



CANADA
4-H Saskatchewan

Archery

Reference and Activity
Guide

4-H Motto

'Learn To Do By Doing'

4-H Pledge

'I pledge

My Head to clearer thinking,

My Heart to greater loyalty,

My Hands to larger service,

My Health to better living,

For my Club, my community and my country'

4-H Grace

(Tune of Auld Lang Syne)

We thank thee, Lord, for blessings great

On this, our own fair land.

Teach us to serve thee joyfully,

With head, heart, health and hand

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Safety, Tackle, Eye Dominance and Range Procedure

1. Introduction



Hunters and warriors have used archery equipment since prehistoric times. The bow could be shot at long ranges, allowing the shooter to stay away from potentially dangerous animals or enemies.

Early bows range from simple staves of wood that were shaped for better performance to strongly recurved bows that were reinforced with horn, bone or sinew to increase toughness, speed or cast. Bows were designed to meet specific needs. Bows used while standing or walking were much longer than those used while riding horseback.

Developments in materials and engineering produced a number of advances in archery equipment. Fiberglass was used as a more resilient substitute for wood. Laminated bows used the strength and cast of fiberglass and the lightness of wood to increase the speed of the bow. Designs changed, adding cast by reflexing or recurving the limbs. Still later, mechanical advantages were added as compound bows were developed and their limbs were fitted with eccentric wheels, cams or even cammed limb tips to make the bows faster still.

Arrow material changed from wooden dowels to fiberglass, aluminum or graphite tubes. Fletching, once mainly turkey or waterfowl feathers, now included both hard and soft plastics.

Strings went from woven strands of waxed linen to Dacron, Kevlar or Fastflight strands with monofilament servings.

Strange looking devices were added to shorten the draw length, balance the bow for accuracy or assist in sighting.

Archery moved into the age of technology, but it continues to be a sport involving hand-eye coordination, consistency and the need for practice to become proficient. Basic knowledge and awareness of common safety considerations are necessary for safe, responsible and enjoyable use of archery equipment.

2. Safety

Arrows are dangerous until they come to a complete stop. The entire flight path, from release until the arrow stops, must be clear and safe. This is the same as with a firearm. As with firearms, the arrow should only be pointed in a safe direction. Unlike firearms, however, straight up is **not** a safe direction. An arrow shot straight up poses an extreme danger, while a bullet shot straight up poses very little threat. The arrow is much more dangerous than a high-powered rifle in that situation.

Archery equipment is designed to penetrate with a heavy, relatively slow projectile that has a large amount of momentum. Even target bows have enough momentum to drive an arrow through a human being.

Arrows produce very little shock on impact, but they penetrate much more effectively than rifle bullets. Unlike firearms, archery equipment has multiple points of potential danger to the user or persons standing nearby. The point of the arrow, the arrow's nock, the tops of the limbs, the nocking point indicator and the string and/or cables of the bow are all capable of producing an injury. Faulty, inadequate or mismatched equipment can also pose a threat to safety.

Bows and arrows can be dangerous weapons, or safe, exciting and entertaining recreational arms. The difference lies in the mind and the control of the user. While the arrow remains on the string and the string is in your fingers, the arrow is under your mind's control. When the string is released, your control comes to a stop and the laws of physics take over.

Archery equipment must be treated with respect and care. All the principles for safety handling firearms apply to archery equipment as well. The user alone is responsible for safe, responsible and appropriate use. If any doubt exists about the safety of a shot, **do not release the string**. The safety of archery is in your hands. So it is essential that simple principles of safe shooting be accepted and enforced. Many of the principles of safe shooting can be summarized in these simple statements:

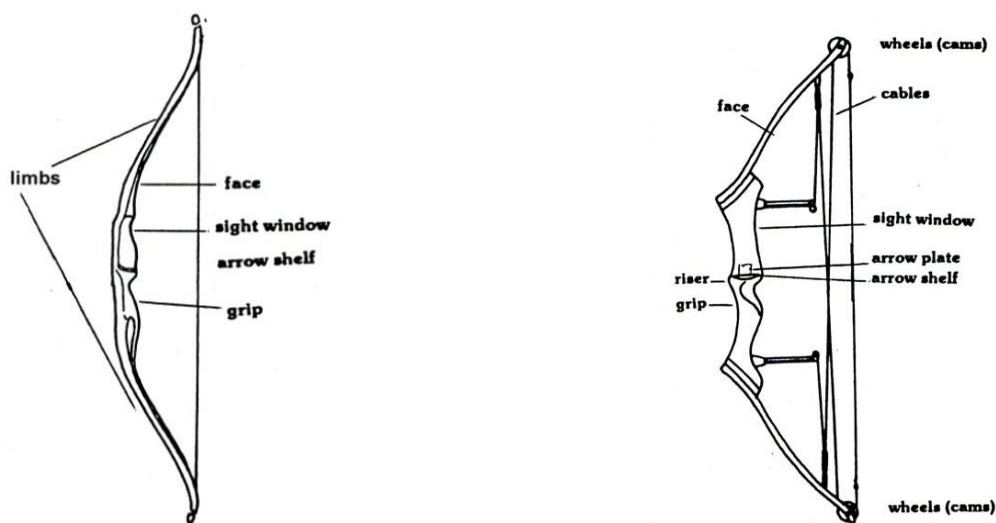
- Always be absolutely sure that the path of the target and beyond is clear.
- Never point a drawn arrow at anything you do not intend to shoot.
- Always be absolutely certain the target is clearly visible, safe to shoot and appropriate.
- Always be aware of the danger areas at the ends of the arrow and the tips of the limbs.
- Place an arrow on the string only when you are ready to take a shot.
- Always treat your tackle with respect. Never fool around with it.
- Never use equipment while your mental ability is impaired by fatigue, distractions or the influence of any drug.
- Always exercise caution when retrieving arrows or remove them from a target.
- Always be sure that all tackle is in perfect working condition and free from damage before it is used.
- Always abide by the strictest codes of behaviour and ethics applied to the sport in which you are participating, including specific range rules.

3. Tackle

Bows

Consist of a handle or **grip**, a center section (**riser**) and a pair of **limbs**. The grip or handle is usually shaped to permit the bow hand to seat well. Just above it is a cutout area known as a **sight window**. The sight window is on the left hand side of the bow for right-handed shooters and on the right side for lefties. The **arrow shelf** is at the bottom of the sight window. It normally is not used to support arrows in modern bows. Instead, an **arrow rest** is positioned just above the shelf. The portion of the rest that lies along the side of the sight window is called an **arrow plate**. Sometimes it is adjustable.

Often shooters install a spring-loaded **plunger** or button to aid in tuning the bow. The entire riser section may be constructed of the same materials as the limbs, or it may be a separate piece of wood or metal. The limbs are usually solid fiberglass, graphite or laminated glass and hardwood. Conventional bows (recurve bows and longbows) have nocks at the end of each limb to hold the string in place. Compound bows have **wheels** or **cams** at the tips of the limbs they also have **cables** and some other items not found on the conventional bows. The part of the bow that faces the shooter is called the **face** or belly of the bow. The part that faces the target is called the **back**.



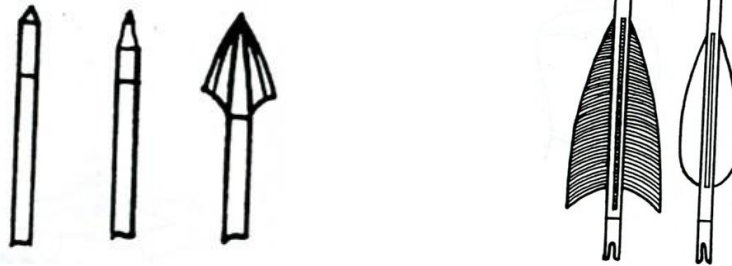
Bow Strings Almost all modern bowstrings are made from a continuous strand of Dacron or some other string material looped several times. Thus, when one strand of a string is broken, the entire string is broken. Most strings have loops on both ends to fit the string nocks or other means of attachment to the bow. These loops are protected by windings of heavy thread known as **servings**. A middle serving, often of monofilament, protects the string from wear where the arrow and the fingers touch it during shooting. The middle serving should have one or more **nocking point indicators** (metal, plastic or thread) to locate the arrow in the same place on the string for each shot.

