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Making Babies with Cows

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CHAPTER 11

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Note: The conceit of section one of this essay is partial role reversal. How would a doctor who was a cow explain to yearling interns how to breed humans? This is what a cow might sound like if she thought about humans the ways that human purebred livestock breeders think about cows. Section two switches back to a human perspective and treats the extensive interventions into cattle reproduction as the mundane options that they have become for many farmers. This essay highlights the traffic of reproductive technologies across the porous human-bovine species boundary.

I. Reproductive Science on Planet Bovine: A Seminar for Cow Interns in Human Reproduction

So, you want to get a human pregnant? The first thing to know about human reproduction is that humans are really touchy about it. This is very important to know if you are concerned with handling practices that keep humans calm and stress-free. Stress is definitely a barrier to pregnancy, and of course, you can injure a human when you are handling her, so you want to be careful. Our knowledge of human welfare has evolved, and best practices for handling folk should always be used.

The good news is that we have many years of research in bovine reproductive medicine to guide us. It turns out that humans make really good

research analogs for cows, so much of what we know transfers readily to human reproduction. Even the gestation length of a folk is almost the same as for us cattle. Over the years, our people have donated our semen and ova abundantly to the cause of perfecting assisted reproductive technologies and cryopreservation, and this has advanced human reproductive medicine tremendously.

Unassisted Reproduction

Folk will reproduce readily if you put them together in the right situation, as long as they are otherwise healthy. However, sires are not able to service as many females as you might think. Some will, quite readily, but many prefer to consort with only one or a few females. It is possible that breed improvement programs could change this, but it hasn't really stood in the way of reproduction. It may be hard to believe, but there are actually more folk than cows on this planet.

Thus, the easiest way to breed humans is to just put some known fertile women together with one or more healthy, disease-free sires. Make them comfortable, and make sure they have nutrient-dense rations, enough food for three meals a day, room to roam, and privacy. But this leaves a lot to chance, and some of those girls will figure out how to keep themselves from getting pregnant.

But suppose you don't want to leave so much up to chance and would prefer to control breeding a little more closely. There are a few ways to do this, depending on your constraints and your goals.

Assisted Reproduction

If you find you need to encourage reproduction, you'll need to know when the woman is ready to ovulate. And when that happens, you'll need to be ready with semen from a suitable man sire.

Estrous Versus Menstrual Cycle

Humans are hormonally very similar to us bovines. However, human females do not have standing heat in which they seek breeding opportunities, and they shed their endometrium through menstruation rather than reabsorb it as we do. Without a standing heat to indicate when a woman is about to ovulate, other signs and indicators will have to be used.

In humans, the menstrual cycle lasts about twenty-eight days but could be longer or shorter. The first day of the cycle is the beginning of menstruation,

when the endometrium is shed in absence of conception. Depending on the length of the cycle, the ovulatory phase will begin a week to two weeks later. A helpful way to detect ovulation is to track the woman's menstrual cycle with a calendar. Keep track of as many of the signs of fertility as you can, and you will soon have a good picture of when the female human is fertile.

These signs include cervical mucus that becomes long and stretchy, a quality called spinnbarkeit. On palpation, her cervix will have lifted up slightly higher in her vaginal canal, and it will be soft. On examination with a speculum, the cervical os will be open, and clear mucus can be seen. Another way is to look under a microscope for a fern leaf pattern in her saliva or cervical mucus. Some behavioral and emotional changes may be displayed. She may seem restless or edgy.

You can also keep a record of her basal body temperature each morning before she gets up from sleeping. Using a digital thermometer accurate to the first decimal place, take her temperature orally at the same time each morning, before she gets up, and make a note of it on a calendar. Her temperature will rise from the baseline at ovulation and remain elevated until the cycle is complete.

You can also detect ovulation by capturing her urine and using a test strip designed to detect a surge in luteinizing hormone (LH). It is best to do this twice a day beginning a couple days before ovulation is anticipated to occur. This will give more precise information so that you can time mating or insemination. Ovulation typically follows 18 to 36 hours after the LH surge.

