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| **Minor Award Name** | **Laboratory Skills** |
| **Minor Award Code** | **5N2751** |
| **Level** | **5** |

**Suggested resources to support delivery:**

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| **Theme/Topic** | **Type** | **Relevance** | **Author/Source** | **Web Link** |
| Component specification. | Website | Learning outcomes and assessment techniques for laboratory skills minor. | QQI | <http://www.qqi.ie/sites/docs/AwardsLibraryPdf/5N2751_AwardSpecifications_English.pdf> |
| PDST.ie - Experiment – practical work | Website | As per component specification (see above) there are a variety of learning outcomes that are best covered doing practical work (learner record and skills demonstrations).  Many of the mandatory experiments in the leaving certificate chemistry syllabus are suitable for this.  This website has experiment methodologies in Word format which can be amended to suit the lab skills minor.  The website breaks down experiments by section and can take some time to find the experiments. | PDST.ie | <http://cmsnew.pdst.ie/node/4381> |
| PDST.ie - Formulae and tables | Online pdf. | The “maths tables” approved for use by the state examinations commission (SEC).  Useful to use to illustrate easily where relevant information is to the entire class.  Can print specific pages for examinations or for use in class. | PDST.ie | <http://www.pdst.ie/sites/default/files/Formulae%20and%20Tables%20Book.pdf>  Maths tables in digital format. |
| Fire Safety | Website | Lab safety is very important part of the lab skills minor.  The links in this section are suggested for use to explain aspects of lab safety but may be worth considering bringing in an outside company to do fire training especially before students go on work experience.  This fire training could be used to complete assessment either as part of the project or learning record/skills demonstration. | Various – firesure.ie, scishow.com, safetyireland.com. | <http://www.firesure.ie/fire_safety_guidance/comparison_of_the_different_types_of_fire_extinguishers.html>  Web link details types of fire extinguisher used in Ireland. |
| Website | Safety Ireland First Response Limited | <http://www.safetyireland.com/fire_extinguisher.htm>  Alternative web link – types of fire extinguisher. |
| Website | [Scishow](https://www.youtube.com/channel/UCZYTClx2T1of7BRZ86-8fow).com | <https://www.youtube.com/watch?v=Epa_2mCi4lw&index=3233&list=LLml52qLxeOubUwcGjeHxilg>  You Tube video (SciShow) detailing types of fires and best fire extinguisher to use. |
| Website | safetyhub.com | <https://www.youtube.com/watch?v=oVnLHgIXEO8>  You Tube video detailing classes of fire and best fire extinguisher to use. |
| hsalearning.ie – part of the HSA website  Health and safety. | Website | HSA learning is an educational platform consisting of a range of free online health and safety courses.  All of the courses have been developed by the HSA with the aim of improving awareness of workplace safety, health and welfare.  The self-directed courses give learners the flexibility to choose a course, and to study it in their own time and at their own pace.  Managing safety and health in the science laboratory is an online course which takes about 140 minutes to complete – designed for teachers but could be used in a variety of ways – in class or self-directed. | Health and Safety Authority - HSA learning – part of the HSA website | <https://hsalearning.ie/>  Home page for HSA online |
| Website | Health and Safety Authority – HSA learning. | <https://hsalearning.ie/mod/page/view.php?id=42>  Direct link to relevant course “Managing safety and health in the science laboratory”  Requires sign up but is free.  Upon completion learner is awarded a certificate of completion. |
| Separation techniques | Website | This link has detailed information on various separation techniques – could be used to create notes/worksheet. | mentorials.com and You Tube | <http://www.mentorials.com/high-school-chemistry-matter-separation-of-mixtures.htm#id-heading-4>  May need to copy and paste link.  Various separation techniques |
| Website | The second link is to a video detailing more advanced separation techniques – NOTE: other videos in this link could be used depending on class group. | Guillotined Chemistry | <https://www.youtube.com/watch?v=x3EfYaJjZz4>  You Tube video describing various separation techniques. |
| Protein assays – biuret and Bradford assay | Website – online pdf | Performing protein assays is difficult to achieve as a spectrophotometer is required.  Contact a local University/college and they may have a program that they can deliver for your students. | Gbiosciences.com (online pdf) | <https://www.gbiosciences.com/image/pdfs/protocol/BE-402B_protocol.pdf>  Experiment procedure for teacher – may be used to illustrate the method for finding concentration of an unknown protein sample. |
| Website | revisionworld.com and You Tube | <https://revisionworld.com/gcse-revision/applied-science/aqa-additional-applied-science/unit-2-exam-topics/food-science/food-tests/biuret-test-protein>  May need to copy and paste link.  Simple food test for protein using the biuret test. |
| Website | Video showing the Bradford assay being performed. | Bio Rad laboratories | <https://www.youtube.com/watch?v=vfY3mVOlGBU>  You Tube video detailing Bradford assay. |
| Website | Video about light and how a spectrophotometer works | Eric Pantano – You Tube channel | <https://www.youtube.com/watch?v=F7D9suDYO5E>  You Tube video detailing spectrophotometry. |
