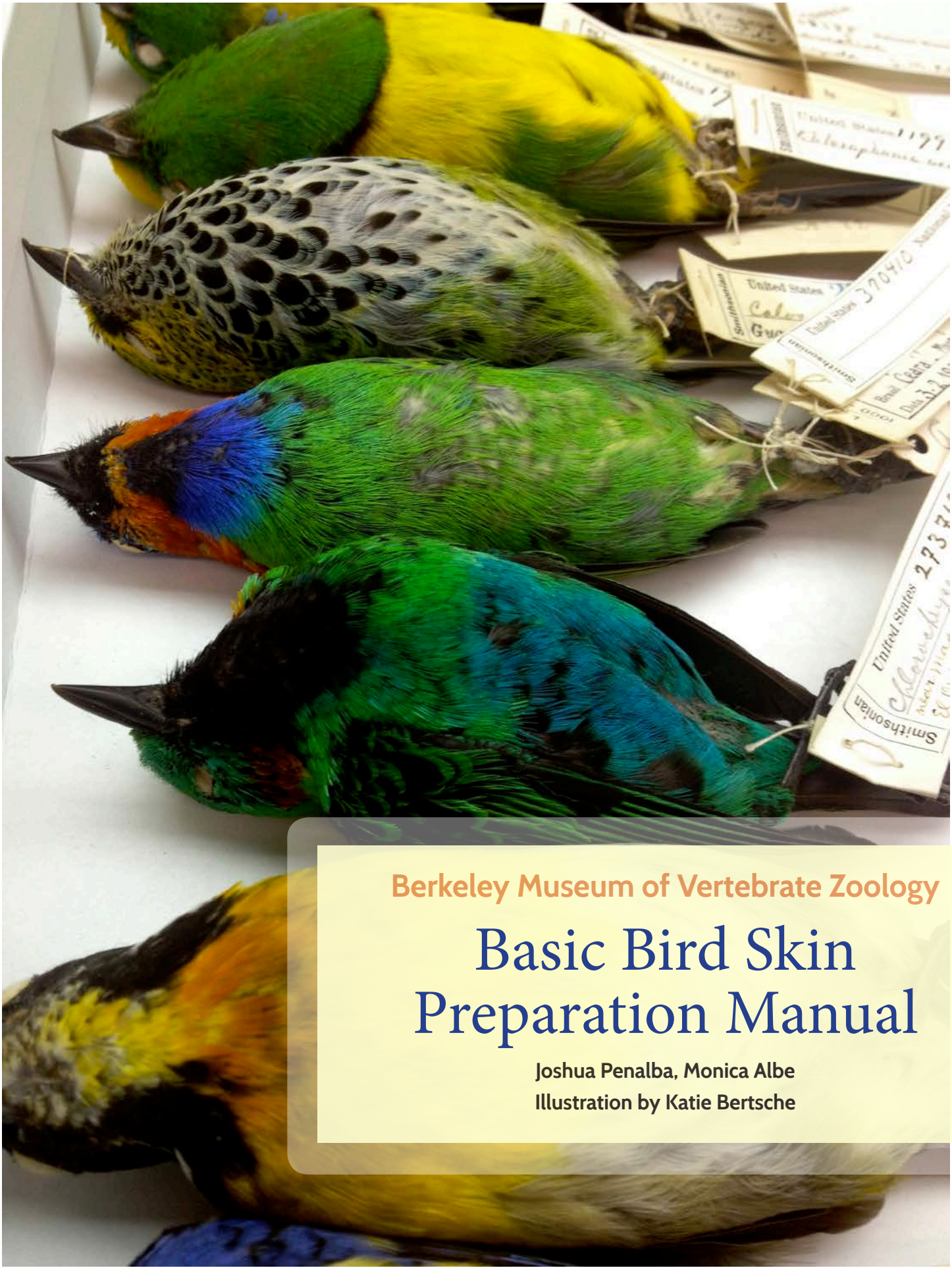
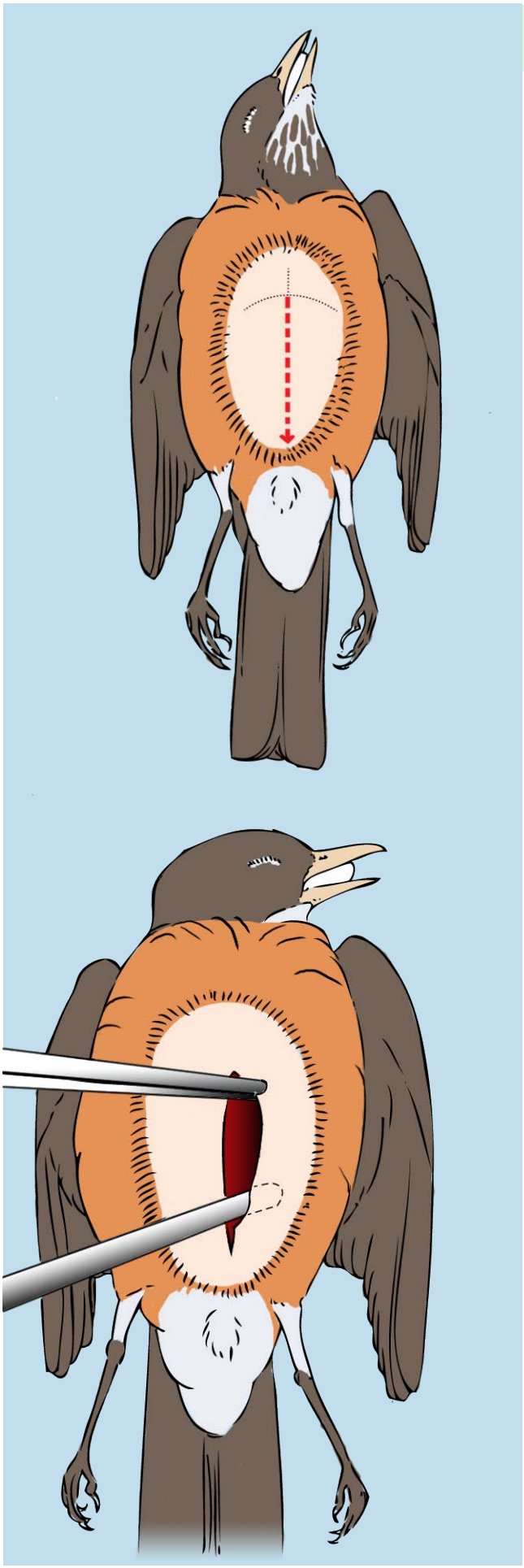


Berkeley Museum of Vertebrate Zoology

Basic Bird Skin Preparation Manual

Joshua Penalba, Monica Albe
Illustration by Katie Bertsche

Removing the Skin



Tools

- Forceps
- Bone Cutters
- Scissors (small and medium)
- Probe
- Sawdust
- Cotton
- Dowel
- Water, in small cup or dish

1. Look up the species of your bird in a field guide and reserve your catalog number by entering the locality information, date of collection, and scientific name of your species. Also determine the family of your bird.

2. Take appropriate measurements: weight and molt, and check for ectoparasites.

3. Place a small piece of cotton in the bird's bill. This will prevent any blood or body fluids leaking from the bird's bill as you skin the bird out.

4. Exercise the bird. Increasing the bird's flexibility by moving the legs and wings will make skinning the bird much easier.

