, then observe again how the egg looks like</li> <li>5) after that immerse the egg in a beaker filled with tap water</li> <li>6) wait for 24 hours again and observe the egg for the last time, adding comments on the different aspect of the egg when kept in liquids of different concentration and explaining the phenomenon of osmosis</li> </ol>
Didactical materials	<p>Lab sheet with assessment questions.</p> <p>Website with another protocol:  <a href="http://sps.k12.ar.us/massengale/egg_osmosis_sample2_lab.htm">http://sps.k12.ar.us/massengale/egg_osmosis_sample2_lab.htm</a></p> <p>Website with animation on osmosis:  <a href="http://www.ac-creteil.fr/biotechnologies/doc_osmosis.htm">http://www.ac-creteil.fr/biotechnologies/doc_osmosis.htm</a></p> <div style="display: flex; justify-content: space-around;">   </div>

## *Credits*

*For realizing the page of the project on the website of “Liceo Calamandrei” - Napoli:*  
Claudio Moscatelli

*For revising the English translation:*  
Marisa Brunetti

*For the “Foamy meatballs” recipe:*  
Renzo Sponza

*For the “Elastic egg” recipe:*  
Augusta Scaramuzza