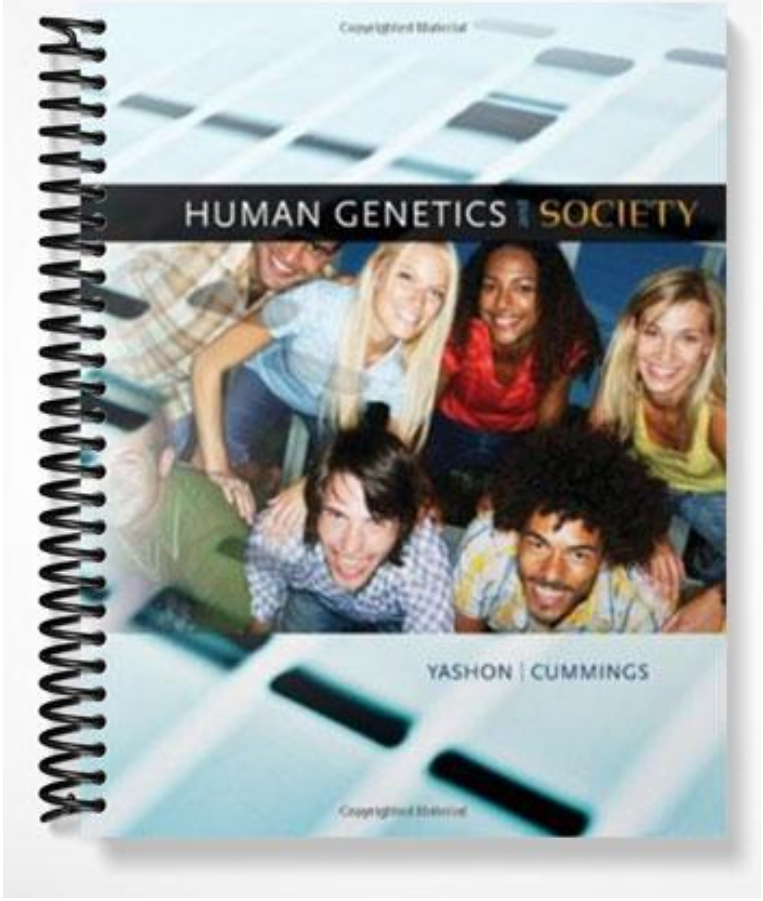
SOLUTIONS MANUAL



Chapter 2
Assisted Reproductive Technology

Chapter Summary

The chapter begins by covering the essentials of spermatogenesis and oogenesis. The major causes of infertility in both men and women are discussed. Assisted Reproductive Technology (ART) provides help to those with infertility problems through the use of various methods. There are a number of legal and ethical issues associated with ART that are presented in the chapter. Some of the legal and ethical issues are: leftover embryos, possible parental rights for egg and sperm donors and financial compensation for those individuals, and how to deal with surrogate motherhood.

Lecture Outline

2.1 How Are Sperm and Eggs Made?

1. Males produce sperm in the testes and sex hormones called androgens.
2. Females produce eggs in the ovaries and sex hormones called estrogens.
3. Sex cells, or gametes, are produced during meiosis.

2.2 What Organs Make Up the Male Reproductive System?

1. The male reproductive system is largely composed of a penis, a set of glands to secrete fluids that allow sperm to be viable and motile, and a system to transport the sperm out of the body.
2. Spermatogenesis takes place in the seminiferous tubules of the testes and begins at puberty.
3. Spermatogenesis continues throughout the life of a male.

2.3 What Organs Make Up the Female Reproductive System?

1. Once the egg is produced, it is released from the ovary and fertilized in the fallopian tubes after sperm enter through the vagina.
2. A fertilized egg is called a zygote.
3. Oogenesis begins during the first trimester of embryonic development, and is arrested until fertilization takes places, which is when the process is completed.
4. A female is born with her lifetime supply of developing eggs in her ovary.

2.4 Is Infertility a Common Problem?

1. Fertility is dependent on both a healthy sperm and a healthy egg. Infertility rates in the U.S. have increased over the last 10 years and seem to increase as age increases.

2. What are the causes of infertility in women?
    a. Hormone levels, particularly luteinizing hormone (LH) regulate estrogen levels, which in turn regulate ovulation.
    b. Damaged or absent ovaries cause infertility since egg maturation is prevented.
    c. Some women begin menopause prematurely and stop releasing eggs.
    d. Other causes of infertility are temporary lack of menstruation, blockage of fallopian tubes, infections, and other uterine problems.
3. What are the causes of infertility in men?
    a. The main causes if infertility in men are problems with sperm formation and with the sperm themselves.
    b. Low sperm count is caused by a variety of factors and prevents a large number of sperm from swimming up to the fallopian tubes.
    c. Low sperm motility prevents sperm from getting to the egg for fertilization.
    d. Impotence does not allow the penis to become erect, thus preventing ejaculation.
    e. Some men fail to produce sperm for a variety of reasons.
4. What other factors influence fertility in men and women?
    a. Personal habits and environmental factors.
    b. Increased age.
    c. Venereal diseases.