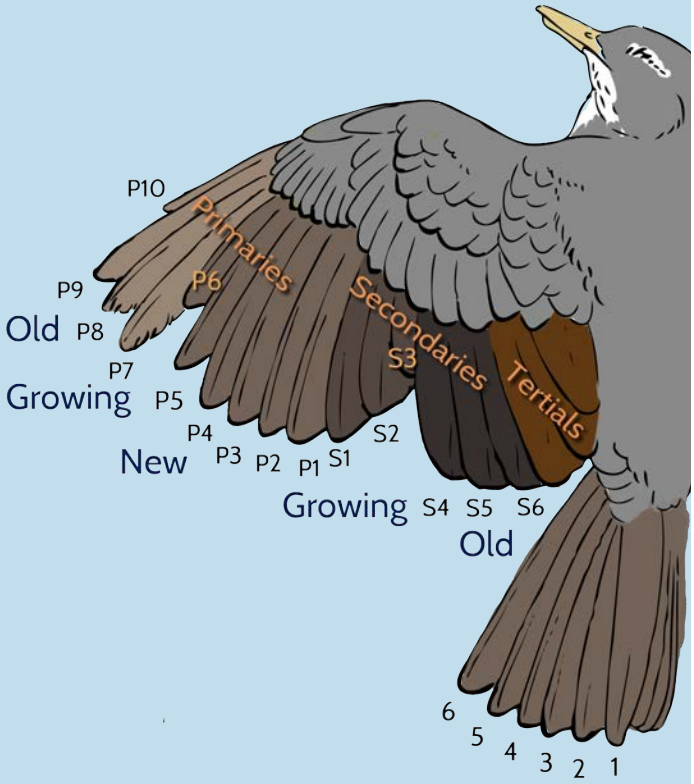
5. For passerine songbirds, identify the degree of feather molt (see inset)

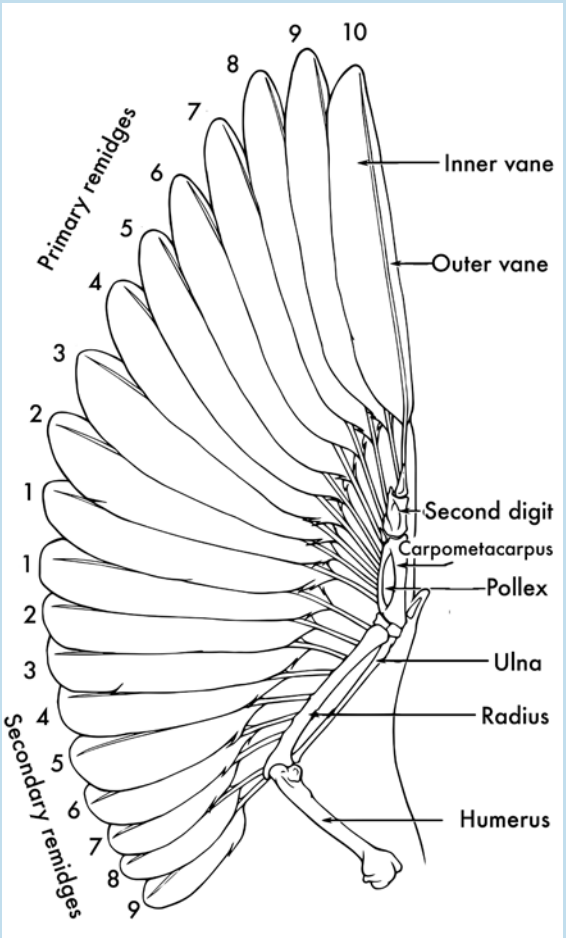
6. Separate the breast feathers covering the keel; there is a tract of skin devoid of feathers on the belly where you will make your first incision.

7. Using small sharp scissors, start from the top of the bird's keel and puncture the skin. Maneuver your scissors under the skin and continue the cut to just anterior to the cloaca. Be careful not to puncture the body cavity.

8. Lift the skin on one side of the incision with a pair of forceps and clear the connective tissue using a probe or another pair of forceps. Try not to stretch the skin too much and keep it as moist as possible.

9. Start adding sawdust on the exposed muscle to prevent feathers from getting dirty. Do this every time you expose more muscle or other parts of the bird's body.





Wing illustration: C. Lily, 2007

Recognizing molt

Bird feathers become worn and damaged over time, and must be regrown and replaced in a process called molt. Feathers that are accidently lost are immediately replaced, but all feathers are regularly replaced. The process of molt varies by species, and can be used to help determine a bird's age and breeding condition. The replacement of all feathers is called a complete molt; the replacement of some of the feathers is called a partial molt. Different bird families may have one molt a year, or may undergo both partial and complete molts during the course of a year, or may take several years to replace all of their feathers. Molting patterns can be observed in wing and tail feathers, as well as body feathers.

The long wing feathers attached to bone are known as flight feathers, and are divided into primary and scondary feathers. The primaries are the outermost feathers attached to the "hand" bones of the bird; the carpometacarpus and the digits. The secondaries are more widely spaced and are attached to the ulna. The connections of the feather shafts to the bones can be observed by lifting the underwing covert feathers to examine the base of the feathers. Primaries and secondary feathers are numbered beginning at the junction of the wrist joint and increase outward (see diagram). Retrices are the long tail feathers and are numbered outward in pairs starting at the center of the tail (see diagram).

Flight Feathers

Molting flight feathers are usually missing symmetrically on both wings and both sides of the tail. Spread the wing and tail, look for gaps or obviously shorter or newer feathers. Examine the base of the feathers; there may be a visible hole in the skin where the feather once was. The shafts of growing feathers may have a darkened shaft and a sheath through which the feather emerges that provides a blood supply to the growing feathers.

Body Molt

Body Molt is usually determined after birds have been skinned. Feathers of many birds are not uniformly distributed all over the body, but lie in distinct tracts on the skin with bare areas in between. Waterfowl have feathers all over their skin. The easiest way to see body molt while skinning a bird is from the inside of the skin. When the bird skin is opened, examine the base of the feather tracts for dark dots. This indicates that blood is still supplying these feathers with nutrients and they are growing in. You can verify this by looking on the outside and you will either see pins feathers with sheaths around them or short feathers with broken sheaths around their bases.

Recording Molt

Wing and Tail:	**Note which flight and tail feathers display molt.**
Body:	
None	No molt is visible
Slight	A few areas on the bird where you see body molt
Moderate	A moderate amount of body molt on the bird (in several areas on the bird's body)
Heavy	Body molt all over the feather tracts.

9. Clear towards one of the knees. When you see the knee, push it out while pushing the skin down to the ankle.

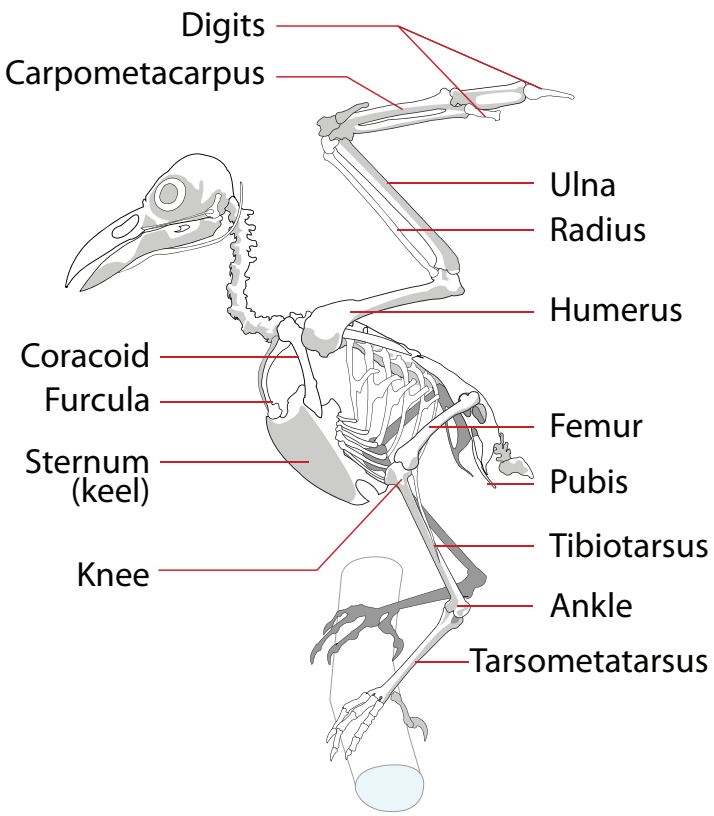
10. Cut the knee using the larger pair of scissors, or bone cutters for larger birds, to separate the femur (upper leg) from the fibula and tibiotarsus (lower leg).

11. Pull the detached lower leg out while clearing the skin toward the bird's ankle. Remove all the muscle from the lower leg by cutting the tendons near the ankle, and push the bone back into the skin. Be careful to keep the tibiotarsus intact. Repeat on the other leg.

12. When the legs are cut and clean, clear the tissue towards the tail until you reach the pubis bones, there will be one on the left and right sides. You will be attempting to detach the tail.

13. Using forceps and a probe, clear the skin from the muscle on the birds sides from the base of the femur to the pubis bones.

14. Clear the skin under the tail, you won't be able to see what is going on so be careful. If this step starts seeming really "easy" and you can see what you're doing – STOP. You have probably ripped the skin. Examine the situation before moving on.



15. Cut through the soft tissue just posterior to the pubis bones, this will disconnect the rectum from the cloaca. Be careful not to cut too high which can the intestines to spill out of the body cavity.

16. Cut the vertebra that connects the tail to the body, being careful not to puncture the skin on the back. Do not make this cut too close to the tail which may cause the tail feathers to fall off. (especially difficult in hummingbirds!)