| Website | Maynooth University offers leaving certificate chemistry practical’s but has tailored these to PLC courses in the past – other universities or Institutes of technology may offer to help complete some of the learning outcomes if approached. | Maynooth University | <https://www.maynoothuniversity.ie/biology/events/leaving-certificate-examination-science-practicals>  Link to Maynooth University leaving certificate practical’s. |
| Microbiology | Website | The links in this section should serve as a good starting point to finding information on aspects of the lab skills minor.  There are few sources of information on procedures for experiments in microbiology and if assessing by learner record/skills demo then experimental procedures may have to be designed.  These experimental procedures could be designed using group work and using this as a “teaching moment” to promote the scientific method.  NOTE: completion of these learning outcomes in microbiology will likely involve specialist materials e.g. petri dishes, nutrient agar, incubator, autoclave (pressure cooker will work), microbiological slides (pre-prepared) and microscopes. | scienceteacherprogram.org | <http://www.scienceteacherprogram.org/biology/franco2-01.html>  Experimental procedure for inoculating and isolating microbiological cultures |
| Website | Austincc.edu | <http://www.austincc.edu/microbugz/aseptic_technique.php>  General microbiological information |
| Website | Microbiologyonline.org | <http://microbiologyonline.org/teachers/observing-microbes/observing-fungi-in-a-petri-dish>  Identifying fungi |
| Website | Microbiologyonline.org | <http://microbiologyonline.org/teachers/observing-microbes/observing-bacteria-in-a-petri-dish>  Identifying bacteria |
| Website | Biotopics.co.uk | <http://www.biotopics.co.uk/microbes/tech3.html>  Serial dilution |
| Histology | Website | Histology is concerned with preparing and analysing slides of different tissue types.  This is a huge area requiring a wide variety of skills. Pre-prepared slides from a variety of tissue types (animal, plant, microbial) would be a good way to represent this. | bitesizebio.com | <http://bitesizebio.com/13398/how-histology-slides-are-prepared/>  How to prepare slides |
| Website | You Tube – medscienceap channel | <https://www.youtube.com/watch?v=P0cZKCfyUwE>  You Tube video detailing tissue preparation for histological analysis |
| Gel electrophoresis | Website | DNA analysis often involves DNA extraction and separation.  As with protein assays may be easier to organise delivery of these sections however it is possible with equipment readily available to complete however there is a significant cost outlay. | Scienceprimer.com | <http://scienceprimer.com/dna-migration-gel-electrophoresis>  Interesting article with DNA fragmentation game and You Tube video explanation. |
| Website | sumanasinc.com. | <http://www.sumanasinc.com/webcontent/animations/content/gelelectrophoresis.html>  Gel electrophoresis animation |
| Website | Learn.genetics – genetic science learning center | <http://learn.genetics.utah.edu/content/labs/gel/>  Alternative gel electrophoresis animation |
| ELISA | Website | This section is concerned with the techniques in carrying out an ELISA test.  This may be difficult to deliver but kits are available – again this may be easier delivered in a similar fashion to the protein assays. | Sumanasinc.com | <http://www.sumanasinc.com/webcontent/animations/content/ELISA.html>  Animation explaining an ELISA test |
| Website | Edvotek Inc – You Tube channel | <https://www.youtube.com/watch?v=zR_xlV5v_f4>  Procedure for performing an ELISA test. |
| Statistics | Website | Dealing with data is difficult and a good understanding of the basics is vital for a good scientist.  Understanding the pros and cons of different statistical techniques is important to the overall understanding of statistics. | bigskyassociates.com, Online pdf (book). | <http://www.bigskyassociates.com/blog/bid/356764/5-Most-Important-Methods-For-Statistical-Data-Analysis>  Website with info on different statistical techniques |
| Online pdf. | R. Lyman OTT  Michael Longnecker | <http://www.univpgri-palembang.ac.id/perpus-fkip/Perpustakaan/Metodologi/Lyman_Ott,_Michael_Longnecker-An_Introduction_to_Statistical_Methods_and_Data_Analysis,_6th_Edition____-Brooks_Cole(2010).pdf>  Online book entitled “Introduction to statistical methods and data analysis” |
| Besmart.ie  Health and safety info. | Online pdf. | Besmart.ie has a variety of tools e.g. risk assessment etc.  The website also contains information on chemical safety.  Link provided is a lengthy file (33 pages) but can be used as source material for chemical hazard symbols, safety data sheets and other useful information. | Besmart.ie – part of the HSA website | <https://www.besmart.ie/fs/doc/Your_Steps_to_Chemical_Safety.pdf>  Link to online pdf  Requires login of choosing to do risk assessments but can be bypassed as guest login (limitations to usability apply). |
| Royal society of Chemistry – various resources useful for experiment design or concept development | Website | Website with a wide variety of useful lesson plans, experiment ideas and teaching resources e.g. interactive periodic table and experiments, practical methodologies and a wide variety of other education resources. This website is very detailed and is aimed at chemistry professionals, educators and students – this wide market means the website is very large. Can also get access to peer reviewed published articles in science journals published by the Royal society. Free but there is a membership page allowing more access. | Royal society of Chemistry - rsc.org | <http://www.rsc.org>  Home page for Royal society of Chemistry |
