NUFFIELD SCIENCE CALCULATIONS pdf

1: Nuffield Science Project - Wikipedia

This publication is from the Nuffield stable and is good! Many of us could have made use of such a book during the past few years. Having been an ardent fan of Exploring Physics by T Duncan, the questions in the Nuffield Co-Ordinated Science course are very poor indeed. In order for pupils to.

Measuring Stomatal Density Measuring Stomatal Density Stomata control the movement of gases in and out of a leaf, making carbon dioxide available for photosynthesis, and controlling the loss of water from the leaf through transpiration. Stomatal density varies between monocots and dicots, between plant species, and between the underside and top side of the leaves on a plant. There are a number of ways to measure stomatal density, and the different techniques are explored here. One popular method has been to use clear nail varnish to make an impression of the epidermis. We also suggest some potential investigations for students to carry out. Because of the size of stomata, you will need a reasonably good microscope for this. Your choice of magnification will depend on the leaf material that you are using, and the size of the stomata. Background Information The image shows a surface view of the lower epidermis of Kalanchoe Kalanchoe sp. Three stomata and their associated guard cells are shown. Each pore or stoma is surrounded by two sausage-shaped guard cells, which change shape to control the size of the stomatal aperture. In the majority of leaves with an upper and lower surface dorsiventral like this dicot, most stomata occur in the lower epidermis. They are usually evenly distributed in the leaves of monocots. The stomata of most species open in daylight and close in the dark. Those plants that use CAM photosynthesis an adaptation to reduce water loss in arid conditions , stomata close during the heat of the day, to reduce evapotranspiration, and open at night to absorb carbon dioxide for use in photosynthesis. The guard cells contain chloroplasts visible in this image , but in most plant species they are not able to carry out the full process of photosynthesis. The wavy blue lines, looking rather like a jigsaw puzzle, are the cell walls of the epidermal cells. Guard cells develop and differentiate from epidermal cells. In this 4 minute video, Alistair explains why fundamental research, such as his own on stomata, helps us respond to climate change. These videos would also be suitable for post biology students. Selecting your plants One of the best plants for doing epidermal peels is the red hot poker plant Kniphofia. Being a monocot its stomata are highly ordered in rows, but they are big and great for stomatal opening and closing using solutions of different concentrations. Almost as good is the Elephants Ear Saxifrage Bergenia. This also peels very easily, but the stomata are smaller although clearly visible at x magnification. This is a dicot so the distribution is more random. Geraniums a dicot and spider plants another monocot also make excellent stomatal peels. Using Clear Nail Varnish Using clear nail varnish is a traditional method to measure stomatal density, since making the impression and viewing it under a microscope can be completed in one lesson. However, some leaves are prone to damage from the solvent in the nail varnish. The leaves absorb it, turn brown, and fail to produce any impression. Also, for a GCSE class, several pots of nail varnish are needed so that no one is left waiting, thus adding to expense. Prepare an epidermal impression by coating the leaf surface with nail varnish. Peel off the dried layer of nail varnish by using sellotape and stick this onto a slide. Alternatively, with some plants you can peel off an epidermal strip directly, which you can mount in water on a slide and place under the microscope. If you have an eyepiece graticule which you can use, you can work at a relatively low power, and you can count the number of stomata within different squares to act as replicates. If you do not have an eyepiece graticule, you can work at a higher magnification and count a number of different fields - the area visible under the microscope - at any one time. You get enough counts to be able to analyse your results statistically, You calculate the area of leaf which you are counting in order to give a quantifiable result e. You will need to calibrate the size of the field of view, or the size of individual squares within a field, using a stage micrometer to do this. A half litre tin is cheap, and can be divided up into smaller amounts for ease of use. Paint the opaque varnish thinly on to the leaf to produce a clear film. Leave it to dry as usual. These water based varnishes take longer to dry, so if the leaves are coated during one lesson, the impressions can be peeled off and examined the next. The varnish is non toxic, so can be used on living plants without removing the leaves â€" this means that school plants do not have to be denuded for this experiment!

