1. Executive Summary

- BIAZA is the professional body for zoos and aquariums within the United Kingdom and acts to lead and support its members to deliver the highest quality environmental education.
- Within BIAZA members, employees routinely work within science and technology disciplines, utilising STEM skills within real world scenarios on a daily basis. The diversity of STEM skills present in those employed within our zoos and aquariums has increased dramatically.
- BIAZA zoos and aquariums go above and beyond the remit of zoo legislation to provide learning resources based within the STEM skills across a diversity of age classes and social demographics.
- BIAZA zoos and aquariums provide a range of formal education sessions for visiting schools and colleges at all key stages, whether from a menu or bespoke, and structured around curriculum outcomes to build on previous learning.
- These sessions are designed to encourage investigation, use of scientific language and problem solving of real world challenges.
- BIAZA members are developing stronger relationships with both further and higher education establishments, providing qualified staff for lectures and workshops, opportunities for research projects, dissertations and practical experience as well as partnering in the delivery of higher education courses.
- BIAZA and BIAZA members support continued professional development both through the development of a unique training course within the profession and through participating in leading training courses run by the European Association of Zoos and Aquariums. In addition many BIAZA zoos and aquariums participate in leading training courses run by the academy branch of the European Association of Zoos and Aquariums (EAZA).
- Examples are given in all areas to demonstrate the diversity of STEM skill learning opportunities within BIAZA zoos and aquariums.
- BIAZA would like to see increased recognition from the government of the value of the role that our zoos and aquariums can and do play in terms of encouraging engagement with STEM subjects. BIAZA also believes that the UK government and the local authorities should be encouraging schools, colleges and universities to increase their relationship with zoos and aquariums and to utilise their resources.
- BIAZA zoos and aquariums represent a unique and undervalued resource in the efforts to counter the STEM skills gap.
2. **What is BIAZA**

2.1 The British and Irish Association for Zoos and Aquariums (BIAZA) is the professional body for zoos and aquariums within the United Kingdom and Ireland. We currently represent one hundred and seventeen members, approximately 30% of organisations holding a zoo licence within the UK. Within BIAZA, 91% of the membership are based within the United Kingdom, with over 75% based in England.

2.2 BIAZA’s mission is to represent its members and promote the values of good zoos and aquariums. One of BIAZA’s key tenants is to lead and support its members to deliver the highest quality educational education, training and research. Within BIAZA members, employees routinely work within science and technology disciplines, utilising STEM skills within real-world scenarios on a daily basis. Since the beginning of this century, the diversity of STEM skills present within our zoos and aquariums has increased dramatically. Job opportunities within a modern zoo or aquarium now include conservation scientist, geneticist, nutritionist, molecular biologist, veterinary scientist, and technician, aquarist and water quality specialist. While many will be expecting zoos and aquariums to employ experts in animal behaviour, animal welfare and zoology, the diversity of disciplines within a modern zoo and aquarium includes veterinary science, nutrition science, genetics, and demographics for population monitoring, conservation science, ecology, parasitology, and water chemistry amongst others. The BIAZA membership represents a range of disciplines utilising STEM skills in real-world scenarios. This in turn allows BIAZA professionals to develop workshops for a range of age classes and social demographics, dealing with subjects as diverse as balancing diets, managing populations, designing enclosures for thick enough Perspex for aquariums holding large volumes of water or strong enough barriers to contain a rhino or elephant. Zoos and aquariums, therefore, represent a unique opportunity to engage within the public or through schools and colleges to achieve STEM skills learning.

3. **What are the opportunities for STEM skill learning in a zoo or aquarium?**

3.1 Zoos and aquariums are required under the EU Zoos Directive and the UK Zoo Licensing Act 1981 to promote public education and awareness in relation to the conservation of biodiversity with a written education strategy and an active education programme. However, it is very apparent that BIAZA zoos and aquariums go above and beyond the remit of the legislation to provide learning resources that are largely based within the STEM skills across a diversity of age classes and social demographics. BIAZA zoos and aquariums have an average of 25 million visits per year, of which 1.3 million are formal education sessions. Between these and the wider remit of informal learning within an environment designed to inspire, BIAZA zoos and aquariums represent a unique resource for schools and colleges (and the government) to encourage STEM skills.

4. **Working with schools (key stages 1 through to 5)**

4.1 BIAZA zoos and aquariums provide a range of formal education sessions for visiting schools at all key stages. Many of our members can offer a range of ‘tried and tested’ sessions (including
workshops and lectures), others are happy to tailor sessions to the needs of the individual school or college visiting. All sessions, whether from a menu or bespoke, are structured around curriculum outcomes to build on previous learning within the school or college framework, and can encourage investigation, use of scientific language and problem solving of real world challenges. Zoos and aquariums have access to facilities which can work to bring sessions alive, stimulate and inspire the children and allow them to discover how to apply STEM skills to real world scenarios.