Inducing Ovulation

If all of this is too much work, you can instead induce ovulation so that you can time insemination accurately. Typical regimens involve administering clomiphene for five days, beginning on day 3, 4, or 5 of a cycle, to stimulate follicular growth, followed by an injection of human chorionic gonadotropin (hCG) to induce ovulation. The hCG can be administered when one or more follicles have grown to 18 millimeters or larger, as verified using transvaginal ultrasound. The hCG injection is called a "trigger shot," and ovulation typically occurs twenty-six hours later.

Using a clomiphene regimen increases odds of twins to about 10 percent. Although gestating twins increases the chance of preterm birth and other pregnancy complications, you don't have to worry about the risk to female fetuses. Human females who are twinned with a male will be reproductively normal, which means they won't androgenize and become freemartins, as among us cattle.

Artificial Insemination

The goal of detecting ovulation is to make sure that sperm cells are present in the fallopian tube soon after the follicle releases the egg so that fertilization can occur before the egg reaches the uterus. Timing is especially important if you are using semen samples that have been previously frozen, since their lifespan is shorter.

Now, some human females will prefer the semen of a particular sire, usually a sire she is pair-bonded with. If possible, for handling reasons and human welfare concerns, use the semen from this sire.

If your pair-bonded folk have been kept together but not produced any offspring, you will need to check the sperm quality of the sire before you waste any more valuable time and money. Bring a sample to a lab for semen analysis to determine sperm count, motility, and morphology. Normal sperm count is above 15 million per milliliter, and at least half should be motile. If low numbers of motile and morphologically normal sperm (mild male factor infertility) are the only problem, then intra-uterine insemination with a fresh, cleaned sample may overcome this.

You will not need to aid the male in ejaculating. Provide a quiet place in the clinic and some images of folk copulating, and he will stimulate himself to provide the sample. Although many folk will copulate in open spaces or outside of their homes, most men will be too stressed to ejaculate if they feel they are watched too closely. If possible, provide a private room with a closed door for him to stimulate himself.

It is possible that the preferred sire possesses too many reproductive defects to use on the preferred dam. In this case, you can select a sire from a sperm bank catalog. However, you will need to enlist the cooperation of the woman if she has a preference for her pair-bonded sire. You may need to keep her separated from the man, who may attempt to dissuade her from using another sire.

Sire Selection

Some female humans are not pair-bonded or are pair-bonded with another female. Some may also be bonded in larger groups. But don't assume that these females have no preferences about the sire. It may seem to you that the motile sperm of one healthy man sire is as good as the motile sperm of any other healthy man, but that is not usually the case for folk. Human welfare has made great strides, and we now recognize that we must learn to recognize her preferences to avoid stress and to ensure that she will care for the baby when it is born.

Women who are pair-bonded with another female may breed naturally with a familiar human male or may prefer to choose a donor sire from a catalog. Some of the factors in these choices are obvious, like a strong, healthy sire who has been tested free of STDs and common genetic defects. However, other factors are not so obvious, like psychological or physical resemblance to the partner and whether or not the partner has desirable traits. We bovines admire good udders, a calm disposition, sound feet, easy calving, and high fertility, and so we admire bulls who can pass these traits on to our young. Folk may disregard these qualities in a donor if the donor is otherwise unlike their mate. Moreover, while many humans claim to be "color blind," fewer donor sires with less sought-after traits like dark skin and eyes are recruited, which means there are fewer to choose from. Humans who prioritize brown skin may not have much choice of other qualities in their donor.

Now, due to breeding limitations, we don't have the same level of information about human sires as we have for ourselves. Human donor catalogs are sparsely informative. Humans attribute a lot of their offspring's success in life to genetics but still prefer to leave all but the most obvious traits to chance. The donor might have been tested free of STDs and then for the most common variants of a small handful of known genetic diseases. Cystic fibrosis, sickle cell disease, and Tay-Sachs, for example, are simple recessive diseases that are common in some human populations and less common in others. In order for the disease to be expressed, a child must carry two copies of the recessive gene. Record-keeping for humans leaves something to be desired, and some humans might not even know that they carry one of these genes; humans do not exploit such information to aggressively breed recessive diseases out of their family lines. Additional testing can be requested if your woman is known to have a genetic disease.

