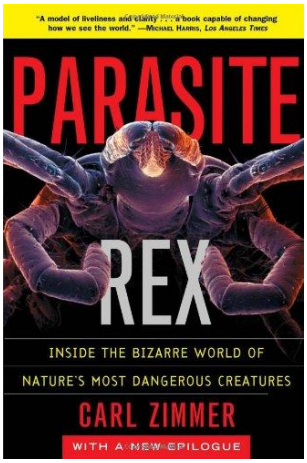
Parasite Rex – Inside the Bizarre World of Nature's Most Dangerous Creatures, Carl Zimmer, Atria Paperback, New York, 2014.



The Author of this book is a master of descriptive prose. This makes the book both an accessible and engaging read for school students. The subject matter of this book is both relevant and useful for AH Biology. Like the AH Biology course it takes a modern look at parasitism focusing on the big ideas and key concepts of biology. A potential downside of this approach is that students often find difficulty in coming to terms with the complexity of parasitic life cycles. An understanding of the classification of animal parasites can often help with this and some advice in this regard is suggested in the box below.

The book covers the immune response and the measures that parasites take to evade the host's immune system. Parasites can alter their host's biology and behaviour to divert resources from the host to the growth and reproduction of the parasite. The host's behaviour can be altered to aid the transmission of the parasite to a new host. The ecological significance of parasites is considered as they can influence the population distribution in an ecosystem by affecting the ability of parasitised hosts to compete with other species. The evolutionary origin of parasitism is considered from the early evolution of parasitic DNA before the evolution of the eukaryotic cell ('genetic parasites' – the selfish DNA of Richard Dawkins). From there the author moves to the evolution of parasites of single cell organisms and multi-cellular organisms. Next the book provides a clear and helpful description of the Red Queen hypothesis and its potential role in the evolution of sex, the immune system and speciation.

The penultimate chapter looks at the recently evolved *Homo sapiens* and its much more evolutionary ancient parasites. Humans have the additional resources of medicines and public health measures such as clean water and sewage and waste disposal to combat parasites. These tools of civilisation although effective in the attempt to eliminate parasites and make them extinct are not always totally successful and may have disadvantageous side effects. For example the rise of allergies may be due to the reaction of the antibody immunoglobulin E (IgE) which is active against parasitic worms. In the absence of worms, the antibodies may react to harmless environmental proteins causing conditions such as hay fever and asthma. Mention is also made on the relationship between the parasite load of a population and the educational success and economic development of that population, a vital consideration for developing countries. In the final chapter the author explains the relative success and failure of parasites in biological control and how measuring the levels of parasitism in an ecosystem can be used as an indicator of its ecological health.

Classification of Animal Parasites

Viruses, Bacteria, Fungi, Protists and multicellular animals all contain parasitic species. For AH Biology there is no need to understand classification much beyond these broad groups. The study of parasites has not been helped by being studied in different fields of Biology. In the main, Microbiologists are interested in viruses, bacteria and fungi, Parasitologists are interested in protists and multicellular animal parasites and Plant Pathologists are interested in viruses, fungi and animal parasites. AH Biology combines all of these interests.

Protists are an informal grouping of eukaryotic unicellular organisms that are grouped together for convenience rather than because of close taxonomic relationships (much like invertebrates are). It might help students to think of the different forms found in protists based on their motility when considering their life cycles - Amoebas (e.g *Entamoeba histolytica*), Flagellates (e.g. *Trypanosoma brucei, Trichomonas vaginalis*), Ciliates (e.g. *Balantidium coli*), and the non-motile sporozoans which often have two hosts (e.g. *Plasmodium sp.*, *Toxoplasma gondii*). This should give a structure or scaffolding for students' learning about parasites enabling them to see patterns and commonality in life cycles rather than treating each parasite's life cycle individually.

The classification of multicellular animal (metazoan) parasites should also help students to see patterns in their life cycles. Three phyla of animals contain parasitic species: Arthropoda, Nematoda and Platyhelminthes. Parasitic arthropods (fleas, lice, bugs, mites) are usually ectoparasites on the body surface often biting and taking blood meals. Nematodes (roundworms) are parasites of animals and plants (e.g *Ascaris lumbricoidies*, *Globodera sp.* (potato cyst nematode)). Nematodes have male and female forms that reproduce sexually to produce eggs from which infective larvae develop to complete the life cycle. There are two orders of Platyhelminthes that contain parasites Cestoda (tapeworms) and Trematoda (flukes). The tapeworms are intestinal parasites that shed eggs and re-infect through a faecal-oral route. The flukes release larvae that penetrate an aquatic snail where the parasite undergoes stages in its life cycle to produce an infective stage that penetrates the vertebrate host.

Introducing an understanding of parasite life cycles based on their classification could be introduced early in the unit when identification and taxonomy are covered in field techniques or later when parasitism is covered (or on both occasions!). There is no need for students to memorise the names of different stages in parasitic life cycles beyond what is clearly stated in the SQA Course and Unit Support Notes. For example see Q 7 in the 2014 Revised AH Biology paper, Q22 in the Multiple Choice of the 2015 Revised AH Biology paper, and Q9 in the Specimen AH Biology paper.