4.2 Onsite formal sessions may be in the form of a classroom based lesson or workshop with relevant props (e.g. skins, skulls, suitable live animals). For the higher key stages computer software with problem solving tasks may be utilised. Additionally onsite formal sessions may involve time outside within the zoo environment (e.g. in a ‘work experience’ scenario or a problem solving challenge). A series of examples from specific zoos and aquariums are given here to illustrate the diversity of opportunities within BIAZA members.

4.3 Colchester Zoo partners with Essex County Council and local industries to deliver a STEM Project focussed on the development of animal enrichment feeders to school children aged between 11 and 16 years. This project is now in its second year and has focussed on bears and elephants; two species that need robust equipment within their enclosure to meet behavioural needs. The project utilises local technology and engineering companies as mentors for the sessions, allowing greater engagement with the local science and technology community. The STEM skills targeted include animal behaviour to understand species behavioural needs, engineering, problem solving and IT skills such as coding and app design. Students work to design and present prototypes of enrichment devises, which are then worked up into a final product for installation in the Zoo.

4.4 Whipsnade Zoo (ZSL) provides sessions for visiting schools under a variety of headings. As an example the session Global Expedition is available for children aged 5 to 11 targeting STEM skills of investigations into animal adaptations, map reading, problem solving, conversion measurement, scientific language and scientific techniques such as displaying data in bar charts. Students will learn identification of habitats, location of countries worldwide, be able to create a correct food chain for identified species, use a scientific key correctly and outline the lifecycle of a species.

4.5 The National Marine Aquarium have successfully run STEMfest, a two week workshop based science festival targeting local schools with children a Key Stage 2 and 3. Approximately 1,000 children participate each year with the workshops serving as an inspiratory introduction to STEM skills in the real world. The growing popularity of STEMfest with the local schools gives clear indication of the value of such an event to the local education community. STEMfest traditionally includes a design and build challenge within an aquarium environment, real world maths calculations and use of laboratory equipment to investigate ocean related phenomena.

4.6 The National Marine Aquarium also runs science workshops for local schools up to Key Stage 4 focussing on a scientific investigation into a given problem through the practical use of laboratory equipment. The students form small teams to carry out investigative procedures. Through this process they develop team skills as well as a scientific understanding of relevant topics and practical laboratory skills.
Written evidence submitted by the British and Irish Association of Zoos and Aquariums (BIAZA) (GAP0045)

4.7 Bristol Zoo provides a menu of resource based workshops for school children at a range of key stages, including ‘Maths in the Zoo’ and ‘Zoomeracy’ (Key stage 2 and 3). These workshops focus on the taking ad recording of measurements using the correct units, solving problems by applying mathematics, using correct mathematical and scientific vocabulary, and appropriate calculation strategies. The students develop an understanding of the importance of having math skills to provide the best animal husbandry and an understanding of animal classification systems.

4.8 Twycross Zoo run a series of secondary school workshops to give real life applications of STEM subjects and inspire children (age range 11 -14 yrs) to participate in and to continue with STEM subjects at a higher level. 7,000 students per year pass through this programme with evaluation showing that 85% of the participants are more likely to study STEM at a higher level, with motivation especially strong in girls.

4.9 Dartmoor Zoo has developed an Enterprise Challenge for older students targeting Maths, Science and Engineering. Students work in teams to produce a plan to develop the zoo within the requirements of the Zoo Licensing Act. This involves the selection of a new species of animal for the zoo to house and the design of a suitable enclosure within a stated budget. This programme targets science (conservation needs, biological needs of the animal), technology (enclosure design, suitable barriers etc) and Maths (establishing and working within a budget). The students are also required to develop their presentation skills.

5. Working with disadvantaged children

5.1 Many of our zoos and aquariums utilise their facilities to work with children from disadvantaged backgrounds (behavioural, social or economic). Working with animals is known to be a positive experience for children with disadvantages and can trigger increased learning and promote confidence.

5.2 For example, London Zoo (ZSL) has developed a Zoo Academy course for 15-17 year olds. This is available to students in FE colleges and the public, but also targets pupil referral units for those who may have been excluded from mainstream schools. The academy provides practical learning opportunities involving class-based and zoo-based activities and learning (including animal husbandry). Students develop skills in observation, data collection, measurements and numeracy and are expected by the end of the academy to demonstrate skills in comparing, observing and identifying real world situations and problems, measuring data and explaining their outcomes.