2.5 How Do Assisted Reproductive Technologies Help with Infertility Problems?

1. There are various methods aimed at helping infertile couples.
2. Donation of gametes (egg or sperm) is a common fertility treatment.
3. IVF, or *in vitro* fertilization, mixes eggs and sperm in a Petri dish, and after incubation the embryos are placed in the uterus.
4. Another option is the use of surrogacy of which there are various types.

2.6 What Are the Legal and Ethical Issues Associated with ART?

1. There are several issues associated with ART such as discarding frozen embryos.
2. Legal issues regarding the parental rights of egg and sperm donors may emerge.
3. There are ongoing cases related to the ethical and legal issues raised by ART procedures.

Teaching Tips and Activities

1. The process of meiosis in males and females is best approached by using visual resources such as a video clip or a web simulation.

2. The male and female reproductive organs may be familiar to most students. You can divide the class in two groups and have each group explain to the class the basics of the reproductive system in each sex.

3. When covering infertility you may want to have the class brainstorm some possible solutions to infertility. The idea is for them to become aware that some solutions may be realistic while others may not.

4. When discussing ART, develop a class debate about whether it should be regulated by discussing success rates of IVF (see the latest statistics from the Centers for Disease Control) and complications (oocyte procurement, sperm surveillance, multiple births, and offspring health).

5. After discussing ART, open up a discussion about who benefits from the procedure given its high cost, and the "right" to have a genetically related child as selfishness.

Discussion Topics

1. Use the In the Media article on Jodie Foster's baby to discuss the status of celebrities when seeking sperm or egg donation.

2. Use the In the Media article on gender selection and discuss questions 1 and 2. This topic will be discussed in chapter 4 but it would be interesting to find out students' perception before the material is covered.

Additional Resources

ABC videos
Rent a Womb? Extreme Measures to Have a Baby, ABC News; Genetics in the Headlines, 2008; ISBN 0495016055

Additional Videos
Frontline: Making Babies (PBS show, 1999)
http://www.pbs.org/wgbh/pages/frontline/shows/fertility/

Suggested Answers to Spotlight on Law Questions

1. Answers may vary. Those answering Mary Sue could argue that she wanted to conceive and should have some proprietary rights over her eggs. Those answering Junior may refer to his unwillingness as a parent, thus enabling him to keep the embryos.

2. Answers may vary. If neither spouse was awarded the embryos, then those could have been destroyed. On the other hand, the embryos could have remained frozen for an indeterminate length of time.

3. Answers may vary. Students could say that Junior's attorney was right for the following reasons: unwillingness to be a parent, unwillingness to provide financial support to the child, and the absence for the child of both parents living together. Those students agreeing with Mary Sue's attorney may argue that she wises to be a parent, she provided the eggs to form the embryos, and that the embryos are considered *live*.

4. Answers may vary. Students answering yes could argue that both parents are no longer alive to choose for them to develop into children, plus there might be a financial incentive associated with wanting the embryos. Students answering no could argue that those embryos could help an infertile woman become a mother.

5. Answers may vary. Students answering yes could argue embryos are potential children and should be protected from possible harm. Those answering no may indicate that embryos are not children yet and could be disposed of as someone wishes to.

6. Answers may vary. Some students may indicate that those embryos should be destroyed after a set period of time. Other students may indicate that they should become property of the fertility clinic and could be donated to an infertile couple.

7. Answers may vary. Possible answers may include: choice of embryos in the event of a divorce, financial obligations for each parent, and fate of the embryos if unclaimed.

8. Answers may vary. Some options may be adoption and surrogacy.

Suggested Answers to Case Study Questions

Case A

1. Answers may vary. Brian and Laura should check if they are fertile before considering other options.

2. Answers may vary. Four possible things could be: verify if they are fertile, in the event that both are fertile determine if they are carriers for any genetic disorder, consider surrogacy if Laura has some problems that prevent pregnancy other than fertility, consider a sperm donor if Brian is sterile.

3. Answers may vary. Laura could have artificial insemination if Brian is sterile, or Brian could fertilize some donor eggs if Laura is sterile. In the event that Laura has trouble carrying a fetus to term surrogacy could be an option.

