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## Medical College Admissions Test (MCAT)

The Medical College Admissions Test (MCAT) is a standardized examination administered by the American Association of Medical Colleges. The test is required as part of the application for admission to almost all medical schools in the United States. It was traditionally a paper-and-pencil examination; however, the computerized MCAT was introduced internationally in 2001 and within the United States in 2004. Beginning in January 2007, only the computerized version has been used.

The MCAT was developed in 1928 as part of an effort to measure aptitude for medical study with the goal of lowering the attrition rate in U.S. medical schools. It has undergone several revisions to accommodate changes in the perceived skills required to succeed in medical education. The first MCAT covered scientific terminology, reading, comprehension, and logic.

In 1946, the MCAT underwent its first major revision: The topics included in the new version were verbal skills, quantitative skills, science, and general knowledge. In 1962, the MCAT underwent another major revision, which broadened the scope of general knowledge covered. The third major revision in 1977 expanded the sections covering science, reading, and quantitative skills and dropped the general knowledge question. The fourth major revision, in 1991, added a writing section and integrated quan-

titative skills within the science sections. The current MCAT is intended to assess three general areas: knowledge of biology, chemistry, and physics; facility with critical thinking and problem solving; and writing skills. Scores are reported in four major areas: Verbal Reasoning, Physical Sciences, Biological Sciences, and Writing Sample. The writing sample consists of two essays on specified topics, and the other sections are multiple choice.

Because the primary purpose of the MCAT is to identify students who are likely to succeed in medical school, researchers have been interested in examining how well MCAT scores predict outcomes such as medical school grades and United States Medical Licensing Examination (USMLE) step scores. The MCAT has generally been supported as a valid predictor. For instance, Julian looked at students who entered 14 medical schools in 1992 or 1993 and found that MCAT scores were better predictors of both medical school grades and USMLE step scores than undergraduate grade point average (GPA). Additionally, a meta-analysis by Donnon and colleagues of 23 studies found a moderate correlation between MCAT scores and both medical school grades and USMLE step 1 examinations, and also found that the biological sciences subtest score was the best single predictor of medical school GPA.

**SEE ALSO:** Healthcare, U.S. and Canada; United States Medical Licensing Examination (USMLE).

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## Medical Entomology

Entomology is the science that studies insects and arthropods. In the case of medical entomology, it spe-

cifically refers to those insects and arthropods that affect human beings and may produce human disease. This complex science comprises the biomedical study of insects and arthropods and their morphology, biology, and systematics.

In addition, this field analyzes the epidemiology, prevention, and methods of control of the infections and infestations vectorized and caused by these organisms, but also the insect behavior and life history and those aspects related to relationships between vectors and hosts. Today, the medical entomology as a discipline is closely related to different biomedical sciences such as tropical medicine, medical parasitology, medical virology, public health, and epidemiology, among others.

Insects and arthropods can cause direct physical affection to humans (e.g., biting, in this case this includes the so-called external parasites or ectoparasites) as well as being vector of infectious diseases agents (in mechanical and particularly biological vectorizing, e.g., malaria, dengue).

New concepts of medical entomology have been recently proposed, according to which this discipline should comprehensively study the effects of insects and arthropods on human health and possible control of these effects. Then, the tasks of medical entomology are markedly widened to embrace cognitively and practically important problems, which have been neglected.

The study of entomology comprises the phylum *Arthropoda* which comprises the following important classes: *Pentastomida*, *Arachnida* (scorpions, spiders), *Crustacea* (crabs, crayfish, copepods), *Chilopoda*, *Diplopoda*, and *Insecta* (insects). Most types of zoological (more than 90 percent of all known species) belongs to this phylum, distinguished by the presence of an exoskeleton.

The most medically important of those classes is the *Insecta*. The class *Insecta* comprises various groups of arthropods, grouped in orders. The most important orders are *Diptera* (e.g., mosquitoes, such *Anopheles*, *Aedes*, *Culex*), *Hemiptera* (e.g., bugs, such as triatomines), *Suctoria* (fleas), and *Anoplura* (louse). Other orders included in this class are *Coleoptera*, *Blattaria* (cockroaches), *Lepidoptera* (butterflies), and *Hymenoptera* (ants, hornets).

Genus and species belonging to this class are responsible of vectorize many diseases, such as ma-

laria, dengue, yellow fever, trypanosomiasis, and viral encephalitis, among others. This represents that those diseases transmitted by these arthropods (so-called arthropod-borne diseases) has a high burden on morbidity and mortality worldwide, particularly in developing and tropical countries. Many epidemiological factors are involved in the figures that those diseases represent year after year, and recently the integration of those factors with ecological ones has emerged in a new science that should support the study of medical entomology, the ecoepidemiology. The tools and approaches offered from this discipline to medical entomology and tropical medicine, as well to public health in affected countries, is related to additional objectives such as prevention, prediction, and forecast of vector-borne diseases. A summary of the most important pathogens and diseases transmitted by insects is shown in Table 1 on page 1080.

In the class *Arachnida* is located the Subclass *Acari* and its order *Acarina* (ticks and mites), whose genus and species members are responsible for diseases such as scabies, allergic processes, dermatoses, borreliosis, and rickettsiosis, among others. A summary of the most important pathogens and diseases transmitted by insects is shown in Table 2 on page 1081.

Until today, most surveillance studies about insects and arthropod remain with the classical taxonomical identification as the first primary tool for the classification of collected samples, but the recent biotechnological revolution in molecular biology has also impacted the entomology leading to a new discipline, the molecular entomology. This discipline explores new promising tools for the control of vector-borne diseases through genetic manipulation of vectorial competence.