17. When the tail and both legs are detached from the skin, carefully push the skin off the body towards the wings. Use plenty of sawdust every time you expose more of the bird's body. Make sure you are not holding the bird by its abdomen as you clear the skin away – this can lead to squeezing all of the guts and making it hard to indentify the sex later.

18. Continue clearing until you reach the wings and furcula.

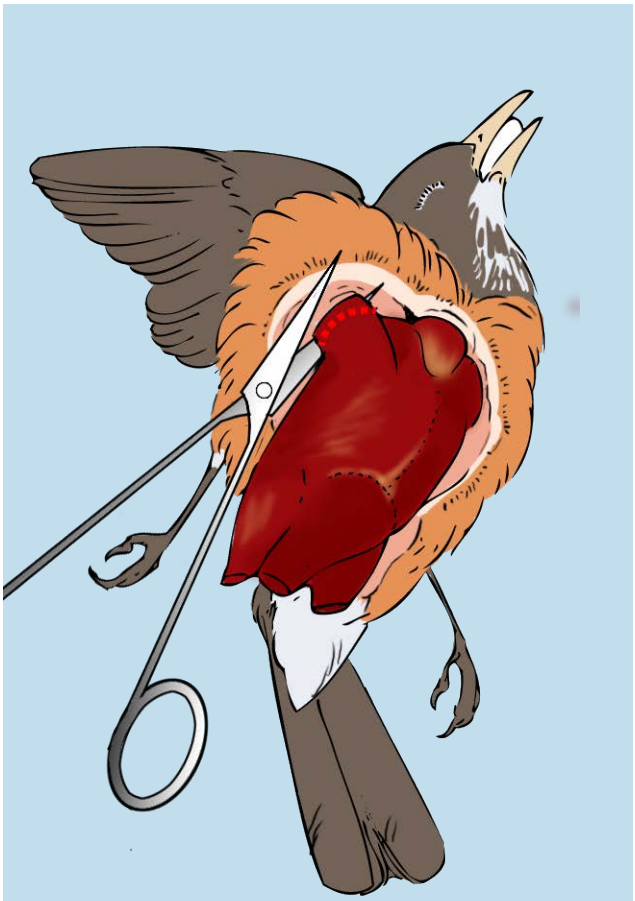
19. Take note of any body molt and how prevalent it is on the skin. Note down the fat content in the furcula or anywhere else in the body.

Body fat in birds

Taking the weight of a specimen is important to research in many fields of ornithology. But besides the weight it is very essential to record the fat deposits in a bird. Unfortunately ornithologists still do not concur on a standard way to assign fat deposits. Several methods were proposed, ranging from numerically defining 6 classes (e.g. Nolan and Ketterson, 1983) to 31 classes (e.g. Kaiser, 1992) to just verbally describing fat deposits. All of these methods are suffering from great variations among observers, although practice helps prevent this. Another problem is that these classes cannot be used without the proper reference to the method used. But still, if observers were perfect in estimating in which category the bird falls, you will not have the correct fat store, since there are only a couple of places were you will generally look for fat deposits.

The body parts commonly investigated are around the furcula and the abdominal region. If there is no visible fat there, it does not mean that the bird completely lacks fat. Rogers (1991) shows that birds in class 0 (=no visible fat) can still have up to 0.2 g lipid per gram lean dry mass. Rogers (1991) moreover emphasizes the changes of morphology in body fat after dead. It would therefore be better to process birds directly after they die.
But, for the time being, it is best to assess fat deposits in our specimens as follows:

Thin	No fat visible and muscles depressed
None	Healthy looking individual, but no visible fat
Slight	A little fat around the furcula
Moderate	A little fat around the furcula and a some fat in abdomen, or a lot of fat in the furcula area, no fat elsewhere
Heavy	A lot of fat in the furcula area, and elsewhere



20. Clear the skin until you find the opening between the bird's neck and shoulder.

21. Using larger scissors or bone cutters, cut the humerus as close to the body as possible.

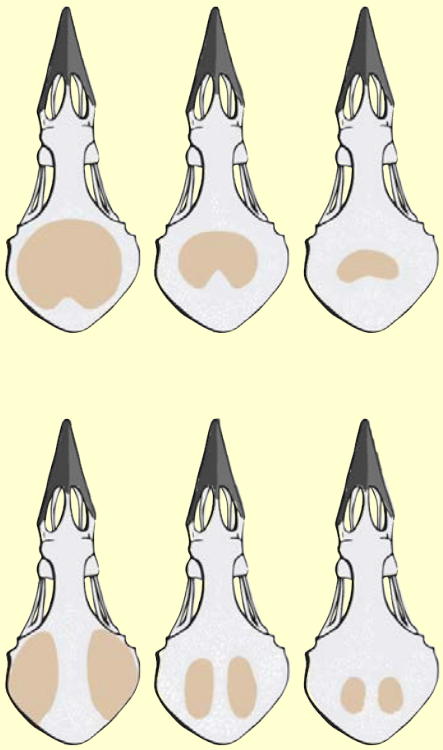
22. Continue clearing the skin through the neck and onto the head. Be very gentle while working along the neck toward the head. The skin here is easily torn. For ducks in particular and all birds with long slender necks and big heads you will need to make a slit in the back of the head to reach the skull.

Skull Pneumatization "Skull Windows" (Passerines only)

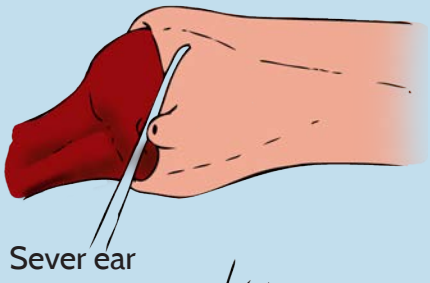
When a young bird first leaves the nest, their skull has only one layer of bone. As the young bird matures, a second layer of bone forms underneath the first layer spearated by small spaces and thin columns of bone. This process is known as skull pneumatization. The presence of unpneumatized "windows" in the skull of a bird can help age the bird as a hatching year bird.

Unpneumatized windows in the skull may appear as pinkish or dull red, while pneumatized areas appear white, grey, or possibly with white dots of the bone columns between layers.

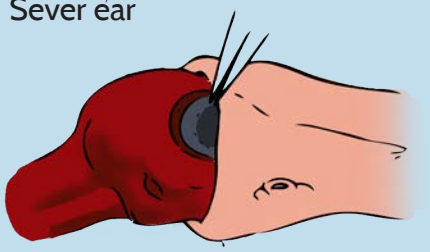
Skull windows are easiest to see once the brains are removed. Rinse the skull under cold water and observe the top of the skull under bright light. Skull windows will appear as clear areas.



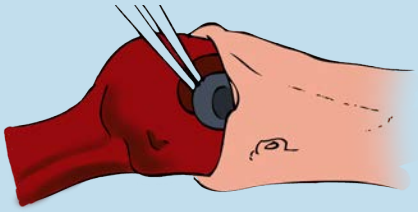
Patterns of Skull pneumatization based on Pyle and others (1987).



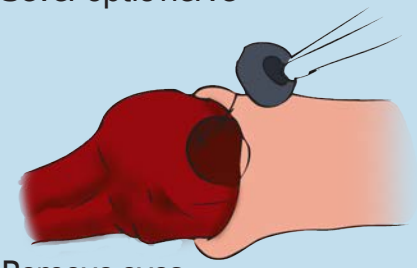
Sever ear



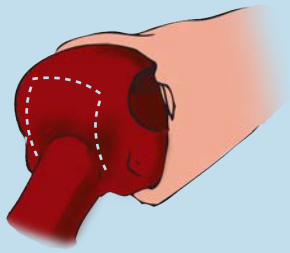
Cut membrane



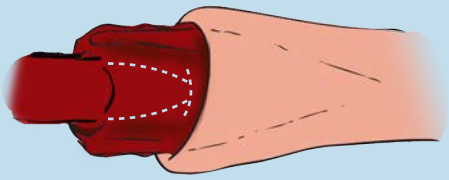
Sever optic nerve



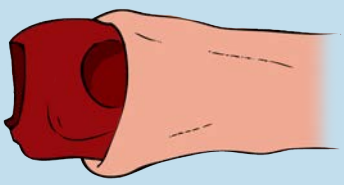
Remove eyes



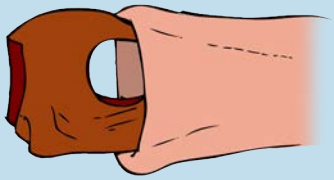
Cuts in skull



Cuts below jaw



Skull removed from body



Fully cleaned out skull

23. When you get to the ears, cut the tubes as close to the skull as possible or gently pinch it out of the skull.

24. Continue clearing until you reach the eye, cut the membrane separating the eyelid from the eye. This will require several cuts. Use caution and avoid tearing the eyelid.

