Positron emission tomography, also referred to as PET imaging is another useful tool capable of generating two- and three-dimensional images of a subject. This process takes advantage of the decay of specific types of radioactive isotopes, specifically those that undergo positron emission (also referred to as beta decay). As the radioisotope decays, it emits a positron (the antiparticle of an electron) that passes through the surrounding tissue until it encounters an electron. The encounter annihilates both particles and releases photons that travel in opposite directions. These photons can be detected with a photomultiplier tube. In a typical PET imaging experiment, the subject is treated with a ligand containing a suitable radioisotope, often referred to as a radioligand. This is followed by a short waiting period that allows the radioligand to reach its intended destination, and then the subject is slowly moved through a detector ring that creates "image slices" similar to those described in X-ray CT scanning. The "image slices" can then be assembled mathematically to produce a three-dimensional image of the subject. Importantly, radioligands are often designed to undergo specific, tight interactions with target biomolecules. As a result, specific pharmacological events or regions of the body will "light up" in a PET image. Amyvid® (Florbetapir, Figure 10.3(a)), for example, binds to β-amyloids

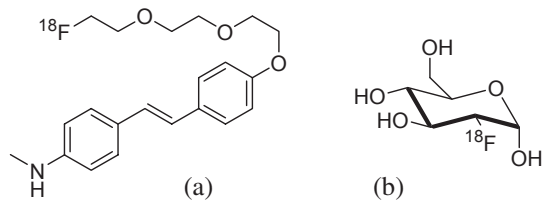

FIGURE 10.3 (a) Amyvid® (Florbetapir) (b) Fludeoxyglucose® (fluorodeoxyglucose, ^{18}F-FDG).

and is used as a diagnostic tool for Alzheimer's disease,[28] while Fludeoxyglucose® (fluorodeoxyglucose, ^{18}F-FDG, Figure 10.3(b)) acts a glucose mimic that accumulates in tumor cells and is a major clinical oncology diagnostic tool.[29]

Although PET imaging can be an effective tool in the drug discovery and development process, there are some limitations that must be considered. The list of radioisotopes that undergo positron emission is relatively small (Table 10.1). In addition, the radioactive half-life of these isotopes is very short (the longest, ^{18}F, is only 110 min). As a result, PET radioligands have a short "shelf life" and must be used quickly once they are prepared. If too much time is allowed to elapse between creation of the radioligand and detection in an experiment, the PET signal will be below the threshold