The gene transfer technology is hoped to make the pathogens vectors incapable of supporting the development of the parasite or viruses which will ultimately lead to eradication of the etiological agents and the diseases. One particular area that is under study is the development of transgenic mosquitoes with the objective to avoid the transmission of diseases such as malaria. The first significant advance in this way is the current availability of the genome sequencing of *Anopheles gambiae*.

Other new discipline in relation to entomology has been the forensic science, which has taken advantage from the fact that necrophagous insects are

Table 1. Insects' Vectors of Medical Importance

Vectors	Pathogens	Diseases
<b>Anoplura (lice)</b>	<b>Bacteria</b>	
<i>Pediculus humanus</i>	<i>Borrelia recurrentis</i>	epidemic relapsing fever
<i>Pediculus humanus</i>	<i>Rickettsia prowazekii</i>	louse-borne typhus
<i>Pediculus humanus</i>	<i>Rochalimaea quintana</i>	trench fever
<b>Diptera (flies)</b>	<b>Viruses</b>	
<i>Aedes</i> spp. particularly		
<i>A. aegypti</i>	DEN virus	dengue
<i>Aedes</i> spp. particularly		
<i>A. aegypti</i>	YF virus	yellow fever
<i>Aedes</i> spp. particularly		
<i>A. triseriatus</i>	LAC virus	LaCrosse encephalitis
<i>Culex</i> spp.	SLE virus	St. Louis encephalitis
<i>Culex</i> spp.	JBE virus	Japanese encephalitis
<i>Culex</i> and <i>Culiseta</i> spp.	WEE virus	western equine encephalitis
Various spp.	EEE virus	eastern equine encephalitis
Various spp.	VEE virus	Venezuelan equine encephalitis
Various spp.	RVF virus	Rift Valley fever
<i>Phlebotomus papatasi</i> (and other species)	sand fly fever virus	sand fly fever
	<b>Protozoa</b>	
<i>Anopheles</i> spp.	<i>Plasmodium falciparum</i> , <i>P. malariae</i> , <i>P. ovale</i> , <i>P. vivax</i>	malaria
<i>Glossina</i> spp.	<i>Trypanosoma brucei</i>	sleeping sickness
<i>Phlebotomus</i> spp. and <i>Lutzomyia</i> spp.	<i>Leishmania</i> spp.	Leishmaniasis, Kala-azar, dum-dum fever
	<b>Nematodes</b>	
<i>Aedes</i> , <i>Anopheles</i> , and <i>Mansonia</i> spp.	<i>Brugia malayi</i>	brugian filariasis
<i>Culex pipiens</i> , <i>Aedes</i> , and <i>Anopheles</i> spp.	<i>Wuchereria bancrofti</i>	Bancroftian filariasis
Various spp.	<i>Dirofilaria immitis</i>	dog heartworm
<i>Simulium</i> spp.	<i>Onchocerca volvulus</i>	onchocerciasis
<i>Chrysops</i> spp.	<i>Loa loa</i>	loiasis
<b>Hemiptera</b>	<b>Protozoa</b>	
<i>Triatominae</i> spp.	<i>Trypanosoma cruzi</i>	Chagas' disease

In the class Crustacea (e.g., crabs), some members could be involved as intermediary hosts in the transmission of some diseases, such as paragonimiasis, a disease caused by a trematode called *Paragonimus*.

Table 2. Acari Vectors of Medical Importance

Vectors	Pathogens	Diseases
	<b>Bacteria</b>	
<i>Liponyssoides sanguineus</i>	<i>Rickettsia akari</i>	rickettsial pox
<i>Leptotrombidium</i> spp.	<i>Rickettsia tsutsugamushi</i>	scrub typhus
Various, particularly <i>Dermacentor</i> spp.	<i>Rickettsia rickettsii</i>	Rocky Mountain spotted fever
<i>Argas</i> spp.	<i>Borrelia anserina</i>	avian spirochetosis
<i>Ixodes scapularis</i> , <i>Ixodes pacificus</i>	<i>Borrelia burgdorferi</i>	Lyme disease
<i>Ornithodoros</i> spp.	<i>Borrelia recurrentis</i>	relapsing fever
Various spp.	<i>Francisella tularensis</i>	tularemia
	<b>Virus</b>	
<i>Dermacentor andersoni</i> (and other species)	CTF virus	Colorado tick fever
<i>Hyalomma marginatum</i>	CCHF virus	Crimean-Congo hemorrhagic fever
<i>Ixodes ricinus</i>	LI virus	loupine ill
<i>Ixodes ricinus</i> (and other species)	TBE virus	tick-borne encephalitis

important in the decomposition of cadavers. The close association between insects and corpses and the use of insects in medicocriminal investigations is the subject of this new discipline, called forensic entomology. Using medical techniques, time since death can only be accurately measured for the first two or three days after death. In contrast, by calculating the age of immature insect stages feeding on a corpse and analyzing the necrophagous species present, postmortem intervals from the first day to several weeks can be estimated. Other uses of entomological data include the toxicological examination of necrophagous larvae from a corpse to identify and estimate drugs and toxicants ingested by the person when alive and the proof of possible postmortem manipulations.

SEE ALSO: Epidemiology; Mosquito Bites; Parasitic Diseases; Tick Bites; Travel Medicine.

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## Medical Geography

Medical geography is essentially a health research hybrid of geography and medicine. It is a method of study to deal with the geographical aspects of health, disease, and healthcare. Although largely drawing from the social components of human geography, it also often includes physical geographical issues such as the role of climate and locale on human health. Many practitioners have begun to use the term *health geography* rather than medical geography. This shift has occurred as more attention is being given to