

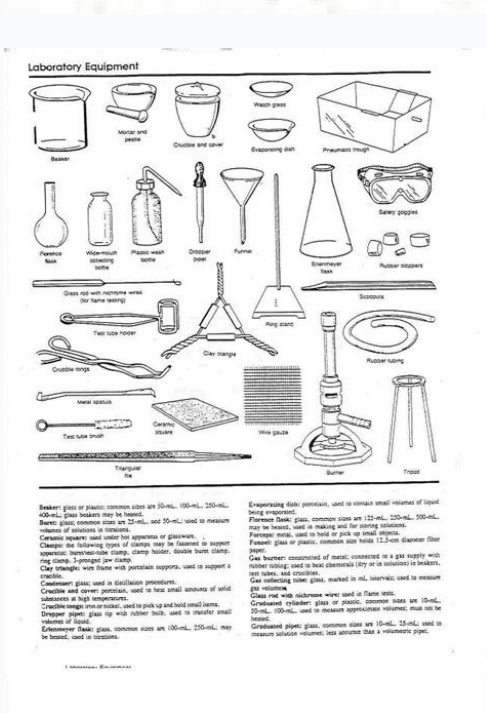
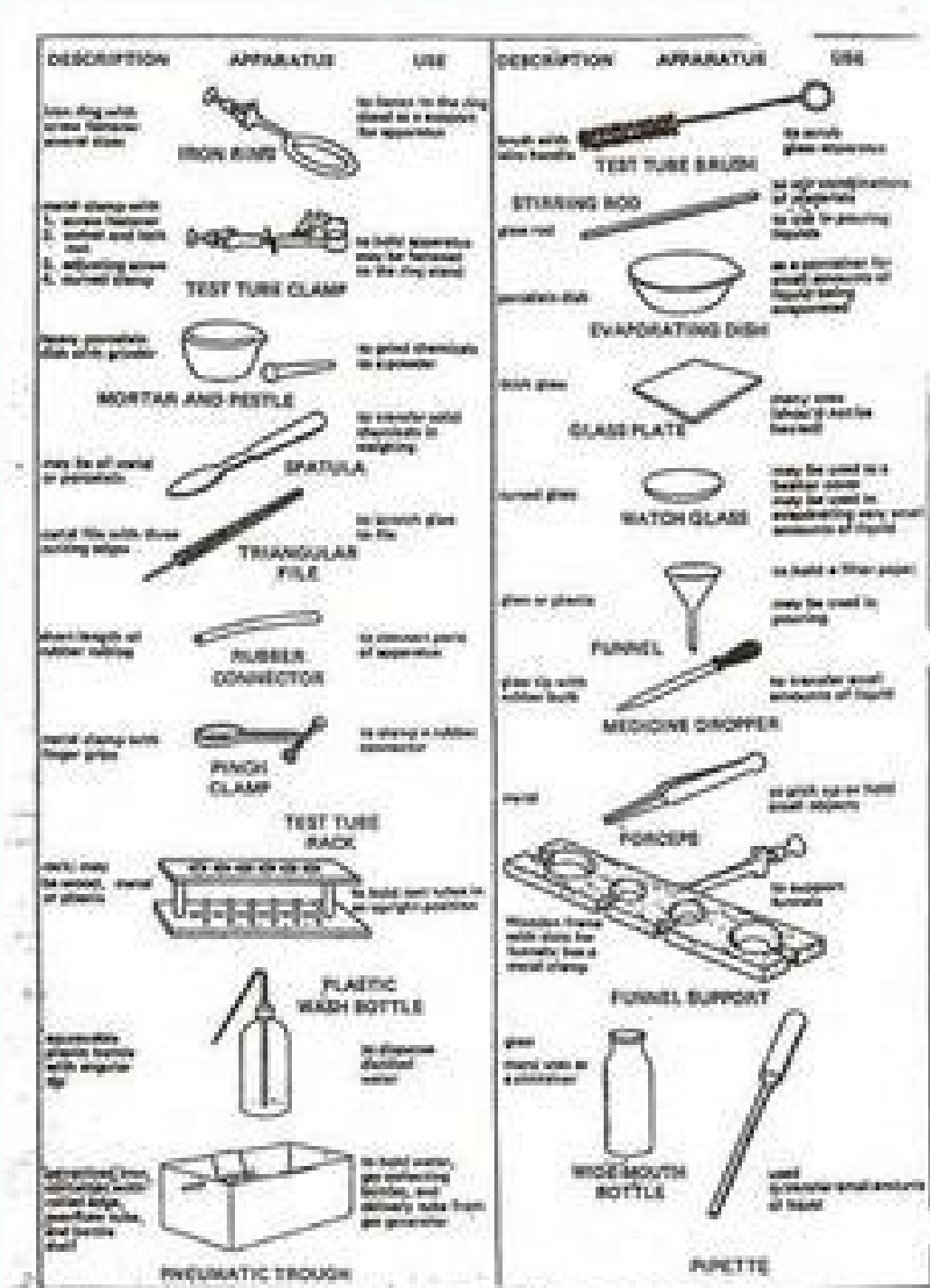
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dependent thinking Practical skill PS 1.1 Solve problems set in practical contexts PS 1.2 Apply scientific knowledge to practical contexts Use and application of scientific methods and practices Practical skill PS 2.1 Comment on experimental design and evaluate scientific methods PS 2.2 Present data in appropriate ways PS 2.3 Evaluate results and draw conclusions with reference to measurement uncertainties and errors PS 2.4 Identify variables including those that must be controlled Numeracy and the application of mathematical concepts in a practical context Practical skill PS 3.1 Plot and interpret graphs PS 3.2 Process and analyse data using appropriate mathematical skills as exemplified in the mathematical appendix for each science PS 3.3 Consider margins of error, accuracy and precision of data Instruments and equipment Practical skill PS 4.1 Know and understand how to use a wide range of experimental and practical instruments, equipment and techniques appropriate to the knowledge and understanding included in the specification Practical skills to be assessed via endorsement Cross-board statement on practical endorsement The assessment of practical skills is a compulsory requirement of the course of study for A-level qualifications in biology, chemistry and physics. The explicit teaching of practical skills will build students' competence. Some are more suitable for highly structured approaches that develop key techniques. Investigation into the effect of a named factor on the rate of dehydrogenase activity in extracts of chloroplasts a, b, c, 9. It will appear on students' certificates as a separately reported result, alongside the overall grade for the qualification. However, the evidence generated by the practical is used to develop the student's skills in the use of apparatus and techniques. Students are expected to have had opportunities to use the following apparatus and develop and demonstrate these techniques. Use of aseptic techniques to investigate the effect of antimicrobial substances on microbial growth c, 17. This list is not designed to limit the practical activities carried out by students. Each student will keep an appropriate record of their practical work, including their assessed practical activities. Practical work is at the heart of biology, so we have placed it at the heart of this specification. Previous A level practical assessment A student may demonstrate the competencies in any practical activity undertaken as part of that assessment throughout the course of study. Students may undertake practical activities in groups. There will be no separate assessment of practical skills for AS qualifications. Many teachers will also use practical approaches to the introduction of content knowledge in the course of their normal teaching. Others allow opportunities for students to develop investigative approaches. The arrangements for the assessment of practical skills will be common to all awarding organisations. Students who demonstrate the required standard across all the requirements of the CPAC will receive a 'pass' grade. A separate endorsement of practical skills will be taken alongside the A-level. The required practical activities will be defined by each awarding organisation. Written papers will assess knowledge and understanding of these, and the skills exemplified within each practical. These arrangements will include: A minimum of 12 practical activities to be carried out by each student which, together, meet the requirements of Appendices 5b (Practical skills identified for direct assessment and developed through teaching and learning) and 5c (Use of apparatus and techniques) from the prescribed subject content, published by the Department for Education. This will be assessed by teachers and will be based on direct observation of students' competency in a range of skills that are not