**Model risk assessment for practical session 06 | DNA sequencing**

Teachers and Technicians are reminded their employer is responsible for health and safety within their institution. Risk assessments must be carried out for all practical activities included in this programme at the school and college, to include considerations for their particular laboratory, situation and group of students involved. Individual risk assessments should be carried out for each practical activity with each different group (a model risk assessment provides considerable guidance but will not suffice). If the risk assessment indicates that the practical activities are too risky to carry out in that situation, the employer is responsible for ensuring that it is not undertaken.

Schools should be aware of guidance from CLEAPSS (Consortium of Local Education Authorities for the Provision of Science Services) and, where applicable, a school or college should refer to local authority guidelines with regards to specific local rules and guidelines about health and safety.

This model activity risk assessment relates to Practical session 6: DNA sequencing.

The first table outlines potential hazards grouped into chemical substances, biological materials, ergonomics, physical hazards and vulnerable groups.

The second table provides information on risks, safety precautions, emergency procedures, safe disposal and an assessment of overall risk, based on likelihood of a risk occurring and the severity should it do so.

| **Hazard** | **Name** | **Description** | **Links** |
| --- | --- | --- | --- |
| Chemical substances | Loading dye | The 6x DNA loading dye is mixed with samples to increase their density, assisting them to descend into the wells. It contains 10 mM Tris-HCl (pH 7.6) 0.03 % bromophenol blue, 0.03 % xylene cyanol FF, 60 % glycerol 60 mM EDTA.  This is not a hazardous substance or mixture according to Regulation (EC) No. 1272/2008. | 6x DNA loading dye [SDS](https://assets.thermofisher.com/TFS-Assets%2FLSG%2FSDS%2FR0611_MTR-EULT_BE.pdf) |

| **Hazard** | | **Name** | | **Description** | **Links** |
| --- | --- | --- | --- | --- | --- |
| Chemical substances | | GelGreen® | | We use 10,000x GelGreen Nucleic Acid Stain in water. This is added to loading dye to be mixed with samples and DNA ladder to allow nucleic acids to be visualised during gel electrophoresis.  This is not a hazardous substance or mixture according to Regulation (EC) No. 1272/2008 and Directive 1999/45/EC. | GelGreen® [SDS](https://biotium.com/wp-content/uploads/2013/11/SDS-41005.pdf) |
| 100 bp DNA ladder | | The 100 bp ladder provides DNA fragments of known size to compare with our PCR amplicons of unknown size. Before use it is mixed with loading dye containing GelGreen®.  This mixture is classified as not hazardous according to regulation (EC) 1272/20. | NEB 100 bp ladder [SDS](https://www.neb.com/en-gb/-/media/6848135e3f994ad08aed1c872171fe2d.pdf?rev=e225d1c041884319ad585c4f00080b8e&hash=59FFF7C62325B0DCB8AD1E17BF59FFD8) |
| TAE buffer | | Supplied as a 10x concentrate, used as a 1 x solution for electrophoresis.  Contains **T**ris (pH8.0), **A**cetic acid and **E**DTA. At higher concentrations EDTA is harmful if inhaled – here it is in solution. At higher concentrations acetic acid is corrosive, flammable and irritant, capable of causing skin burns and eye damage. 10x TAE buffer, or the diluted 1x TAE buffer is not a hazardous substance according to Regulation (EC) No 1272/2008. | UltraPure 10X TAE Buffer [SDS](https://assets.thermofisher.com/TFS-Assets%2FLSG%2FSDS%2F15558026_MTR-EULT_BE.pdf) |
| Agarose | | Supplied as a light cream powder solid.  Not a hazardous substance according to Regulation (EC) No 1272/2008. | Electrophoresis grade agarose [SDS](https://assets.thermofisher.com/DirectWebViewer/private/document.aspx?prd=ALFAAJ66501~~PDF~~MTR~~CLP1~~EE~~2024-02-08%2023:56:42~~Agarose%20%20Electrophoresis%20Grade~~) |
| Biological materials | | PCR product | | DNA produced by PCR in the previous practical session.  Biological material with very low risk of contaminating living cells. |  |
| **Hazard** | **Name** | | **Description** | | **Links** |
| Ergonomics | Micropipetting posture | | Using a micropipette involves using shoulder, wrist and hand movements that could cause muscular injury if used repeatedly over at least 2 consecutive hours per working day. | |  |
| Environmental factors | | Environmental factors, including insufficient space, low lighting levels and strong air movements or drafts could be a hazard. | |  |
| Physical hazards | Equipment | | The MiniOne Electrophoresis system, vortex, microcentrifuge and microwave (if used) are powered by 240V. | | MiniOne ® electrophoresis system - [Instruction manual](https://theminione.com/wp-content/uploads/2021/02/M1000-M1010-MiniOne-Electrophoresis-Instruction-Manual-120120-.pdf) |
| Equipment | | The MiniOne electrophoresis system has a 42V current running through the 1 x TAE electrophoresis buffer. | | MiniOne ® electrophoresis system - [Instruction manual](https://theminione.com/wp-content/uploads/2021/02/M1000-M1010-MiniOne-Electrophoresis-Instruction-Manual-120120-.pdf) |
| Heat | | Preparation of agarose gels by heating agarose in 1 x TAE buffer produce super-heated molten agarose, liable to bubble up within a container when swirled or knocked. | |  |
| Vulnerable groups | Young people | | Inexperience in laboratory procedures means that all hazards can give an increased risk to young people. | |  |
| New or expectant mother | | All controls in place protect new or expectant mothers during laboratory procedures. | |  |
| Disabilities and health issues | | Laboratory procedures can sometimes be more challenging for those with disabilities or health issues. | |  |