In addition to revealing the stomata, the cell walls also show up. Other Methods Other suggestions include producing impressions on acetate film, by placing a leaf in propanone and then pressing it onto the acetate. This does not work for some plant leaves, especially those that have an uneven surface â€” and the leaf still has to be removed from a plant. Another method is to rub a board pen over the surface. The solvent-based ink permeates the leaf, showing up the stomata. However, this seems to work only with certain types of pen â€” probably related to the strong solvent in the pen. This also raises health and safety issues. Suggestions for investigations As well as studying stomatal patterns and densities in a variety of plants, the following questions may be posed to students: Does the density vary over a leaf surface? Does the density vary between different leaves of the same plant? I have looked at a number of the Brassicaceae: All these leaves are available from greengrocers - and you can eat the rest of the vegetable afterwards! Does the density vary between plants from different habitats. I have used a number of cacti and succulent plants to do this. For plants that reproduce vegetatively, is there any difference between parent and offspring? Kalanchoe and begonias are useful here.

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2: A microscale acid-base titration- Learn Chemistry

Nuffield Science Calculations This Nuffield Foundation publication was prepared to help students master the calculations involved in GCSE Science courses. The book is divided up into a series individual topics.

Topic Topic Topic Topic 23 24 25 26 iv How much gas? Topic 27 Topic 28 Moles of gases 76 Calculating gas volumes 78 How much electrolysis? Topic 29 Electrode reactions Topic 30 The charge needed to produce one mole 84 Topic 31 Electrolysis calculations 85 Topic 32 Charges on ions 88 How much energy? Topic 33 Energy transfers in chemical reactions 89 Topic 34 Energy-level diagrams 93 Topic 35 Bond energies and energy transfer 95 How fast? Scientists spend a lot of time recording their measurements, and then doing mathematical calculations to make sense of them. It is divided up into a lot of individual topics. Each topic is presented in three parts. You should already have studied these ideas during your Science lessons. Worked examples, to show you how to tackle problems in a step-by-step way. These will also show you how to set out your calculations clearly. The first questions in each topic are straightforward, but they become gradually more difficult as you work your way through them. Here are four different ways of showing the relationship between current, voltage and resistance: The best way is to remember what the quantities mean. If you understand what voltage, current and resistance mean, then you will remember how they are related. However, you may need to use the relationship before you have a very firm grasp of the ideas. If this is the case, it is a good idea to memorize one form of the equation. It is up to you to decide which one to memorize: If you learn the units equation, then you must know what they are the units of. They can help you to rearrange an equation, in order to make a different quantity its subject. Cover up the quantity that you want to make the subject of the equation the quantity which you want to find.

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3: Nuffield Science Calculations - IOPscience

This publication is from the Nuffield stable and is good! Many of us could have made use of such a book during the past few years. Having been an ardent fan of Exploring Physics by T Duncan, the.

How much energy is there in food? Class practical Take samples of a range of foodstuffs and set them alight in turn. Burn food samples under a boiling tube containing a measured amount of water. Measure the temperature increase in the water. Calculate the amount of energy needed to cause that temperature increase. This gives an estimate of the amount of energy stored in the food. The apparatus is very simple and the protocol gives only a very approximate estimate for each foodstuff, so there is scope for students to suggest improvements in an evaluation. Lesson organisation This could be a teacher demonstration, or carried out by students in groups of two or three. Nuts are best avoided Note 1. Some students may be allergic to some of the foodstuffs or the fumes produced by burning them. Be alert to the signs of allergic reactions in your students â€" such as skin rashes or breathing difficulties â€" be prepared to administer first aid. The risk of anaphylactic shock following allergic reaction to peanuts or other nuts is such that it is probably best to avoid nuts as foods for this investigation Note 2. Avoid nuts as foods for this investigation. Check with the students if they have any known allergies and ask them to avoid the foods to which they are sensitive. Be aware of your first aid procedures in case of extreme reactions. A well-ventilated laboratory is not considered adequate. Students can reuse the same boiling tube repeatedly in this practical, but the washing up might be quite difficult. You can line one of these with Superwool and to hold liquid foods and foods that melt on heating. Ethical issues Discussing the energy content of food can lead to discussion of body mass and weight loss which is a sensitive area for many students. Check in advance if any students have known food allergies. Ensure none of those allergens are used for the procedure by any group. Be prepared with first aid for minor burns. Check all students are wearing eye protection during the procedure. Warn students to avoid foods to which they might have allergies. Take care with mounted needles. Make sure food drying like this does not attract mice or other vermin. Investigation a Use the measuring cylinder to measure 20 cm3 of water into the boiling tube. Record the temperature in a suitable results table. Record the mass in the table. Note 3 f Light the Bunsen burner and hold the food in the flame until it catches alight. Try to make sure that as much of the heat from the burning food as possible is transferred to the water. Do this by keeping the flame under the tube. If the flame goes out, but the food is not completely burnt, quickly light it again using the Bunsen burner and replace the food beneath the tube. Before measuring, stir the water carefully with the thermometer and note down the highest temperature reached in the results table. Note 5 k Calculate the rise in temperature each time. Teaching notes Make a note of the energy values for the foods used from their packaging. It is usually quoted for g of the food. Compare this value with the estimates from this activity. Although joules are the SI units for energy, you might want to talk in terms of calories when discussing food. Most students will be more familiar with thinking about calorie content than joule content of foods! So you can use the formula above, but take out the 4. This is a useful example of a situation where accurate use of a scientific term seems to contradict normal use of the term in our language! This apparatus is very simple and there are many ways in which it could be improved. For example, using a soft drinks can as a draught shield, using more or less water, considering whether a test tube is better than a boiling tube. With some foodstuffs, small volumes of water will boil. The student sheet shows an alternative apparatus for collecting the heat from burning food. You will probably find several variations on this in your textbooks. Have a look in the prep room for one, too. Comparing and contrasting the features of each, students could develop their own designs for calorimeters. Health and safety checked, September Downloads.