25. Carefully remove the eyeballs by going under and separating the membrane. Repeat on the other side of the head. Note the size and shape of the eyeball for reference in making cotton eyes later.

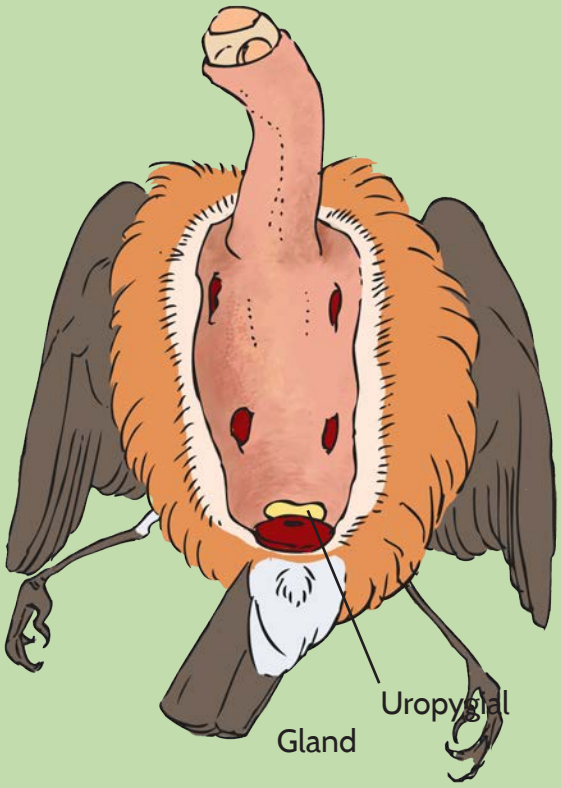
26. To disconnect the skull from the neck, make two vertical cuts from either side of the base of the neck towards the top of the skull

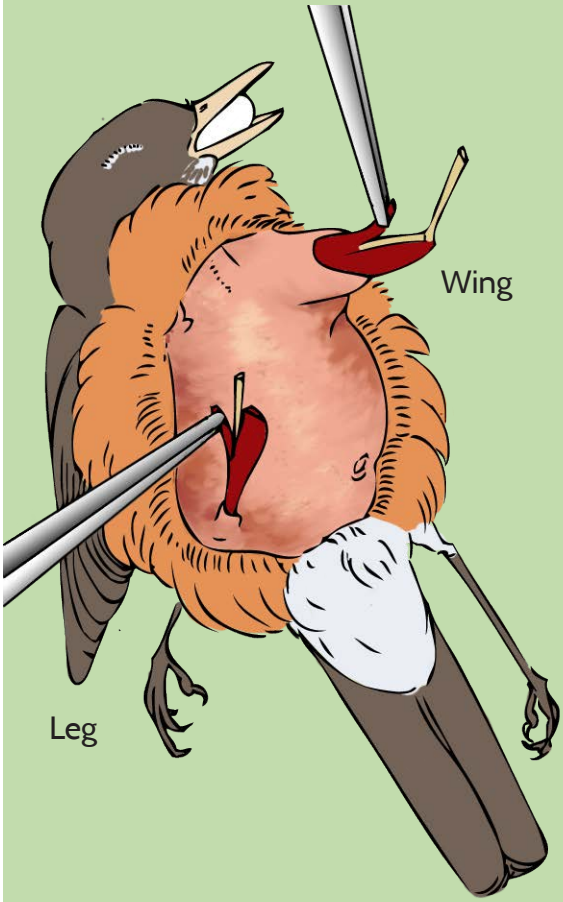
27. Connect the top of these cuts with a horizontal cut.

28. Make three cuts on the underside of the jaw, one vertically up through the palate into the skull cavity and two on either side inside the mandible. Do not disturb the joint of the jaw. Disconnect the neck and body from the skull and skin. Be sure to note the size and shape of the body for later reference in stuffing the skin.

29. Clear the brain, bones between the orbits and most of the muscle. Leave the cranium and the mandible intact to provide structure to the head.

Cleaning the Skin





After completely removing the skin, clean as much muscle, fat and tissue from the remaining bones as possible.

Tail

Carefully invert the base of the tail, clearing the skin if necessary, revealing two yellow glands on top of the tail called the uropygial glands. These glands will be filled with an oily substance and will need to be removed. Also remove any excess muscle on the base of the tail without disturbing the tail feathers.

Wings

Pull the skin to the base of the humerus, cut the tendons and remove the muscle. If the large end of the humerus is still attached, cut it off. Clear the skin along the radial side of the arm, towards the radius and ulna, remove all the muscle in this area. Avoid pulling out the feathers attached to the ulna.

If you have a large muscular bird, You will have to make an incision in the skin on the underside of the wing.

Legs

For larger birds (larger than a red-tailed hawk for example), the marrow needs to be removed from the tibiotarsus by carefully inserting a syringe in the bone at the ankle and injecting water to push out the marrow. Marrow can also be removed by inserting a skewer or toothpick into the bone.

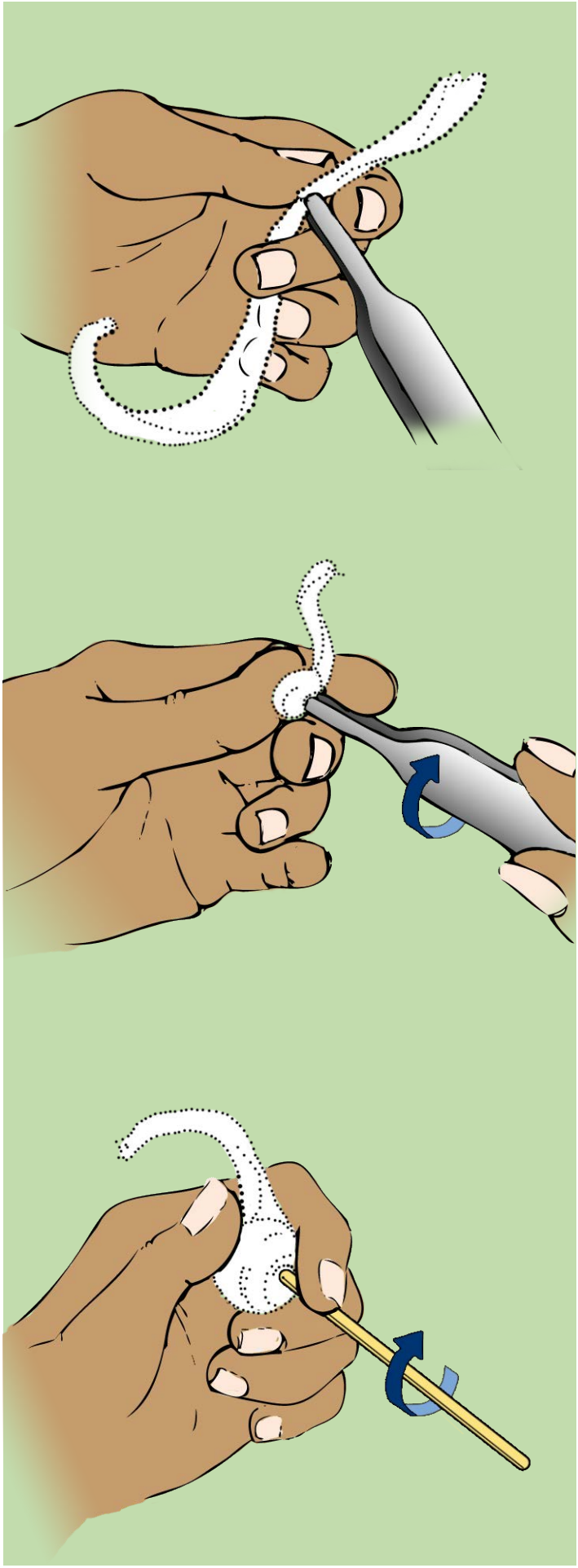
Skin

Carefully remove any fat or muscle still attached to the skin without making tears. For heavy, fat birds, use a lot of sawdust and use a smooth scraping tool like a spoon to gently scrape the skin surface to remove the fat. Avoid plucking too much fat along the delicate skin of the feather tracks and around the base of the tail to prevent feather loss and holes in the skin.