When judging risks, it is assumed that:

* All students working in a science laboratory follow good laboratory practice, including: not eating or drinking in the lab, tying back long hair, keeping lab benches clear of clutter, clearing up spills immediately, handling materials and equipment with care, and washing hands with soap after completing lab work.
* All users read, understand and follow guidance from eth Health and Safety section in the student guides.
* Disposal occurs following advice in the educator guides.

Overall risk has been judged using the risk matrix below:

A chart with different colored squares

Description automatically generated with medium confidence

| **Risk(s)** | **Safety precautions** | **Emergency procedures** | **Likelihood** | **Severity** | **Overall risk** |
| --- | --- | --- | --- | --- | --- |
| Contact with loading dye containing GelGreen® | Wear eye protection (safety glasses are sufficient).  Use non-powdered, nitrile gloves as a barrier to contact (eg; Kimtech nitrile gloves 99211). | In case of contact with skin wash off with plenty of soap and water.  If it gets into eyes, rinse with water using an eye bath for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.  Seek medical advice if required. | Unlikely | Minor | Low |
| Contact with 100 bp DNA ladder premixed with loading dye containing GelGreen® | Wear eye protection (safety glasses are sufficient).  Use non-powdered, nitrile gloves as a barrier to contact (eg; Kimtech nitrile gloves 99211).  Use in a controlled way, similar to aseptic techniques. | In case of contact with skin wash off with plenty of soap and water.  If it gets into eyes, rinse with water using an eye bath for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.  Seek medical advice if required.  If biological materials contaminate surfaces or equipment, wipe with a disinfectant-soaked paper towel and clean the surface with a suitable disinfectant. | Unlikely | Minor | Low |

| **Risk(s)** | **Safety precautions** | **Emergency procedures** | **Likelihood** | **Severity** | **Overall risk** |
| --- | --- | --- | --- | --- | --- |
| Contact with 1 x TAE buffer | Wear eye protection (safety glasses are sufficient).  Use non-powdered, nitrile gloves as a barrier to contact (eg; Kimtech nitrile gloves 99211). | In case of contact with skin wash off with soap and water.  If it gets into eyes, rinse with water using an eye bath for several minutes. Remove contact lenses, if present and easy to do.  Seek medical advice if required. | Unlikely | Minor | Low |
| Contact with PCR product | Use non-powdered, nitrile gloves as a barrier to contact (eg; Kimtech nitrile gloves 99211).  Use in a controlled way, similar to aseptic techniques. | In case of contact with skin wash off with plenty of soap and water.  If it gets into eyes, rinse with water using an eye bath for several minutes. Remove contact lenses, if present and easy to do.  If surfaces or equipment get contaminated, wipe with a disinfectant-soaked paper towel & clean the surface with a suitable disinfectant. | Unlikely | Minor | Low |

