Nuclear Energy

A tiny little nucleus packs a powerful punch. Unstable nuclei of some elements such as U–235, Pu-239, or Th-232 can split into smaller nuclei. When an unstable nucleus splits it is called **fission**. During fission, neutrons released by fissile (able to undergo fission) nuclei bang into other fissile nuclei and cause them to undergo fission. When fission occurs, mass is not conserved. Some mass is converted into energy. The amount of energy is described by Einstein's famous equation $\boldsymbol{E = mc^2}$. This is a huge amount of energy compared to mass. When a large mass of fissile material is available, it can fuel a nuclear reactor or make a nuclear bomb.

A nuclear reactor is a device that converts nuclear energy into heat energy. The main components are the fuel, a moderator, coolant, control rods, and shielding. The fuel is usually U-235, a fissile isotope of uranium. A moderator is a substance that slows neutrons down without absorbing them in order to increase the chance of collision between the neutrons and the U-235 nuclei. Coolant keeps the system from overheating. Serious overheating could cause a meltdown. Control rods are rods made of boron or cadmium steel. They absorb neutrons, controlling the rate of fission. If the number of neutrons absorbed is greater than the number of neutrons released, fission stops. Shielding provides protection from radiation damage. The core which contains the fuel is surrounded by a steel vessel 20 cm thick. The rest of the reactor is surrounded by high density concrete. A meltdown could breech the shielding and release radioactive material into the environment.

There are pros and cons to nuclear energy. Nuclear energy produces no air pollution, but it produces wastes that are radioactive. Radioactive wastes need to be stored underground in special containers, since no safe way of disposing of them has yet been found.

Answer the questions below based on the reading above and on your knowledge of physics.

1. What is fission? _____
2. Which elements are fissile, and can be used as fuels for nuclear reactors? _____
3. What are the pros and cons to using nuclear energy? _____

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4. What have you heard in the news about nuclear energy? What do you think should be done about nuclear energy? Explain.

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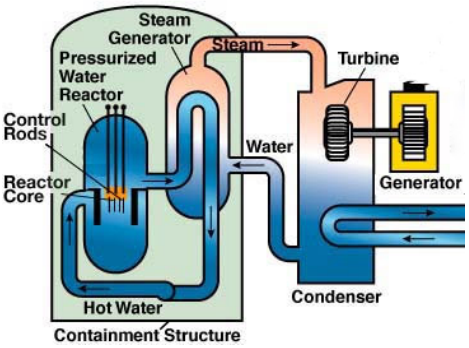
Refer to the diagram of the nuclear reactor below to answer the questions that follow.

5. If a nuclear reactor is just "a device that converts nuclear energy into heat energy," how does it generate electricity?_____



6. What would happen if the control rods were pushed all the way down into the fuel and absorbed all the neutrons? What would happen if the control rods were left all the way up? _____

7. The "containment structure" shown in the diagram refers to the shielding. What is it made of, and what does it do? ___

8. If the nuclear reactor is functioning properly, where is the only place that radioactivity is found? _____

9. Why doesn't the steam, turbine, or generator become radioactive? _____