4: Measuring Stomatal Density

NUFFIELD SCIENCE CALCULATIONS Editor of this book Authors of this book David Sang David Sang Jean McLean Terry Parkin Contributor Andrew Hunt The Nuffield Foundation is grateful to Richard Sale and Neill Travers for checking the material, and to the publishing editor Laurice Suess.

Bring fact-checked results to the top of your browser search. Calculating the value of an electric field In the example, the charge Q1 is in the electric field produced by the charge Q2. The electric force on Q1 is given by in newtons. This equation can be used to define the electric field of a point charge. The electric field E produced by charge Q2 is a vector. The magnitude of the field varies inversely as the square of the distance from Q2; its direction is away from Q2 when Q2 is a positive charge and toward Q2 when Q2 is a negative charge. Using equations 2 and 4 , the field produced by Q2 at the position of Q1 is in newtons per coulomb. When there are several charges present, the force on a given charge Q1 may be simply calculated as the sum of the individual forces due to the other charges Q2, Q3,â€¦, etc. This sum requires that special attention be given to the direction of the individual forces since forces are vectors. The force on Q1 can be obtained with the same amount of effort by first calculating the electric field at the position of Q1 due to Q2, Q3,â€¦, etc. To illustrate this, a third charge is added to the example above. The locations of the charges, using Cartesian coordinates [x, y, z] are, respectively, [0. The goal is to find the force on Q1. From the sign of the charges, it can be seen that Q1 is repelled by Q2 and attracted by Q3. It is also clear that these two forces act along different directions. The electric field at the position of Q1 due to charge Q2 is, just as in the example above, Figure 3: Electric field at the location of Q1 see text. The electric field at the location of Q1 due to charge Q3 is in newtons per coulomb. Thus, the total electric field at position 1 i. The total force on Q1 is then obtained from equation 4 by multiplying the electric field E1 total by Q1. In Cartesian coordinates, this force, expressed in newtons, is given by its components along the x and y axes by The resulting force on Q1 is in the direction of the total electric field at Q1, shown in Figure 3. The magnitude of the force, which is obtained as the square root of the sum of the squares of the components of the force given in the above equation, equals 3. Superposition principle This calculation demonstrates an important property of the electromagnetic field known as the superposition principle. According to this principle, a field arising from a number of sources is determined by adding the individual fields from each source. The principle is illustrated by Figure 3, in which an electric field arising from several sources is determined by the superposition of the fields from each of the sources. In this case, the electric field at the location of Q1 is the sum of the fields due to Q2 and Q3. Studies of electric fields over an extremely wide range of magnitudes have established the validity of the superposition principle. The vector nature of an electric field produced by a set of charges introduces a significant complexity. Specifying the field at each point in space requires giving both the magnitude and the direction at each location. In the Cartesian coordinate system , this necessitates knowing the magnitude of the x, y, and z components of the electric field at each point in space. It would be much simpler if the value of the electric field vector at any point in space could be derived from a scalar function with magnitude and sign. Electric potential The electric potential is just such a scalar function. Electric potential is related to the work done by an external force when it transports a charge slowly from one position to another in an environment containing other charges at rest. The difference between the potential at point A and the potential at point B is defined by the equation As noted above, electric potential is measured in volts. The charge q is taken as a small test charge; it is assumed that the test charge does not disturb the distribution of the remaining charges during its transport from point B to point A. Consider the work involved in moving a second charge q from B to A. Along path 1, work is done to offset the electric repulsion between the two charges. If path 2 is chosen instead, no work is done in moving q from B to C, since the motion is perpendicular to the electric force ; moving q from C to D, the work is, by symmetry , identical as from B to A, and no work is required from D to A. Thus, the total work done in moving q from B to A is the same for either path. It can be shown easily that the same is true for any path going from B to A. The sphere in this example is called an equipotential surface. Choosing B far away from the charge Q and arbitrarily setting the electric potential to be zero far from the charge results in a simple equation for the potential at A: The contribution of a charge to the electric potential at some point in space is thus a scalar quantity directly proportional to the magnitude of the charge and inversely proportional to the distance between the point and the charge. For more than one charge, one simply adds the contributions of the various charges. The result is a topological map that gives a value of the electric potential for every point in space. The potential energy of a charge q is the product qV of the charge and of the electric potential at the position of the charge. A Potential energy of a positive charge near a second positive charge. B Potential energy of a negative charge near a positive charge see text. Courtesy of the Department of Physics and Astronomy, Michigan State University The electric field is related to the variation of the electric potential in space. The potential provides a convenient tool for solving a wide variety of problems in electrostatics. In a region of space where the potential varies, a charge is subjected to an electric force. For a positive charge the direction of this force is opposite the gradient of the potentialâ€"that is to say, in the direction in which the potential decreases the most rapidly. A negative charge would be subjected to a force in the direction of the most rapid increase of the potential. In both instances, the magnitude of the force is proportional to the rate of change of the potential in the indicated directions. If the potential in a region of space is constant, there is no force on either positive or negative charge. In a volt car battery , positive charges would tend to move away from the positive terminal and toward the negative terminal, while negative charges would tend to move in the opposite directionâ€"i. The latter occurs when a copper wire, in which there are electrons that are free to move, is connected between the two terminals of the battery.

