**Application for Aerosol Society undergraduate research bursary.**

**Project Title:** Characterisation of bioaerosol bacterial communities in different size factions from urban, industrial and agricultural environments.

**Applicant:** Dr. Robert Ferguson, School of Biological Sciences, University of Essex, rmwfer@essex.ac.uk tel: 01206 873345

**Rationale and project background:** Since deleterious health effects can arise following exposure to infective airborne microorganisms, it is important to better understand their identities, distribution and abundance. Particle size within bioaerosols influences both their dispersal behaviour in the environment and their exposure risk via inhalation. In bioaerosols, viable bacteria can exist as single cells, small cell aggregates, or conglomerations of many cells with other particles such as dust and water droplets. The smallest fraction of bacterial bioaerosols, (<1.1 µm) can penetrate deep into the alveoli, thus posing a greater human health risk than larger bioaerosols (>7 µm) that only penetrate the nasal cavity. Smaller particles also settle out of the air slower, enabling them to disperse over a wider area. It is therefore vital to determine if the structure of the bacterial community in bioaerosols varies between the different size classes of particles and to identify if human pathogenic bacteria predominate in the smaller size fractions.

**Project Aim:** To characterise bioaerosol bacterial communities in different size fractions from a range of environmental sources.

**Approach:** Replicate aerosol samples will be collected using an Andersen 6 stage impactor at three sites: i) Urban (Colchester), ii) industrial (composting facility), and iii) agricultural (poultry farm). DNA will be extracted from each stage of the Andersen impactor with each representing deeper penetration of the respiratory system: stage 1 nasal cavity (>7µm), stage 2 pharynx (4.7-7µm), stage 3 trachea (3.3-4.7µm), stage 4 secondary bronchi (2.1-3.3µm), stage 5 terminal bronchi (1.1-2.1µm), and stage 6 alveoli (0.6-1.1µm). Bacterial abundance will be quantified by Q-PCR using Eubacterial 16S rRNA primers (Muyzer et al 1997) and specific primers that target key human pathogens e.g. *Mycobacterium* sp. (Cole et al 1998). Bacterial community structure will be determined from each fraction using Denaturing Gradient Gel Electrophoresis (DGGE) and sequencing to identify the dominant species present.

**Project Goals and Timetable:**

1. Collect bioaerosol samples from urban, industrial and agricultural sites (**Week 1**).
2. Extract DNA from all size fractions from across the different sites (**Week 2**).
3. Quantify bacterial community abundance (including key human pathogens) by Q-PCR of the 16S rRNA genes (**Weeks 3 and 4**)
4. Determine bacterial community structure by DGGE and sequencing (**Weeks 4 and 5**)
5. Project report write-up and oral presentation of results to lab group (**Week 6**).

**Student training, support and experience.** The student will gain an excellent research experience, as the project is part of a larger RCUK-funded bioaerosol research project (ca. £1 mill.) currently undertaken at Essex University, led by Prof Colbeck who is a world leader in aerosol science. By working alongside top researchers in the field, the student will have the opportunity to gain vast knowledge and experience in a wide range of bioaerosol sampling methods. Dr Robert Ferguson is an experienced PostDoctoral Researcher and will oversee project management of the studentship and provide close supervision of the student on a daily basis. The student will join the Environmental Microbiology/ Aerosol Group (led by Prof Colbeck/ Dr Whitby) which comprises: 2 PDRAs, 6 PhD students (two on aerosol related projects) and 3 technicians, who will provide additional lab support, training and expertise to ensure that the resources, physical and personnel, required for the project are in place. The student will also have access to the Group's molecular facilities e.g. Q-PCR and DGGE. Although the part of a larger project, the studentship is designed for scope for innovation on the part of the student whereby methodological approaches such as aerosol sampling techniques and primer design to identify key pathogens may be further developed. The student will be encouraged to develop as a researcher through publications and presentations to the scientific community. They will also be encouraged to give a lab Group seminar and will be supported by the School to attend an Aerosol Society conference to further enhance their research careers.

**Student Selection Process:** An excellent candidate (Charlotte Neath, top 5% of cohort- see CV) has been selected for this project based on academic ability and background knowledge.