Our fastidious record-keeping for two hundred years has helped us develop statistical evaluation techniques that provide strong predictions of heritable traits, especially because our wide use of artificial insemination has allowed our best bulls and cows to breed prolifically. This record-keeping has enabled the development of genetic tests for even complex traits, so that statistical predictions can be genetically enhanced. Despite enthusiasm for pedigree keeping among some folk, their records aren't good enough to develop statistical evaluation, given their reduced capacity for reproduction. Genetic testing has become inexpensive, but most of the panels are not considered to be particularly useful for either health planning or reproductive purposes.

Perhaps because of stigma attached to using donor sperm and eggs, humans have been reticent to document the traits of their donors completely. So your donor catalog may describe the height and weight as well as the skin,

eye, and hair color of the donor along with a few other traits. Sometimes this information is included for his parents as well, though it is unlikely that his grandparents will be documented. Sometimes an essay or other piece of personal writing is included, so that prospective human parents can feel sympathetic to the donor. A photo of the donor as a baby or child may be provided, or, more rarely, an adult photo of the donor. Sometimes, more information about the donor has been collected, which can be provided for an additional fee. As you know, this is the opposite of our community, in which full information about a sire and his ancestors is considered key to his prestige.

Another issue that results from the lack of documentation is not being able to identify the most successful sires. The best advice is to choose a proven sire with many pregnancies from his donations. However, many sperm banks limit the number of pregnancies from a single donor to as few as ten. Before human collection studs (banks) settled on best practices, a few donors were used for several hundred pregnancies. While it's not a problem for us bovines, humans have a strongly socialized inbreeding avoidance mechanism, and they worry that their children could accidentally meet a genetic half-sibling and breed. Although this is statistically extremely unlikely, the very idea causes revulsion for some of them, and they feel better if there are fewer donor siblings, even if this may mean that it takes longer to achieve pregnancy with a particular sire. The trade-off for a genetically more unique child is that folks have less knowledge about sires, constituting a missed opportunity for breed improvement.

The human donor sires are not named, so they are functionally anonymous, and their pedigrees cannot be identified. Some donors have agreed to have identifying information shared once offspring have reached maturity (considered to be eighteen years old in humans). Folk can be very possessive of the babies they raise and do not want interference from other people. Pair-bonded males and females who use donor gametes also prefer to elide the biological parentage of the offspring. Unlike bovine males, man sires sometimes aid their dams in feeding and sheltering their babies. However, some men won't do this if they think that the baby is not their genetic offspring. Men also prefer that other folks don't know when they are not genetic parents of their babies.

Folk might try to avoid inbreeding, but many seem to prefer mates who are slightly more similar to them than the general population. This influences the selection of donor gametes. Humans can be very sensitive to the presence or absence of recessive traits like light-colored eyes (blue or green) or hair (blond or red). Additionally, of human phenotypes, folk are typically most sensitive about skin tone and will use that criterion as a first screen

for donor gametes. However, the human tradition of selecting somewhat similar mates is relaxing in many populations and heterosis prevails. Still, for pair-bonded males and females, any trait that could draw attention to the fact that the bonded male did not sire the offspring should be avoided.

Semen Quality

Now, if you are purchasing sperm from a bank, you'll want to be sure that you buy a big enough sample of motile sperm. Most banks guarantee a minimum number of motile sperm; others will sell you vials by the number of motile sperm per milliliter. Banks recruit and then screen young donors with physical examinations and health histories. Then donors take blood tests for STDs and a basic genetic screening panel. Each deposit is processed with an extender for cryopreservation. The straws are frozen and quarantined for six months and are released from quarantine when the donor has been retested to be clear from STDs. This is because human males cannot be kept away from other humans. Even keeping them segregated from females will not keep them from engaging in sexual activity with other males. Sexual activity with other males is perceived to be associated with disease transmission and decreased fertility, so by an old tradition, sperm banks will not knowingly release samples from quarantine if the donor has had sex with other men.