Feathers

If the feathers are dirty, carefully wash them with cold water. Dry them first using sawdust to soak the up the water and then blow-dry.

Tip! Make sure to keep the exposed neck and body skin hydrated with some water so that it stays flexible! If the skin dries out, it will become difficult to revert the skin over the head without tearing it. If you need to store the skin before stuffing it later, make sure that it is well hydrated before putting it away.



Eyes & Brain

The first step in stuffing the bird is creating cotton eyeballs and a cotton "brain" to fill out the head and anchor the "spine" of the final study skin.

Eyes

Refer to your notes on the size and shap of the original eyes. Recreate the eyeballs using a long strip of cotton and Adson forceps. The teeth on the Adson forceps help grip the cotton as you spin and pack the cotton. Grab the cotton with forceps and push against the thumb of your non-dominant hand, apply pressure from the sides using your pointer and middle finger, carefully rotate the forceps making sure it stays shut. Make sure to pack the eyeball tight, and roll til the cotton eye is the same size as the original eyeball.

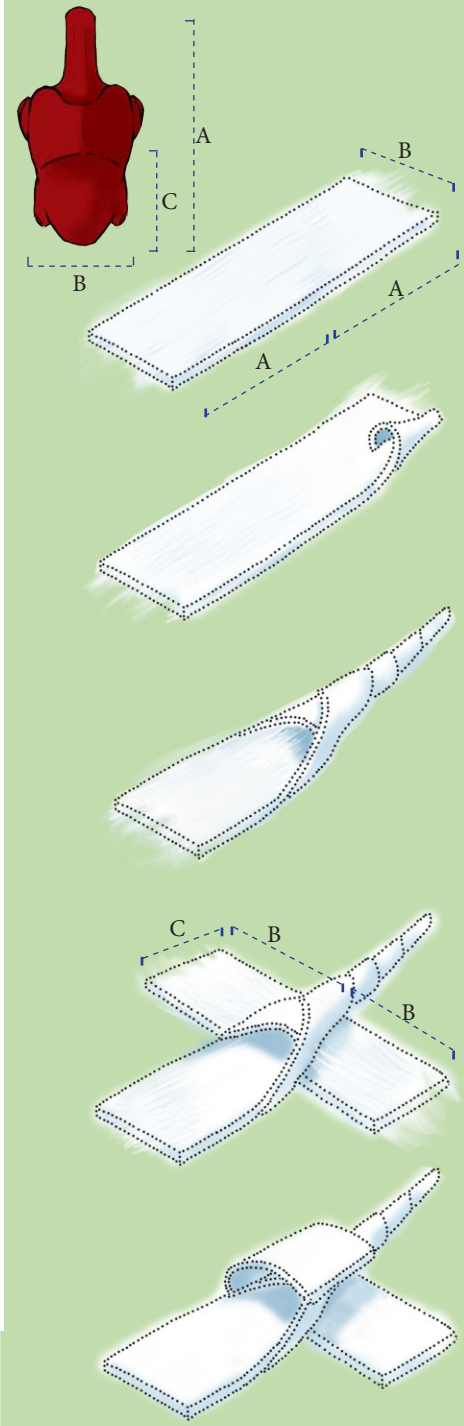
When ready to remove the forceps, loosen the grip and slightly rotate in the opposite direction. Pull the forceps lightly out making sure not to pull the middle of your cotton eyeball out with it. The eye will have a slightly flatter side which will be placed toward the inside of the head with the rounded si de filling out the skin.

Brain

Use a dowel with a length similar to the size of the bird's body, this will serve as its spine. Break or notch the tip of the dowel to create a grip for cotton to wrap around. You can also moisten the tip of the dowel for a better grip.

Make a cotton brain with the same method as the eyes except using the dowel instead of the forceps. The brain should be large enough to be secure in the skull but small enough to fit entirely inside the braincase. You should have to stretch the lower jaw joints outward to place the new "brain" and they should hold it securely in place.

Shaping the Body



The cotton body which will fill the skin should be about the same size as the original body. (refer to your notes on the original body size.)

1. Take a piece of cotton that is little longer than the twice the body and the neck (A) and a little wider than the body (B). Make sure this piece is thin and the cotton fibres run lengthwise.

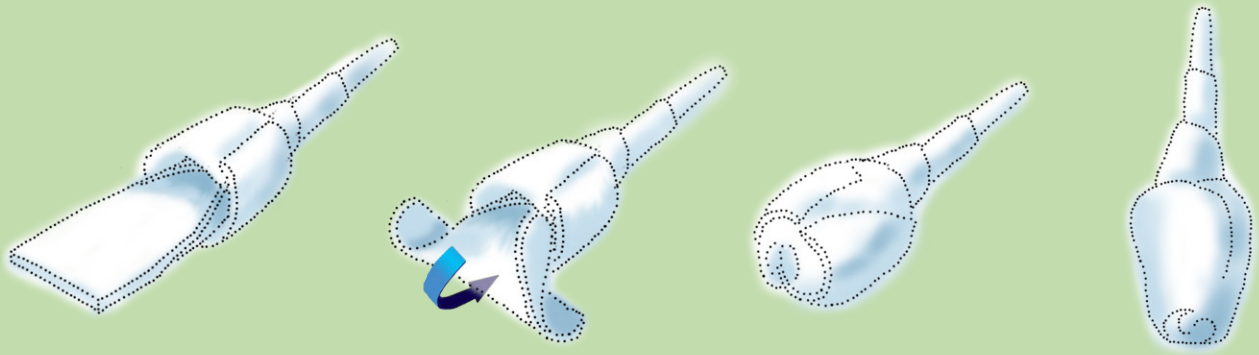
2. Roll one end of this piece of cotton tightly to form the neck; making sure the other end stays open. Open up the body side further if necessary. Roll the necck tightly to ensure that it won't break when tugged and make sure it is not thicker than the real neck.

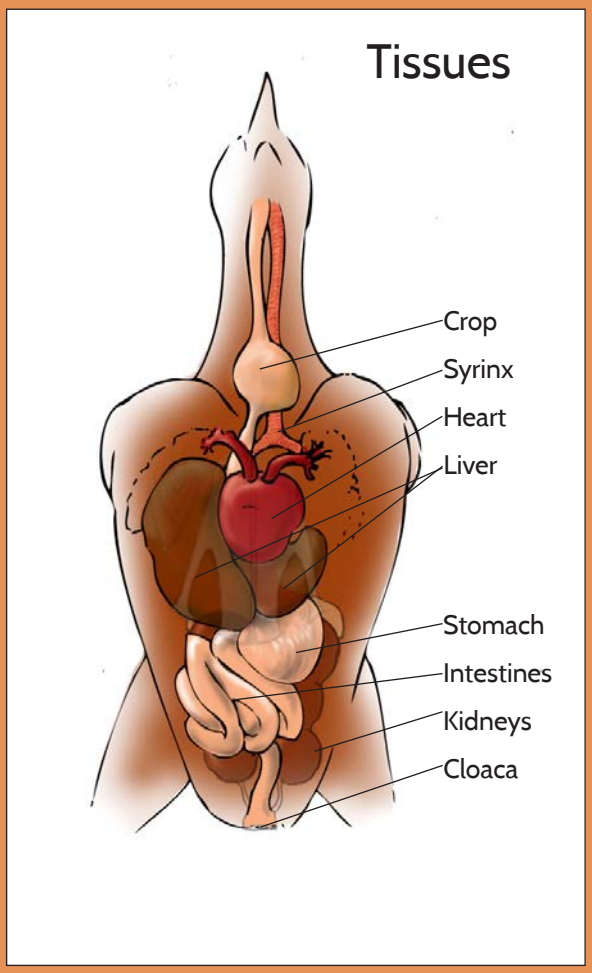
3. Take a second piece of cotton, as wide as half the body (C) and twice as long as the width of the first piece. Lay this second piece horizontally under the first piece, where the rolled cotton changes into the opened cotton.

4. Fold both ends of the horizontal piece around the front of the body.

5. Fold the opened part of the first piece underneath the body and wrap the corners back to the front over the second piece of cotton.

6. Shape the cotton so the body resembles the original; the upper part where the keel would be is broader and higher than the bottom part. The cotton body should have a flat back, and the neck should be at least twice the length of the real neck.





Tissues

When the body is separated from the skin, determine the bird's sex and take tissue samples.