4. Answers may vary. Three possible reasons: some of the IVF techniques could lead to a genetically-related child for at least one of the partners, techniques are fairly safe, and techniques have been successful.

5. Answers may vary. Adopting a child seems generous for a child without parents, it is less expensive to adopt than to undergo fertility treatments, and there are no invasive methods involved.

6. Answers may vary. Some students may not know anyone willing to admit infertility or ART.

7. Answers may vary. Two possible reasons may be: ability to have genetically-related children and the relative safety of the procedures.

Case B

1. Answers may vary. Students could answer yes so that Alex would not inherit a genetic disorder. Students could answer no based on the grounds that by choosing she is designing the traits of her child.

2. Answers may vary.

   a. If yes, students could argue that Alex is entitled to know the identity of her father when she reaches an age at which she can process such information. Also, Alex may wish to meet her father at some point.

   b. If no, Alex could be emotionally disturbed by finding out the truth about her father or she may never have a chance to meet him.

3. Answers may vary. If yes, Alex is an adult and should be entitled to find her father and establish contact with him. If not, the sperm donor might have chosen not to have his identity revealed.

4. Answers may vary. Five possible arguments could be: need to know if he has a sex-linked condition, for possible organ compatibility if donation is needed, to be legally recognized as her father's daughter, to have a father-daughter relationship, to figure out any questions regarding her race or ancestors.

5. Answers may vary. Three possible reasons could be: having a family and not wanting to inform them about his sperm donation, considering himself unfit to assume a parental relationship, lack of desire to provide financial support.

6. Answers may vary. Some reasons may be embarrassment for not having a paternal last name, social concerns for not having a traditional family, and financial issues associated with a single household.

7. Answers may vary. Not much is known (or at least informed). There is no indication about Alex's father's genetic predisposition for a disorder. Alex might inherit a sex-linked or autosomal condition.

Suggested Answers to End of Chapter Questions

Review Questions

1.

Infertility Problem	Cause 1	Cause 2
Lack of ovulation	No estrogen	Too little estrogen
Damaged or absent ovaries	Surgical removal or damage	Inflammation, radiation, infection
Premature menopause	Extremely athletic	Low body weight
Secondary amenorrhea	Low body weight	Excessive physical activity
Fallopian tube blockage	Sexually transmitted infections	Appendicitis or bowel problems
Uterine problems	Lack of uterus	Endometriosis

2.

Infertility Problem	Cause 1	Cause 2
Low sperm count	Exposure to chemicals or radiation	Injury to the testes
Low sperm motility	Malformed sperm tails	Lack of direction when swimming
Impotence	Insufficient blood supply	High blood pressure and diabetes
No sperm formation	Vasectomy	Birth defects

3. Answers may vary. For instance, for uterine problems in women a surrogate mother may help. For men, low sperm count can be alleviated by pooling sperm from several ejaculations.

4. Egg donor surrogacy has more physical problems because the donor needs to have her eggs removed, and after artificial insemination she will have the embryo(s) implanted.

5 Answer may vary. Basically, a man can choose a reversible vasectomy.

6. Aspermia.

7. Hormones are easy to administer and may correct infertility due to low hormone levels.

8. Hormone levels, any other factor affecting fertility, and any genetic predisposition to a disorder.

9. Smoking, exposure to chemicals such as pesticides, and increased maternal age.

10. Exposure to chemicals.

Application Questions

1. Answers may vary. If yes, there seems to be an increase in the number of infertile couples. If no, there will be a reduction in births or more couples may decide to adopt.

2. Answers may vary. The number of adoptions may be significantly reduced. The number of abortions may increase since there are more possibilities to have children with desired traits.

3. Answers may vary. Gestational surrogacy may bring more legal problems since the surrogate may choose to keep the baby. Also, since the sperms and egg may be from two people unrelated to the infertile couple a number of legal issues may emerge.

4. Answers may vary according to a student's choice.

5. Answers may vary since IVF, surrogacy, sperm donor use, and egg donor use could change from year to year.

6. Answers may vary. A woman over 55 may have physical problems that could interfere with the gestation, she may not be able to lactate, and there may be complications during childbirth.

7. Answers may vary. Students may answer that it is more common for older men to have children than women of the same age. Some reasons given may include that men are capable of producing sperm throughout their life and that {men are not usually involved in parental care.} Is this correct?

8. Answers may vary. If the donor waived her rights to seek any rights, the judge may not grant any custody or visitation rights. On the other hand, if the donor did not waive any rights, the judge may decide that the woman receiving the ovary transplant carried the fetus to term, gave birth, and is legally considered the biological mother.