assessable in written exams. Competency/Practical mastery In order to be assessed in written papers, students must demonstrate the required standard across all the requirements of the CPAC. A minimum standard required for the achievement of a pass. However, teachers are encouraged to develop students' abilities by inclusion of other opportunities for skills development, as exemplified in the right-hand column of the content section of this specification. These questions may draw on, or range beyond, the practical activities included in the specification. Such evidence(a) will comprise both the student's performance during each practical activity and his or her contemporaneous record of the work that he or she has undertaken during that activity, and(b) must include evidence of independent application of investigative approaches and methods to practical work.1. Follows written procedures(a) Correctly follows written instructions to carry out experimental techniques or procedures.2. Applies investigative approaches and methods when using instruments and equipment(a) Correctly uses appropriate instrumentation, apparatus and materials (including ICT) to carry out investigative activities, experimental techniques and procedures with minimal assistance or prompting.(b) Carries out techniques or procedures methodically, in sequence and in combination, identifying practical issues and making adjustments where necessary.(c) Identifies and controls significant quantitative variables where applicable, and plans approaches to take account of variables that cannot readily be controlled.(d) Selects appropriate equipment and measurement strategies in order to ensure suitably accurate results.3. Safely uses a range of practical equipment and materials(a) Identifies hazards and assesses risks associated with those hazards, making safety adjustments as necessary, when carrying out experimental techniques and procedures in the lab or field.(b) Uses appropriate safety equipment and approaches to minimise risks with minimal prompting.4. Makes and records observations(a) Makes accurate observations relevant to the experimental or investigative procedure.(b) Obtains accurate, precise and sufficient data for experimental and investigative procedures and uses this to make a valid conclusion.5. Uses appropriate apparatus and techniques(a) Uses appropriate apparatus and techniques to carry out experimental and investigative procedures.6. Investigates the effect of a named variable on the rate of an enzyme-catalysed reaction a, b, c, f, 12. Investigation into the effect of a named factor on the permeability of cell-surface membranes a, b, c, 15. In order to be able to answer these questions, students need to have been taught, and to have acquired competence in, the appropriate areas of practical skills as indicated in the table of coverage below. Carrying out the 12 required practicals in section 8.2 means that students will have experienced use of each of these apparatuses and techniques. Investigation into the effect of a named variable on the rate of respiration of glucose of single-celled organisms a, b, c, 10. Apparatus and techniques A1 a suitable apparatus appropriate to record a range of quantitative measurements (to include mass, time, volume, temperature, length and pH) AT b use appropriate instrumentation to record quantitative measurements, such as a colorimeter or potometer AT c use laboratory glassware apparatus for a variety of experimental techniques to include serial dilutions AT d use of light microscope at high power and low power, including use of a graticule AT e produce scientific drawing from observation with annotations AT f use qualitative reagents to identify biological molecules AT g separate biological compounds using thin layer/paper chromatography or electrophoresis AT h safely and ethically use organisms to measure: plant or animal responses physiological functions AT i use microbiological aseptic techniques, including the use of agar plates and broth