The use of embryonic stem cells in medical research is highly controversial and has met with intense public and political ambivalence. A battle has waged over the ethics of using these important cells ever since researchers announced in 1998 that they had removed stem cells from a human embryo and grown the cells in culture. But what exactly are stem cells, and why are they so important?

Generally speaking, stem cells are unspecialized cells that have the potential to develop into many different types of specialized cells and tissues. Most stem cells also have the ability to divide indefinitely and thus provide a never-ending supply of new stem cells. However, stem cells vary both in their potential and in the source from which they are obtained.

One type of stem cell that is generally not recognized in the stem cell debate because it is not harvested as a source of these important cells is the fertilized egg cell, or zygote. A cell at this developmental stage is said to be totipotent, which means that it has the potential to create any type of cell necessary for embryonic development, including placental tissue. In the first few hours after fertilization, the zygote undergoes several cell divisions resulting in a number of totipotent cells. If any one of these cells were to become split off from the rest and implanted in the lining of the uterus, it would develop as a separate embryo. This is how identical twins arise.

Approximately four days after fertilization, the rapidly dividing cells create a hollow sphere called a blastocyst, with a small cluster of cells inside called the inner cell mass. While the outer layer develops into the placenta, the inner cell mass will develop into the fetus. Scientists call these stem cells pluripotent, which means that they have the potential to develop into any type of fetal cell, but not the placental cells needed to support a fetus.

As development continues, embryonic stem cells give rise to a wide variety of specialized cells, including somatic (adult) stem cells. Somatic stem cells are responsible for replenishing specific types of cells throughout a person's life. Adults have these stem cells in many places in the body -- in their blood and skin, for example. Many researchers think we may have several other types of multipotent stem cells, including nerve stem cells.

Of all the different types of stem cells available, most scientists consider somatic stem cells to be the most promising for medical uses. Because the cells themselves are not capable of developing into a fetus, as embryonic cells are, the ethical dilemma of doing research with them is somewhat diminished. Collecting pluripotent stem cells, however, still requires the killing of several-day-old embryos -- albeit embryos that have already been discarded from fertility clinics -- and so the debate continues. Because of this, many researchers are searching for ways to trigger somatic cells to, in a sense, regress -- to expand their development potential to a broader range of cell types.

Video: News Hour PBS:
http://www.pbs.org/wgbh/nova/body/stem-cells-research.html

Stem Cell Discussion Questions

1. What is a stem cell?
2. What is the difference between an embryonic stem cell and a somatic stem cell?
3. How might stem cells be used to treat a disease such as diabetes?
4. What do you think is an important issue that needs to be debated as we make decisions about stem cell research?
5. What is a blastocyst?
6. What parts of the human body contain stem cells?
7. In what ways might the use of embryonic stem cells be better than the use of adult stem cells?
8. In what ways might the use of adult stem cells be better than the use of embryonic stem cells?
9. Define the following terms:
    a. Differentiated cell.
    b. Undifferentiated cell
    c. Stem cell
    d. Somatic stem cell
    e. Embryonic stem cell