The samples are prepared two different ways: for intra-uterine insemination, and for intra-cervical insemination. Additionally, straws with smaller numbers of motile sperm may be adequate for embryo transfer (ET), because the procedure differs from ET amongst us bovines, as discussed below. Finally, whereas it is possible to select sex-sorted bovine semen, that is considered a specialty service for humans. Sex selection for human pregnancies involves advanced technologies, like IVF with pre-implantation genetic diagnosis (PIGD).

Embryo Transfer

Among our own people, some cows are very good mothers, and can become mothers with embryo transfer (ET), so that they can mother the very best calves. For humans, ET is used when the woman has a strong mothering instinct but has been unable to conceive, or when she carries a catastrophic genetic disease. In addition to different applications for embryo transfer, the technique for ET is somewhat different for humans. Whereas we typically fertilize eggs in vivo, for human embryo transfer eggs are extracted from the woman or a woman who is a willing egg donor after a similar hormone

regimen, and then fertilized in a petri dish and allowed to divide several times before implantation. The egg can also be fertilized by injecting a single sperm into it, in a process called intracytoplasmic sperm injection. ICSI allows a healthy sperm cell to be selected. IVF can also allow genetic testing of the resulting embryos (PIGD). If there are any eggs or embryos left over after the cycle, these can be cryopreserved for future use.

Human females are astounding mothers. Like us, they typically give birth to singletons, occasionally to twins, and rarely to triplets. But, implanted with multiple embryos, women have been known to successfully gestate and give birth to as many as eight babies. There have been some instances when humans have been implanted with several embryos at once, on the mistaken assumption that most will not implant in the uterine wall and grow. This has resulted in higher numbers of multiple births. However, time and observation have shown that using two embryos is optimal. Multiple fetuses increase the chances of pre-term births and other complications. Humans don't have freemartins; heifer calves that are twinned with a male will not androgenize or be sterile. Although the opportunity to get several babies from a single gestation is exciting, it is not actually cost-effective as each of the surviving offspring may have health problems at birth that result in later difficulties.

Conclusion

In a nutshell, these are the most common strategies available for encouraging reproduction among folk. Other options are available, though they are more costly and technologically intricate and thus more expensive and suitable for only the most valuable folk. Humans can be nervous and touchy about reproduction, so it is best to choose a strategy that minimizes handling and stress. Although their behavior sometimes suggests otherwise, humans are picky about their sexual partners and mates, and strategies should be chosen that line up with their preferences in order to minimize stress and ensure successful parenting.

II. Reproductive Science on Planet Earth: Modern Breeding Techniques for Cattle Growers

So you want to get a cow pregnant? We can help with that, whether it's because you want her to make milk for you to drink or to raise a calf for meat or even to create embryos to transfer to another cow. Back in the day, this was a very simple matter of getting a bull, maybe borrowing one, or maybe raising up one of your own calves into a bull, instead of castrating him to make him

a steer to fatten or an ox to pull a cart. Today, new assisted reproductive technologies offer more choices and more control, enabling you to improve herd performance or to match the sire's traits even more closely to your cow. And this high technology is easy and available to use, even on an ordinary farm.

The Old-Fashioned Way

Using a bull to get your cow pregnant can be practical and easy, especially if you already have one on hand. However, for a few reasons, you might want or need to get your cow pregnant another way. First of all, you have to maintain the bull, keep him in good condition and disease-free, even for all of the months he's not in service. And if you borrow or lend a bull, you'll worry that the bull might carry a sexually transmitted disease. I'm sure you didn't think about it, because what could seem more pure and natural than cows in a pasture, with a bull for consort? But he may well carry trichomoniasis, vibriosis, or brucella, or some other disease. Even if it doesn't bother him much, it will bother your cow. If you get her pregnant, she will probably abort.

So maybe now this doesn't seem so simple, but really it is. Modern technology can come to your aid. Many farmers use it. All you need is a cow in heat and some straws of frozen semen. Here's how to do it.