1. Cut through the chest cavity to reveal the internal organs.

2. Look for the birds gonads and take appropriate measurements. (see below)

3. Take tissue samples (heart, kidney, muscle, liver) and place in a cryo vial and store in the freezer.

4. Carefully extract the syrinx and store in ethanol. The syrinx is the bird's vocal chords, and is a Y shaped branching at the base of the bird's trachea.

5. Check the stomach contents and for endo parasites.

6. When finished, dispose of the body.

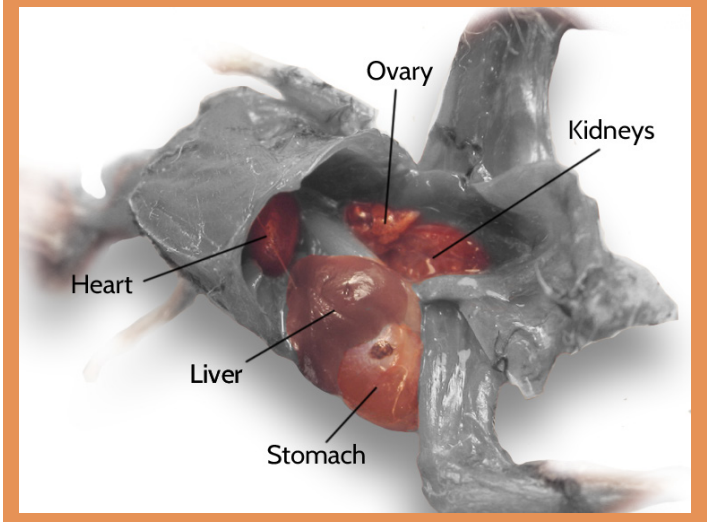
Determining Sex - Joanna Wu

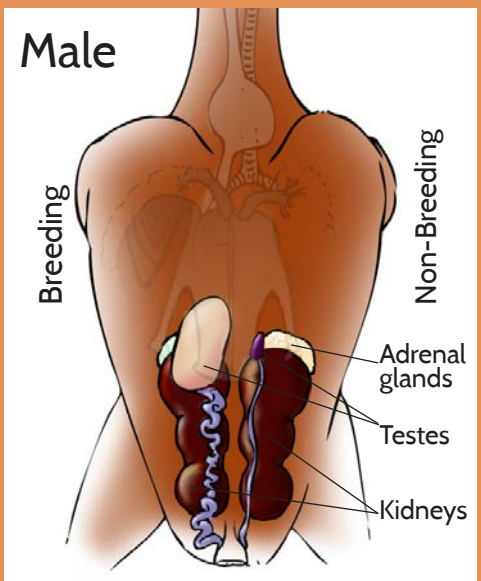
When you have your bird's abdominal (stomach) cavity open, without cutting anything out, gently lift up the digestive system (mostly intestines and liver) with blunt forceps. You will push through some mesentery to get to the back. It is easiest to lift/push the digestive system to the side of the animal. This exposes the back of the abdominal cavity.

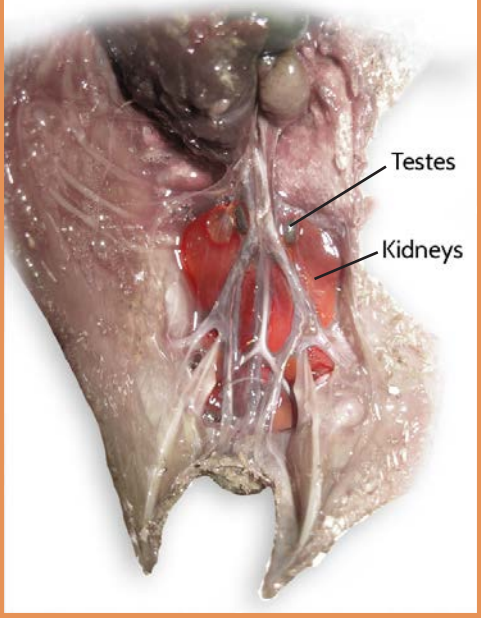
NOTE: DO NOT remove organs before sexing the animal! It can lead to destroying the gonads –sometimes membranes connect the gonads to the liver/stomach area and often a well intentioned prepper has completely removed all trace of gonads or butchered them while attempting to make things clearer for themselves.

2. With the intestines out of the way, look for the dark red kidneys, clear connective tissue, tubule structures, and the gonads. The gonads lie toward the middle of the bird, ventral to the kidneys.

3. Note the characters of the gonads and take measurements. It's always a good idea to look at your bird's gonads under the microscope with light to familiarize yourself with texture, shape, and detail.







Males

Male birds have two testes which are usually of equal size, shape, and color. In some cases they can be significantly different in appearance, including having one black testis and one white testis. The color of the testes depends on the condition of the bird and the time of the year – they can range from being white to black. In the spring and summer the testes are usually white or yellow, and in the winter the testes can be grey or black.

One distinguishing feature is that the testes will always be smooth with no bumps, and of uniform texture when examined under a microscope.

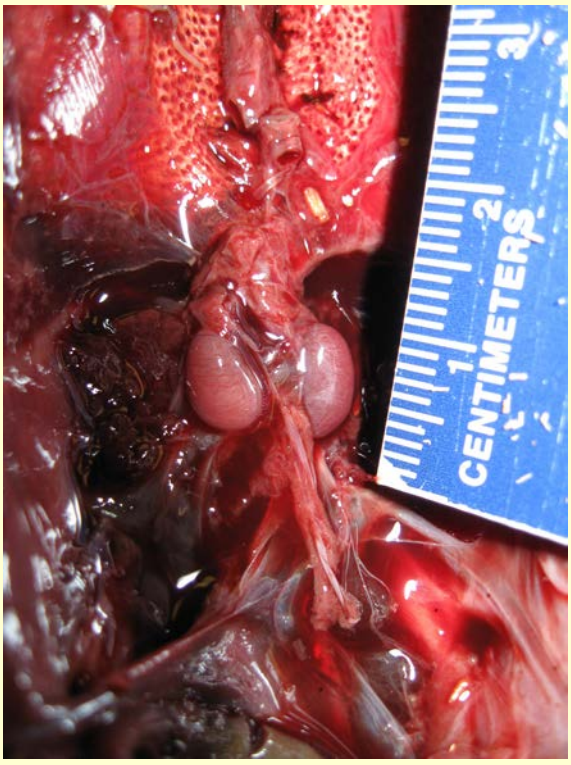
Testes can vary in size, depending on whether it is breeding season or not; they can be small 1 x 1 mm spots or can take up most of the abdominal cavity. In general, look for two smooth, round or oval-shaped structures. In some aquatic birds, the testes are much longer than they are wide – but their position laying ventral (on top) of the kidneys will be the same.

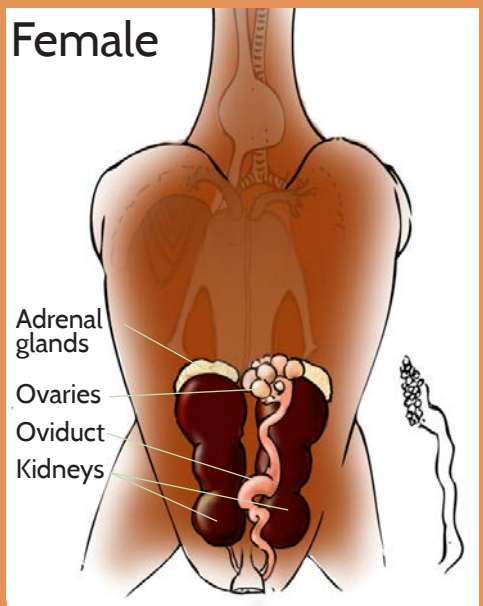
Do not remove the testes to measure them – take the measurements inside the bird.

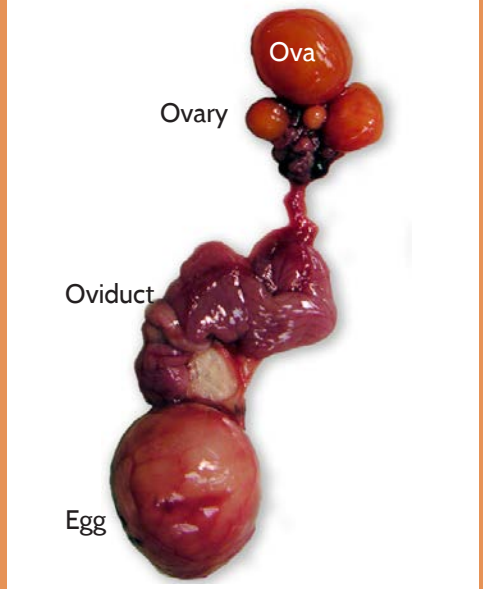
During breeding season, some males may store sperm in their cloaca, which resembles a conglomeration of thick, white tubules. Their testes will be light in color ranging from pink to white. Breeding season typically happens in January, February, and March. During the summer months, the testes may still be swollen and light colored.