| Website | Royal society of Chemistry - rsc.org | <http://www.rsc.org/learn-chemistry>  Link to resource page |
| Website | Royal society of Chemistry - rsc.org | <http://www.rsc.org/learn-chemistry/collections/experimentation/screen-experiments>  Interactive experiments |
| Teacher resource page with a variety of subjects including the sciences. | Website | Has a variety of worksheets, videos and activities in all subjects – the science related areas would be useful across a variety of science subjects including the teaching of lab skills. There are a number of activities that would aid the completion of experiments in lab skills.    According to the teachervision.com website “For more than 15 years, we've equipped a community of over one million educators with certified, expertly curated teaching resources designed to help their students succeed.” | Teacher Vision – US based website.  Subscription required. | <https://www.teachervision.com/> - Home page |
| Website | Teacher Vision – US based website.  Subscription required. | <https://www.teachervision.com/subjects/science>  Science specific page |
| SciShow – YouTube based channel with a vast library of science videos.  General science knowledge. | Website – YouTube | Has a variety of entertaining and informative videos about science – many may not directly suit lab skills however there are a few gems and many videos can provide a good “hook” at the start of a lesson. | SciShow – US based online web video series. | <https://www.youtube.com/user/scishow/>  SciShow home page |
| SciShow – US based online web video series. | <https://www.youtube.com/playlist?list=PL245B82FF8F8ECAC2>  Examples of suitable videos – SciShow Chemistry playlist. |
| Owlcation.com  All topics from H&S to periodic table.  Educator produced articles in a variety of areas including STEM. | Online lesson plans/articles | The following is taken from the website about us page “We are a site created by educators and experts on topics related to education—sharing our unique expertise and knowledge about all things academic.  We offer articles ranging from the ten most important moments in history to the different types of owls in Florida. If you’re looking for information that is education or academia related, we are here for you!”  Website features a variety of articles written by educators on a variety of topics – the STEM section and the chemistry in particular would be of great use in teaching lab skills e.g. safety in the lab and glassware used in the lab article (see second web link). | Owlcation.com – many authors who send in articles for their subject area. | <https://owlcation.com/>  Home page |
| Owlcation.com – many authors who send in articles for their subject area. | <https://owlcation.com/stem/A-Chemistry-Guide-List-of-Common-Laboratory-Equipment-Names-and-Uses>  Sample article in chemistry section. |
| All science topics | Website | Screen casting allows the user to record a short video – records what is on the screen and what is said. Screen casting has many uses but for difficult concepts or detailed explanations can be useful to record the “perfect” explanation. Once recorded this video can be used repeatedly and stored on Moodle or other VLE. This frees teacher to get supplies etc. to speed up practical work.  Free to use but limitations apply (can only save one video at a time unless you purchase a premium account – this can be bypassed by downloading each video after production). | Screencast-o-matic.com - Open source tool. | <http://www.screencast-o-matic.com/>  Can be used free or subscription for more features. |
| Science week | Website | Resource gives details about science week (dates, posters for download, activities).  Could be used to promote STEM at school level by organising a science week competition or other activity.  Science.ie is the Science Foundation Ireland Education and Public Engagement flagship website, providing you with a space to submit or search for science events taking place all over Ireland, throughout the year. Here you can access news, feature articles, competitions, videos and much more relating to Irish science. Science.ie is home to Science Week and you are welcome to use the same event calendar to submit or search Science Week events. | Science.ie | <http://www.science.ie/> |

**Useful Organisations:**

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| **Name** | **Contact Information** |
| Irish Science Teachers Association – membership required for full access. | <http://www.ista.ie/> |
| Science Foundation Ireland | <http://www.sfi.ie/> |
| Science week | <http://www.science.ie/> |
| Sci Fest | <http://www.scifest.ie/> |
| Royal Chemistry Society | <http://www.rsc.org/> |

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| **MOOCs (Massive Online Open Courses)** | |
| Free access to online courses  Search regularly for new courses and new start dates | <https://www.mooc-list.com/> |
| <https://www.mooc-list.com/course/basic-science-understanding-experiments-futurelearn>  Experimentation in chemistry |
| <https://www.mooc-list.com/course/chemistry-building-blocks-world-open2study>  Basic chemistry |