Detecting Heat

The key to successful breeding is knowing when your cow is in heat. You can do this just by keeping an eye on her, but you'll have to watch her at least a couple times a day, first thing in the morning and last thing at sunset. A cow in heat will mount other cows or will stand still while other cows mount her. This is called "standing heat," and it doesn't last long—usually between six and fourteen hours. Ovulation occurs twenty-eight to thirty-two hours later. You want the sperm to be right there waiting when the egg is released, so you'll need to know pretty accurately when standing heat began in order to know when to put a bull in the pasture with her or use procedures like artificial insemination (AI). Other signs of estrus include restlessness, rubbing against other cows, or changes in appetite. She may have mucus coming from her vulva or walk around with a raised tail. She may make less milk than usual.

It might be a lot to keep track of, though, if you have a bunch of cows. Who has time to walk through the pasture for a couple hours a day? Heat-detecting technologies can help. These include scratch-off or pressure-sensitive patches to stick or glue to your cow's tailhead that change color when she's been

mounted by other cows. You can also go high-tech with a patch that has a pressure sensor and a transmitter to relay to a farm computer when a cow has been mounted. You could even set it up to text you when that happens.

Another method is to use a paint dispenser called a chin-ball marker that is attached to a teaser bull that will leave color when he mounts. Teaser bulls have been surgically altered to be sterile or otherwise physically unable to impregnate a cow. A cow that you were going to cull anyway can be treated with testosterone to do the same work.

Estrous Synchronization

For those who have a lot of cows, waiting for them to come into heat and then coordinating getting each of them pregnant can be a lot to juggle. Time is money, and you don't want to miss your chance to get your cows pregnant. Months later, as the bellies of your pregnant cows swell, the cows who are still "open" (not pregnant) won't be any closer to producing milk and beef for you.

Instead, you can give them a hormone regimen to synchronize estrous and induce ovulation so that you can plan for procedures like artificial insemination or embryo transfer as well as project future milk or beef production. What these hormones do is override the cow's endogenous hormones in order to reset the estrous cycle and trigger ovulation. You can synchronize the ovulation of all of the cows in your herd so that you can inseminate them all at the same time, which also means that they will all give birth around the same time. Or you can stage them to extend production through the year. Not only can you can plan future production, you might even know when to put a vacation on your calendar.

Cows have an estrous cycle that typically lasts between eighteen and twenty-four days. Assuming a cycle of twenty-four days, the first seventeen days, approximately, are the luteal phase and the remaining days are the follicular phase, culminating in standing heat. Ovulation occurs shortly thereafter and marks the first day of the cycle. Cows typically have two or three waves of follicular development, each with the selection of a dominant follicle that will either regress or ovulate. Only the final follicular wave results in ovulation. These follicular waves add to the complexity of the cow's cycle. The ovary, uterus, and pituitary gland release hormones that work in a complex feedback loop.

That complexity can be simplified and controlled with a protocol to synchronize estrous, ovulation, or both. This may involve progesterone delivered orally or with an intravaginal progesterone device (IVPD) or injections

of hormones or both. Synthetic gonadotropin, prostaglandin, estrogen, and progesterone may be used. There are quite a few protocols on the market, so check the specific instructions from the pharmaceutical company whose protocol you use. You can also find estrous synchronization calendars from animal scientists on the internet to help you track cycles and plan for procedures. Sperm that has been frozen has a shorter lifespan in the reproductive tract than fresh sperm, so artificial insemination should take place four to twelve hours after the onset of estrus.

Artificial Insemination

Now, of course, ovulating isn't enough. You've got the egg lined up. Now you need to make sure that semen is in the right place at the right time. If you do it the old-fashioned way, by turning your bulls out into the pasture with your cows, you'll need to make sure that you have enough bulls on hand. You'll need a bull for every twenty to thirty cows. A bull with libido enough can service a cow about every half-hour.