If the testes are dark, then it is an indication that either the bird has never bred or is not preparing for breeding season.

In juvenile males, the testes may be ecxceptionally small and difficult to find, and can be confused with adrenal glands.







Females

In female birds, typically only the left ovary and oviduct mature and develop as an evolutionary adaptation to reduce weight. In hawks it is the right ovary that becomes mature, and in rare cases, there may even be two mature ovaries. For the average bird, if it is a female, you'll see just one object on the left of the bird, ventral to the kidneys, and it will be granular in texture and more triangular in shape.

Each individual egg follicle is called an ovum, and a clump of ova (resembling a clump of grapes) makes up the ovary. In females, the ova are described as undeveloped, minute, granular, or developing.

If the ova are "undifferentiated," the ovary will be a flat, cloudy sheet lying above the left kidney, and the ova may not be visible, even under a microscope – it's best to get assistance from an expert in these cases.
If the ova are "minute," you can see them under a microscope, but the ovum will measure less than 1mm in diameter.

If the ova are "differentiated," the ova will be uniform in size and each ovum will be around 1mm in diameter.

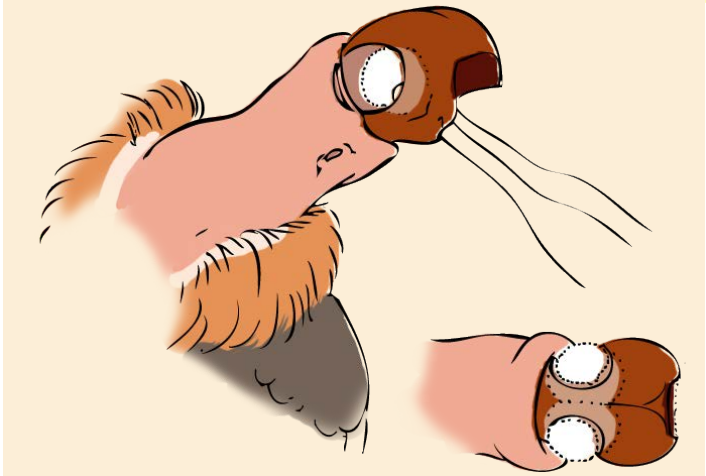
When ova are developing into eggs, you will see typically 3-4 ova that are much larger than the other, smaller ova. Measure the largest and second largest ovum you see.

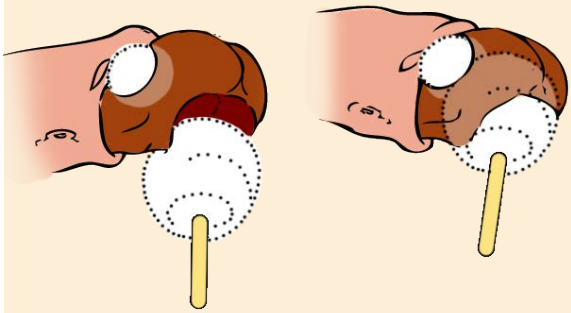
During the breeding season, you may find an enlarged oviduct in the abdominal cavity. This will look almost like a second set of intestines, but you will find that it is completely separate from them, only connecting together at the cloaca. Most of the year, the oviduct will be so reduced in size that you will not be able to see it. Consider yourself lucky if you find an egg in the oviduct that is ready to be laid -- it is a dead giveaway of a female bird!

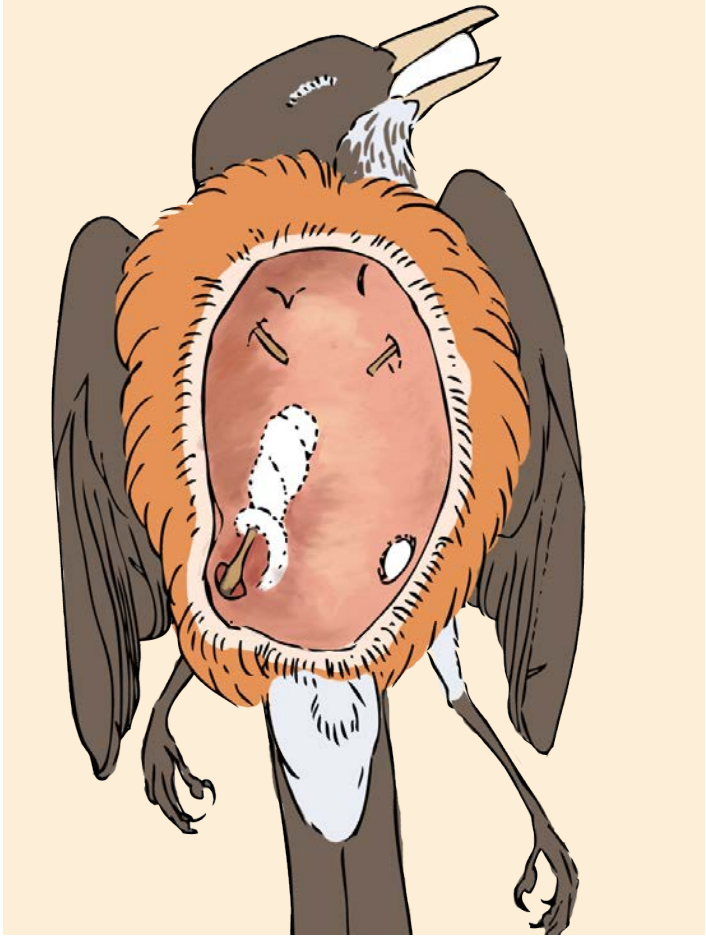
It can be hard to sex a female if she is a juvenile whose ovary has not become granular yet. Make sure to use lighting and/or a microscope and look for a gray-clear floppy patch at the junction of the intestines with the kidneys, the precursor to a mature ovary. Also, you can tell male juveniles apart from female juveniles because male juveniles tend to have testes, however small they may be. If you can't see testes, it could be a female, but you shouldn't assume this and should seek expert advice. And once again – make sure you're not mistaking the adrenal glands for testes!

Note: In certain families of birds (for example: Accipitridae hawks), the females have two ovaries.

Stuffing the Skin







Eyes

There are several possible methods for placing the cotton eyes.

1. While the skin is still inside out, place the eyes into the orbits from the opening in the back of the skull. The eyes should fill the socket and sit securely in the skull.

2. If the skin has been reverted to right-side out, create a pathway through the neck using the probe to the eye sockets and place the eyeballs through the back of the skull using the forceps.

3. Alternatively, if the skin has been reverted, the eyes can be placed through the bill if the opening of the mouth is large enough.

Brain

4. Insert the brain into the skull, making sure the bill is at a 45° angle (this will ensure that the tip of the bill does not hit the cases when the bird is installed into the collection). The dowel should lie straight down the back of the bird.

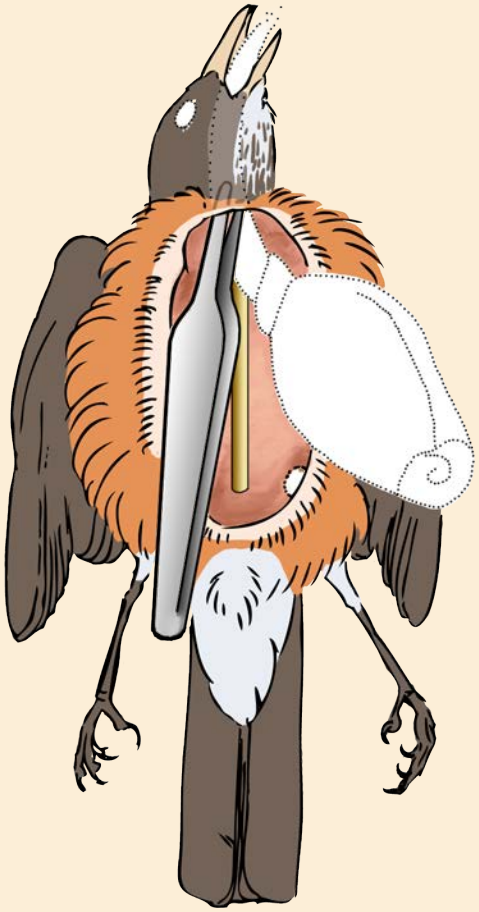
5. When the skin is reverted, Trim the dowel to an appropriate size based on neck and body length. Adjust the eyeballs through the bird's bill.