6. Further and higher education

6.1 Zoos and aquariums are becoming integral to the progression of students from schools into their academic futures in a number of ways. As the skills sets of those employed by zoos and aquariums is becoming more diverse, so are the opportunities for inspiring students to engage in STEM based subjects. Many zoos and aquariums now participate in career days, with some running
workshops, experience days or academies to give practical experience of these roles within a work place situation.

6.2 While zoos and aquariums have often been a destination for undergraduate students studying courses related to animal behaviour for carrying out their final year dissertations, many of our BIAZA members are developing stronger relationships with both further and higher education establishments. This may include partnering with further education colleges providing lessons, workshops and opportunities for practical experience, even to the extent of developing college outreach centres on site. Many BIAZA zoos and aquariums also partner with higher education establishments to provide qualified staff for lectures and workshops, opportunities for research projects and dissertations as well as partnering in the delivery of higher education courses. Universities such as Exeter, Plymouth, University of West England, Manchester Metropolitan, Southampton and the Royal Vet College among others have participated in several close collaborations with zoos and aquariums to ensure the delivery of high quality higher education. Again the following examples give an understanding of the diversity of work in this field but are by no means exhaustive.

6.3 Whipsnade Zoo (ZSL) run Zoo Vet Careers Day for students aged 15 to 17 years to stimulate awareness of the routes into veterinary careers (vet nursing, vet technician etc as well as vet surgeon). The students gain skills in veterinary type activities on site. The days focus on the correct use of scientific language, knowledge of scientific skills of breeding animals, the practical application of science and of technology in science as well as veterinary applications in the zoo environment and practical field conservation skills from experienced zoo vets working in the wild.

6.4 Many zoos and aquariums make themselves available for research students coming in to carry out dissertation work at undergraduate or post graduate level. This can be as simple as allowing non-invasive research more geared towards training in research techniques, or can be facilitating doctoral level research, particularly in animal behaviour, animal cognition, veterinary disciplines and others. In some circumstances the relationship between the zoo or aquarium and the student is developed further to answer questions necessary for the good management of the animals. In these cases the zoo or aquarium may gain much needed answers whilst the student gains valuable experience in applying research techniques. These positions will tend to develop into research placements, commonly sandwich years or industrial placements, allowing development of useful research for the host zoo or aquarium whilst giving the student the opportunity to develop skills within a real world scenario.

6.5 One of the most comprehensive relationships between zoos and universities is the Living Links programme between Edinburgh Zoo (the Royal Zoological Society of Scotland) and the Scottish Primate Research group (Edinburgh, Aberdeen and Sterling Universities). This collaboration achieved external funding to build an exhibit space within the zoo designed to provide appropriate housing for primate species and for undertaking research projects. The building was also designed to encourage public engagement with science. The resulting partnership also led to the establishment of further research within Edinburgh Zoo within fields such as animal behaviour and animal cognition.
6.6 The South West Environmental Parks (Paignton Zoo, Newquay Zoo and Living Coasts Zoo) have partnered with Exeter University for the delivery of units within the university’s MSc Animal Behaviour course, utilising the expertise of post graduate qualified zoo staff. These zoos also partner with Plymouth University to co-deliver an MSc Zoo Conservation Biology. This course combines elements of theoretical learning with practical experience gained through workshops and units hosted at the zoos. The course focusses on all aspects of wild animal husbandry including nutrition and population management, zoo biology, research skills, wildlife monitoring and project management. Many of the students go on to achieve PhD, or develop zoo or conservation related careers.

7. Professional training for STEM based jobs

7.1 Within the profession BIAZA values and promotes continued professional development of the employees of BIAZA members. BIAZA has partnered with Sparsholt College to produce and deliver the Diploma in the Management of Zoo and Aquarium Animals. This is a two year distance learning course designed to complement the development of new zoo keepers to qualified zoo keepers, and is unique. This uniqueness has led to the course being implemented in the United Arab Emirates and Latvia as well as the United Kingdom, with further interest from Singapore and Indonesia.

7.2 In addition many BIAZA zoos and aquariums participate in leading the training courses run by the academy branch of the European Association of Zoos and Aquariums (EAZA). Paignton Zoo recently ran a four day primate nutrition course for EAZA. This brought in students from both the UK and other European countries, demonstrating the wider value placed on the expertise and professionalism of our zoos and aquariums.

8. Recommendations

8.1 BIAZA would like to see increased recognition from the government of the value of the role that our zoos and aquariums can and do play in terms of encouraging engagement with STEM subjects. BIAZA zoos and aquariums represent a unique and undervalued resource in the efforts to counter the STEM skills gap.

8.2 BIAZA also believes that the UK government and the local authorities should be encouraging schools, colleges and universities to increase their relationship with zoos and aquariums and to utilise their resources, particularly through initiatives designed to ease the increasing financial costs involved with accessing external learning opportunities.

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