

HIV makes a compelling case study because it illustrates public health issues likely to influence the life of every reader. It is an emerging pathogen. It rapidly evolves drug resistance. And, of course, it is deadly. AIDS is among the 10 leading causes of death worldwide (Lopez et al. 2006; WHO 2008).

Here are the questions we address:

- What is HIV, how does it spread, and how does it cause AIDS?
- Why do therapies using just one drug, and sometimes therapies using multiple drugs, work well at first but ultimately fail?
- Are human populations evolving as a result of the HIV pandemic?
- Where did HIV come from?
- Why are untreated HIV infections usually fatal?

While one of these questions contains the word *evolution*, some of the others may appear unrelated to the subject. But evolutionary biology is devoted to understanding how populations change over time and how new forms of life arise. These are the issues targeted by our queries about HIV and AIDS. In preparation to address them, the first section covers some requisite background.

As a case study, HIV will demonstrate how evolutionary biologists study adaptation and diversity.

1.1 The Natural History of the HIV Epidemic

AIDS was recognized in 1981, when doctors in the United States reported rare forms of pneumonia and cancer among men who have sex with men (Fauci 2008). The virus responsible, HIV, was identified shortly thereafter (Barré-Sinoussi et al. 1983; Gallo et al. 1984; Popovic et al. 1984). Nearly always fatal, HIV/AIDS was devastating for those infected. But few physicians or researchers foresaw the magnitude of the epidemic to come (Figure 1.1).

Indeed, many were optimistic about the prospects for containing HIV (Walker and Burton 2008). Smallpox had been declared eradicated in 1980 (Moore et

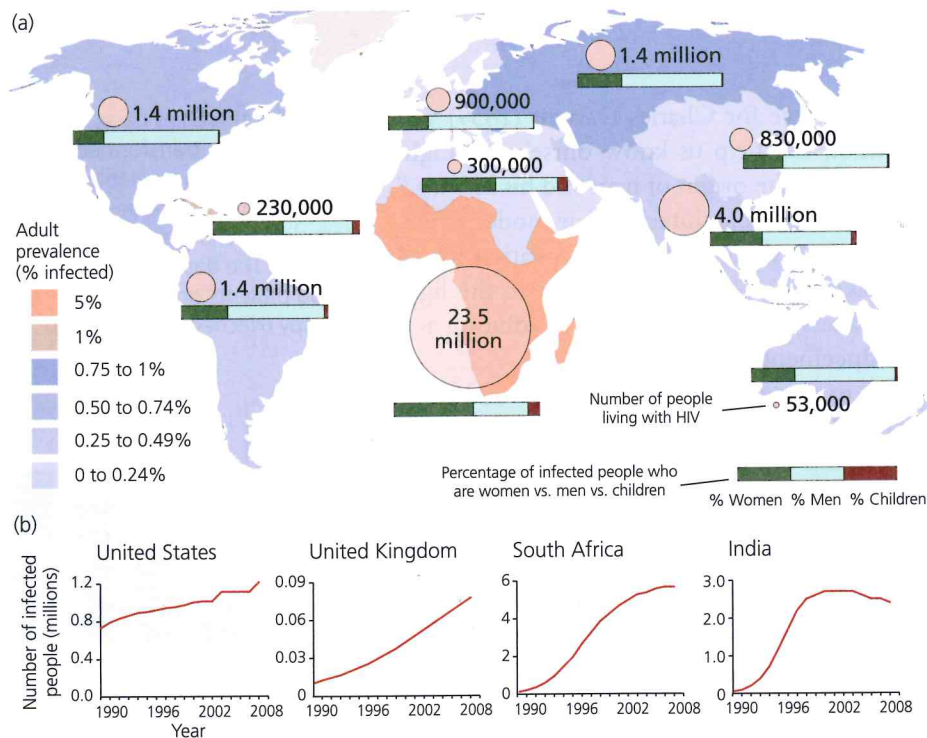


Figure 1.1 The HIV/AIDS pandemic The map (a) shows the geographic distribution of HIV infections. The color of each region indicates the fraction of adults infected with HIV (UNAIDS 2012b). The areas of the circles are proportional to the number of individuals living with HIV (UNAIDS 2012b). The bars divide individuals living with HIV by sex and age (UNAIDS 2008). The graphs (b) show the growth of the epidemic from 1990 to 2008 in four countries. Prepared with data from UNAIDS (2008).