But here's where you can really control production. Buying and maintaining a bull can be expensive. You may not want to leave performance up to him. You may not have a share in a bull or have a friend with a bull that you can borrow. So instead you can fire up your internet connection, browse a catalog, pick a bull, and buy straws of his semen to be delivered frozen in a nitrogen tank. This means you can have your pick of the best bulls with the best performance traits, and you aren't limited by geography. You can even pick vials from several different bulls to complement the traits of the cows you will use them on.

Some people think of artificial insemination as the turkey baster method, but that gives so many wrong impressions. First of all, a turkey baster holds a lot of liquid. Rest assured, you are not going to be dealing with a lot of liquid. Sperm are very small. Many millions of them fit in just a milliliter of semen. A straw of bull semen is typically .25 ml or .5 ml, with a standard of 10 to 20 million sperm cells. Another wrong impression is that there is some generic vat of semen to be sucked up into a turkey baster bulb, rather than carefully collected and prepared samples from specific, named, and vetted bulls. The last inaccuracy is the idea that the semen is going to just be squirted up in somewhere. The whole point of AI is control. You will be leaving as little to chance as possible. You will be depositing the semen into the body of the uterus to get the sperm as close to the ovaries as possible.

The semen comes in straws that are kept frozen in extremely cold nitrogen tanks. You must be careful when you retrieve the straws to avoid pulling out the ones you aren't using yet and also to limit the time the tank stands open while

you do this. You'll need to use insulated gloves to avoid frostbite. The straws must be carefully thawed, either in a lukewarm water bath or in your shirt pocket, and used soon after thawing. The straw is inserted into an inseminator gun, which is essentially a long metal catheter with a single-use protective sheath.

Now, a cow is a big animal. Wear coveralls and opera-length rubber gloves. Once you have the cow settled in the chute, you'll need to locate her cervix. Don't put your hand in her vagina. You'll put your hand into her rectum and carefully palpate her uterus through her large intestine. After you clean her vulva, you'll insert the AI gun into her vagina without touching it to her labia and then guide it into her cervix with your other hand. She'll have three or four cervical rings you'll have to pass the catheter through without injuring her. The uterine body is quite short, so you'll go just another half-inch and deposit the semen. Slowly press the plunger while slightly withdrawing the catheter. Other methods involve depositing the semen further up the uterine horn and closer to the ovary, but this method should be sufficient for most cows.

If you are doing this for your entire herd, this can take a while. Don't thaw more straws than you can use in about fifteen minutes.

Embryo Transfer

The procedure described above takes for granted that you want to get your cow pregnant with her own egg. But maybe you have a cow who has been a good mother but otherwise is a pretty ordinary cow, and you want a chance to grow an even better cow with different genetics. Or maybe you have an exemplary cow and you want to get even more calves from her than the handful she is likely to bear in her lifetime, if left to her own devices. Well, you're in luck. With embryo transfer technology, you can get your cow pregnant with an embryo created in vivo with another cow's egg and sperm from a high-performance bull, or you can get your cow to superovulate, inseminate her, then retrieve those embryos for use in other cows.

Flushing

If you want embryos from a cow you already own, you'll have to "flush" her. Just as you can use a hormone protocol to synchronize her estrous cycle and induce ovulation, you can induce superovulation so that you can create and then retrieve multiple embryos in her reproductive tract. The hormone regimen for superovulation is more complicated than the protocol for estrous synching. As with estrous synching, several products are commercially available. Carefully follow the instructions for the protocol you select.

Plan to inseminate your cow twice, at twelve hours and again twenty-four hours after administering the final ovulation-triggering hormone. Then, six or seven days later, you will flush her uterus with a flushing medium. This is a tricky procedure, but will become familiar with practice. You'll need some special equipment, including a balloon catheter, some flushing medium, and some embryo filters.

With the cow in a chute, administer a lidocaine epidural. Then, as before, you will insert your non-dominant hand into her rectum to palpate the cervical os and guide the catheter into the uterus. Inflate the cuff on the balloon to block off the flow of the medium back through the cervix. Then, you'll squeeze or allow gravity to push fluid into the uterus. Carefully massage the uterine horns to aid in suspending the embryos in the fluid. Switch the valve on the catheter to allow the fluid to drain back into a catching tank, through a filter that catches the embryos. You will do this 5 times, with 50 to 150 ml of fluid each time. You may retrieve only a few or perhaps two dozen embryos this way.