Legs

6. Wrap the tarsometatarsus bones with a small strip of cotton, recreating the muscles that were previously on the legs. Gently pull the legs back into the skin

Setting Skull Feathers

7. Before placing the body into the bird, run a probe between the skin and skull. Make sure that the head feathers are not bunched due to folds in the skin. Ensure that the ear holes are situated correctly.



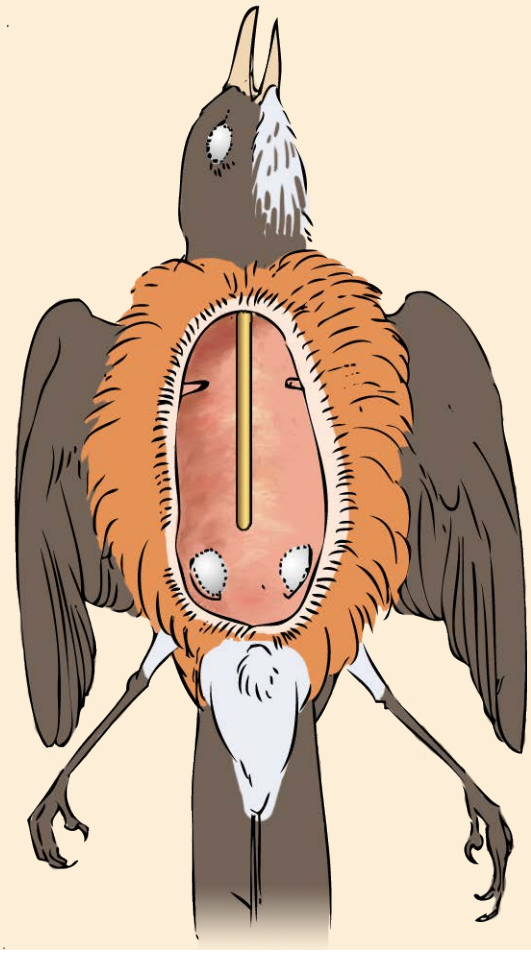
Body

1. Using a probe or forceps, clear a pathway through the neck from the incision on the body to the bird's mouth. Using forceps, slip the twisted cotton through the bird's bill until you can pull it out.

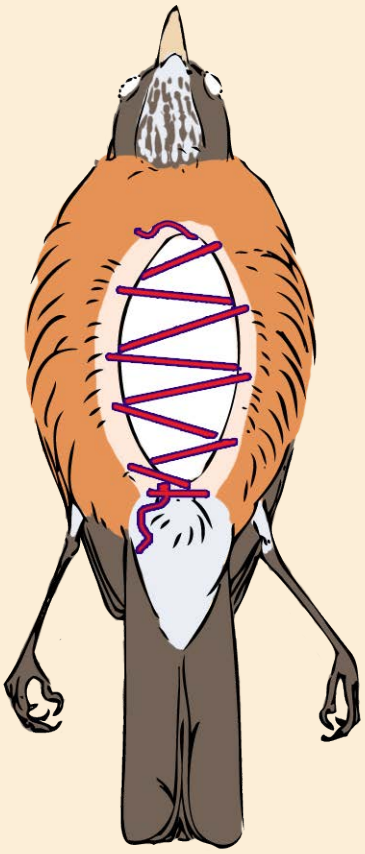
2. Pull the cotton neck out enough so the body sits in the correct place. Work the skin around the breast. Make sure the stick is still on the median line of the body. Double-check that the skin is not twisted anywhere and that the feathers on your bird are lying properly. Adjust with a probe if necessary.

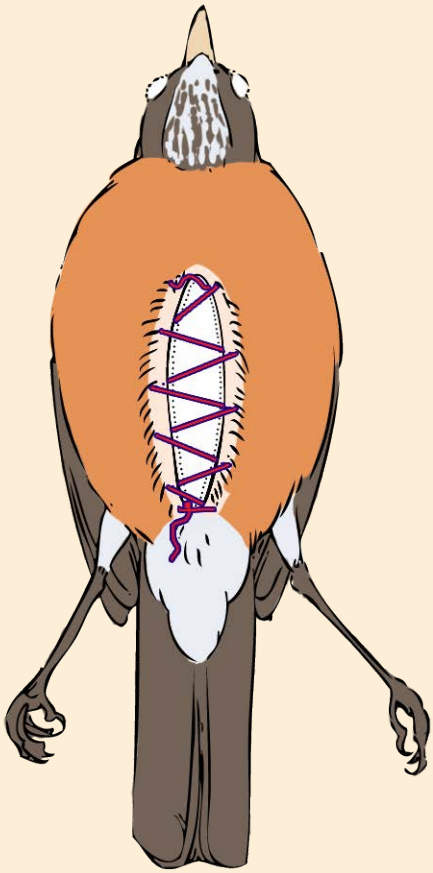
3. Grab the elbows of the wing through the skin and be sure the humeri are still in the neck parallel to the the stick. This will place the wings correctly. If the wings are in the right place, their tips will symmetrically meet in the center of the back. They should not overlap. Some preparers tie the humeri together. However, be careful with this method, as it sometimes twists the wings and prevents them from lying properly.

4. Add or remove cotton to fill the body appropriately.



Sewing the Skin





Before proceeding:

- Ensure that the wings lie flat on the back and only come up about halfway on the sides of the body.
- Check that the top half of the tibiotarsus is in the body cavity and nestled securely in the cotton body.
- Check one last time that the feathers and skin are properly in place so that there are no strange folds or twists that cause feathers to pop out in odd places.
- Make sure the head is securely attached and not at risk of coming off the dowel.
- Moisten the inside of the skin to make it easier to work with.

1. When everything is in place start sewing the body shut by starting from the top of the original incision (the anterior most part of the original cut)

2. Insert the needle from the inside of the skin at the top of the incision and, in most birds, make 5-6 evenly spaced stitches. Stitches should be about 1cm apart. Have at least one stitch going through the cloaca to secure the bottom.

3. Tighten the stitches as much as you can. A small space is fine and can be covered by feathers. Tie off the end of the thread.

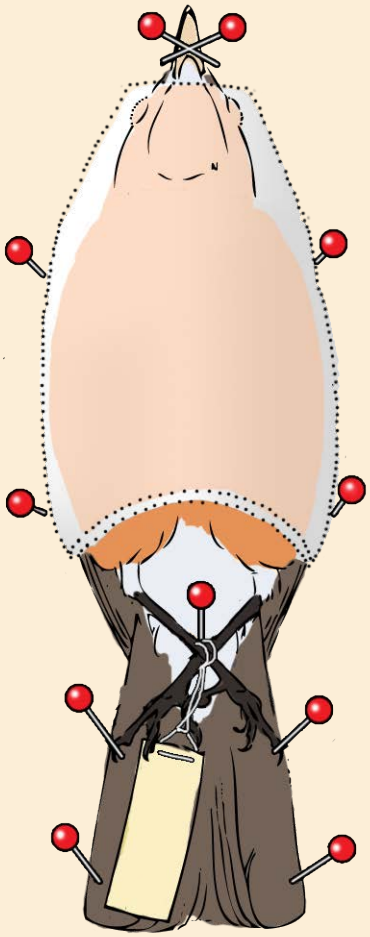
4. Check that the eyes are properly placed for a final time by moving them with forceps through the bird's mouth.

5. Cut off the cotton in the bird's mouth and push the rest into the neck. Smooth the head feathers. Make sure your bird is satisfactory, there are no do-overs after this!

6. Super-glue the bill shut and hold it closed for a few seconds to secure.

7. Cross the legs and attach a study skin tag that has been filled out. Double check the wing placement one more time. Using forceps, preen the bird's feathers until everything seems to be placed properly.

Final Pinning



1. Wrap the bird with a thin piece of cotton to prevent the feathers from getting displaced during the drying process.

2. Pin the bill at a 45° angle from the board.

3. Pin the sides to support the body (but do not press into the body!)

4. Pin above the cross of the legs to prevent them from rising.

5. Spread the tail no wider than the body and pin the retrices down.

6. Pin the longest claw for most birds, and the halux for raptors. The claws should not extend past the outer tail feathers.

7. Use a dowel and double check the bird's symmetry, adjust if necessary.

8. Check on the bird over the next week to determine when it is dry. Some feather misplacement can be repaired after one day but no later than that.

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