AT j safely use instruments for dissection of an animal organ, or plant organ AT k use sampling techniques in fieldwork AT l use ICT such as computer modelling, or data logger to collect data, or use software to process data Required practical activities The following practicals must be carried out by all students taking this course. Production of a dilution series of a glucose solution and use of colorimetric techniques to produce a calibration curve with which to identify the concentration of glucose in an unknown 'urine' sample b, c, 10. A-level practicals will be based only on marks from written exams. Use of chromatography to investigate the pigments isolated from leaves of different plants, eg leaves from shade-tolerant and shade-intolerant plants or leaves of different colours b, c, 9. Preparation of stained squashes of cells from plant root tips; set-up and use of an optical microscope to observe the cells and draw a diagram of a cell. Students are expected to have had opportunities to use the following apparatus and develop and demonstrate these techniques. Use of aseptic techniques to investigate the effect of antimicrobial substances on microbial growth c, 17. This list is not designed to limit the practical activities carried out by students. Each student will keep an appropriate record of their practical work, including their assessed practical activities. Practical work is at the heart of biology, so we have placed it at the heart of this specification. Previous A level practical assessment A student may demonstrate the competencies in any practical activity undertaken as part of that assessment throughout the course of study. Students may undertake practical activities in groups. There will be no separate assessment of practical skills for AS qualifications. Many teachers will also use practical approaches to the introduction of content knowledge in the course of their normal teaching. Others allow opportunities for students to develop investigative approaches. The arrangements for the assessment of practical skills will be common to all awarding organisations. Students who demonstrate the required standard across all the requirements of the CPAC will receive a 'pass' grade. A separate endorsement of practical skills will be taken alongside the A-level. The required practical activities will be defined by each awarding organisation. Written papers will assess knowledge and understanding of these, and the skills exemplified within each practical. These arrangements will include: A minimum of 12 practical activities to be carried out by each student which, together, meet the requirements of Appendices 5b (Practical skills identified for direct assessment and developed through teaching and learning) and 5c (Use of apparatus and techniques) from the prescribed subject content, published by the Department for Education (DfE). Students' work in these activities can also contribute towards the endorsement of practical skills. Practical skills to be assessed in written papers Overall, at least 15% of the marks for an A-level Biology qualification will require the assessment of practical skills. Dissection of animal or plant gas exchange or mass transport system or of organ within such a system e, h, j, 6. Practical assessments have been divided into those that can be assessed in written exams and those that can only be directly assessed whilst students are carrying out experiments. A rich practical experience for students will include more than the 12 required practical activities. Investigation into the effect of an environmental variable on the movement of an animal using either a choice chamber or a maze h, 11. Required activity Apparatus and technique reference 1. These apparatus and techniques are common to all A-level Biology specifications. Production of a dilution series of a solute to produce a calibration curve with which to identify the water potential of plant tissue c, h, j, 14.

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