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5: Nuffield Research Placements - Cornwall Council

Nuffield Science Calculations by Jean McLean, etc., David Sang (Volume editor) starting at $ Nuffield Science Calculations has 1 available editions to buy at Alibris.

Many of us could have made use of such a book during the past few years. In order for pupils to achieve a sense of success in what they are doing they need reassurance and the reward of being able to complete a good number of calculations successfully without them appearing a chore. In Nuffield Science Calculations, the questions are categorized by syllabus sections: Each section is further split into topics: Resistance, Electrical Power and Electrical Charge. Each topic is given a brief summary of factual content, with the introduction of the equation about to be tested. There is a worked example for the pupil to follow before embarking on the questions. The questions within each topic become more complex, expecting the pupil to be more careful with units and rearrange the formula. What I particularly like and welcome is the care given to the treatment of units. In the worked example units are retained within the calculation, and do not just appear in the final answer, as if by magic! There are nearly Questions on physics alone, and any pupil who works through these will certainly be ready to tackle the GCSE examination. All the formulae that are currently required to be recalled by candidates for the Core or Central Tier papers are tested. However, some extension strand material for the Physics is missing, notably no questions on: There are a further questions on Chemistry and 40 or so on Biology. I am certainly planning to use this text in my own teaching. It is printed in black and white with a good clear layout. The worked examples are easy to follow and some have the addition of speech bubbles to clarify or add extra emphasis when doing a calculation. There are suggestions on solving problems, providing the reader with guidance in tackling a calculation. My only regret is that it has been so long before someone has had the idea to produce such a book. I recommend it to all teachers of Physics. Export citation and abstract.

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8: Heat energy from alcohols- Learn Chemistry

Science education. We support science teachers and learners through innovative resources, professional development and research. We often work in partnership with other experts in science education.

9: Nuffield Primary Science | STEM

The Nuffield Primary Science materials were based on the findings of a research project called the Science Processes and Concept Exploration (SPACE). This was the first set of resources published in the UK for primary science teaching that was explicitly based on a constructivist view of learning.

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