Once you are satisfied that you have retrieved all embryos, flush the donor cow with prostaglandin (trade name Lutalyse) and then give it twice by injection three days later, to abort any remaining embryos and avoid the possibility of multiple births. You can collect embryos from her again on her next cycle.

Use a microscope to see how well the embryos have developed and to grade and sort them. If you have a cow with a synched estrous cycle (at day 5–8), you can transfer a grade 1, 2, or 3 embryo to her right away. Otherwise, you should sort the highest-grade embryos into straws and freeze them.

If you don't have a donor cow to flush, you can buy cryogenically preserved frozen embryos from a selection of high-performance sires and dams. You'll synchronize your recipient cow's estrous cycle so that you can transfer the frozen embryo at day 5.5 of her cycle.

Put your recipient cow in the chute and prepare her with an epidural. As in all of these procedures, you'll palpate her cervix and uterus transrectally to guide the instruments into her uterus. Thaw the embryo, then palpate her ovaries to discover her corpus luteum and hence, which side ovulated. Place the embryo in the uterine horn as close to that ovary as possible.

Sire Selection

Whether you are preparing your cow for AI or embryo donation, carefully select the sire you will use. Think about important traits you'd like the calf to inherit from the bull. It's unlikely you'll be able to go visit a bull and inspect

him yourself. But you can carefully examine his pedigree and sire summary or EPD (expected progeny differences) chart and think about what he might add to your herd. EPDs take into account the performance data of that bull's sons and daughters and their progeny as well as genomic information that can also help predict traits. The bull should also have been tested to be free of known genetic diseases. Additionally, you may choose to purchase sperm that has been sorted to increase the likelihood of a bull or heifer calf. This is a good option if you would like to breed replacement heifers for your dairy operation.

Pregnancy Testing

Now that you've done the hard part, how do you figure out if your cow is pregnant? Blood tests are costly and impractical. Ultrasounds require special equipment. But now that you are already very familiar with her reproductive tract, you can learn to reliably detect pregnancy using transrectal palpation of her uterus.

A Note on Biosecurity

As you've seen, getting your cow pregnant can involve invasive procedures that put her at the risk of injury, infection, and sexually transmitted disease. Animals, semen, and embryos from other farms can bring disease to yours. At all times, observe best practices to screen bulls for disease and use semen and embryos only from reputable studs that adhere to the Certified Semen Services (CSS) standards established by the National Association of Animal Breeders. Use sterile instruments and supplies whenever required and handle your cow carefully to keep her stress- and injury-free.

The Bottom Line

You may be tempted to breed your cow the old-fashioned way and avoid all the hassle. It may seem more complicated, but it's not hard to reap the advantages of assisted reproductive technologies. You can prevent disease transmission, keep your cow healthy, get more calves from your best cows, and use a better bull without paying to feed him. This is the perfect opportunity to evaluate your breeding program, choose traits you'd like to see in the calf and in your herd, and plan for the future. Assisted reproductive technologies are in wide use, and the supplies and support you need to use them will be easy to find. There's never been a better time to get your cow pregnant.

Suggested Readings

On human sexual and gender identity and do-it-yourself fertility, see:

Stephanie Brill. 2006. *The New Essential Guide to Lesbian Conception, Pregnancy, and Birth*. New York: Alyson Books.

On the high stakes of using assisted reproductive technologies, see:

Charis Thompson. 2005. *Making Parents: The Ontological Choreography of Reproductive Technologies*. Cambridge: MIT Press.

On reproductive sciences and human-animal relations, see:

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On the history and use of assisted reproductive technologies, especially in cattle, see:

Robert H. Foote. 2002. "The History of Artificial Insemination: Selected Notes and Notables." *Journal of Animal Science* 80: 1–10.

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