| **Risk(s)** | **Safety precautions** | **Emergency procedures** | **Likelihood** | **Severity** | **Overall risk** |
| --- | --- | --- | --- | --- | --- |
| Unsafe disposal of chemical or biological substances | Discard single-use disposable items, such as pipette tips, and microfuge tubes, into labelled disposable plastic jars for safe disposal.  Wear safety glasses whilst disposing of electrophoresis buffer down the sink with copious amounts of water.  All pipette tips, tubes and gels that contain biological materials should be placed into an autoclave bag for autoclaving prior to disposal. | If contact is made with skin during disposal of chemical or biological substances, wash with plenty of soap and water.  If chemical or biological substances go into eyes during disposal, rinse with water using an eye bath for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.  Seek medical advice if required.  If biological materials contaminate surfaces or equipment, wipe with a disinfectant-soaked paper towel and clean the surface with a suitable disinfectant. | Unlikely | Minor | Low |
| Shoulders / wrists / hands sore from micropipette use | Don’t micropipette for long periods (>2 hours) without a break. Stretching is recommended every 20 minutes to minimise risk. | If shoulders, wrists or hands become sore, stop pipetting and stretch. | Unlikely | Minor | Low |

| **Risk(s)** | **Safety precautions** | **Emergency procedures** | **Likelihood** | **Severity** | **Overall risk** |
| --- | --- | --- | --- | --- | --- |
| Inappropriate environment | Ensure that laboratory work is carried out with sufficient space, lighting and without strong air movements or drafts. | Stop work immediately if the environment becomes unsuitable (eg; if lights go out). | Unlikely | Minor | Low |
| Use of electrical equipment | Manufacturer's instructions are read by supervisors and available for reference.  Check that portable electrical equipment (110V and above) fitted with a plug is within 12 months of use from new or has an ‘in date’ PAT Passed label attached.  Portable electrical equipment which is either untested or where the test is 'out of date' should not be used.  Never use electrical equipment with a damaged cable or cracked plug. | Immediately isolate the power and stop using any electrical equipment which is overheating or if signs of damage become apparent during use. | Unlikely | Moderate | Low |

| **Risk(s)** | **Safety precautions** | **Emergency procedures** | **Likelihood** | **Severity** | **Overall risk** |
| --- | --- | --- | --- | --- | --- |
| Use of electrophoresis equipment – risk of electrocution from electrical current passing though buffer | To prevent access to the 1x TAE buffer with an electrical potential of 42V during electrophoresis, the orange top covers the buffer chamber. The electrical supply will not flow if the photo hood is removed or if the tank is not properly placed inside the base unit, and electrodes are not making contact. | Contact should not occur with the electrophoresis buffer whilst the electric current is on. If electrocution occurs, turn off the electrophoresis unit at source, use a dry, non-conducting object to move the electrophoresis unit away from the injured person and summon a First aider. | Rare | Moderate | Low |
| Burns from molten agarose when preparing agarose gels**\*** | Use a heat resistant glove, ensuring the cuff of the glove is over the lab coat sleeve, to handle heated products from the microwave so that there is no exposed skin on the arm.  Do not jolt or swirl agarose vigorously whilst melting in electrophoresis buffer to pour a gel. | If a burn occurs, run the affected area under cool or tepid water for 20 minutes. For bad burns notify the local First aider. | Possible | Moderate | Medium |
| Young people don’t follow laboratory protocols correctly due to inexperience | Clearly explain instructions, answer questions and monitor students as they complete the practical work. | If a student is not following the laboratory procedures or behaving in a way that endangers themselves or others they should be prevented from carrying out the practical work. | Unlikely | Moderate | Low |

| **Risk(s)** | **Safety precautions** | **Emergency procedures** | **Likelihood** | **Severity** | **Overall risk** |
| --- | --- | --- | --- | --- | --- |
| Impaired health or physical disability makes practical work more risky | Whether practical work is possible, and the precautions required to complete it safely, need to be assessed on a case by case basis. | These will again need to be assessed on a case by case basis. |  |  |  |

**\***Note: This is the biggest risk, but with careful handling and correct use of heat resistant gloves the risk is low.