Arrows The projectiles or arrows are made from fiberglass, graphite or aluminum. The stiffness or spine of these shafts is matched to the draw weight (strength) of the bow. The end of the arrow that is placed on the string has a nock; usually plastic with a notch that holds the string. The other end has some type of point, depending on the type of shooting being done. **Target points** are usually bullet shaped. **Field points** usually feature a point with an elongated and somewhat thinner tip than the main body of the point. **Broadheads** usually have two or more cutting edges attached to a central ferrule (a metal ring or cap to give added strength).

Near the nock, the arrow is equipped with some type of **fletching**. Usually the fletching consists of three shaped feathers or plastic vanes. Some arrows use four or even six vanes or feathers. The fletching may be straight, slightly angled or spiral, depending upon the intended use. Its purpose is to help stabilize the arrow in flight.

Hunting arrows usually have at least three large vanes or feathers. The fletching on target arrows may be much smaller. **Flu-flu arrows** have massive amounts of fletching to limit the flight distance of an arrow.

Just beyond the fletching, the shaft may be marked with a pattern of painted stripes, called **cresting**. The cresting is used either to decorate or to identify the ownership of the shafts. Many archers mark each arrow individually so they can watch for differences in performance between them.



Other Accessories The beginner needs a few other items to be fully equipped. An **arm guard** is needed for the bow arm. It should be worn on the inside of the arm between the wrist and the elbow. Arm guards help reduce the pain of string slap and to keep clothing out of the strings path.



Several types of gear are used on the string hand, **finger tabs**, **shooting gloves** or **mechanical releases** to hold the string. All have merits and drawbacks. For learning purposes, a finger tab is recommended. The tab is worn on the inside of the index, middle and ring fingers of the dominant or string hand. Most tabs have a split that lines up between the index finger and the middle finger to permit split finger shooting. A single finger attachment is used on the middle finger of the shooting hand most times.

Many types of **quivers** are available. For the first few trips to the shooting line, your leader will be the quiver, handing you the arrows one at a time. Later we you will switch to using ground quivers. As you progress, you will want to get a quiver (or quivers) that matches your shooting needs.



4. Eye Dominance



Before you learn to shoot you need to determine your eye dominance. Pick a partner to help test for eye dominance. Stand facing each other about 2 meters (6 feet) apart. Place one thumb over the other and cross your fingers over the fingers of the other hand, leaving a small triangle. Raise both hands together, keeping both eyes open and head straight toward your partner. Look at your partner's nose through the opening. The partner should note which eye could be seen through the opening. Now, keeping the nose in the opening, bring your hands slowly back to your face. Your partner should watch for any cheating where the hands seem to wander from eye to eye. The eye that your hands return to is your dominant eye. Now switch roles and try again.

Your best shooting will occur when the dominant eye is on the same side as the drawing or string hand, and the "off" eye is on the same side as the bow hand. All directions will be given using these terms. The handedness of the bow is determined by holding it as you would when shooting. The sight window is on the opposite side of the bow from its handedness. That is, a right-handed bow (for a right-eyed shooter) will have the sight window cut into the left side of the bow and be held in the left hand. Once you have selected a bow that is appropriate to your eyedness, discuss its parts with your partner. If you need help, ask your leader for assistance or advice.

5. Stringing and Unstringing

There are many ways to string or unstring bows. Most compound bows are simply left strung all the time, but recurve bows are usually unstrung between uses. Use some type of bow stringer. They are inexpensive to buy or make, and they save both the eyes and bows.

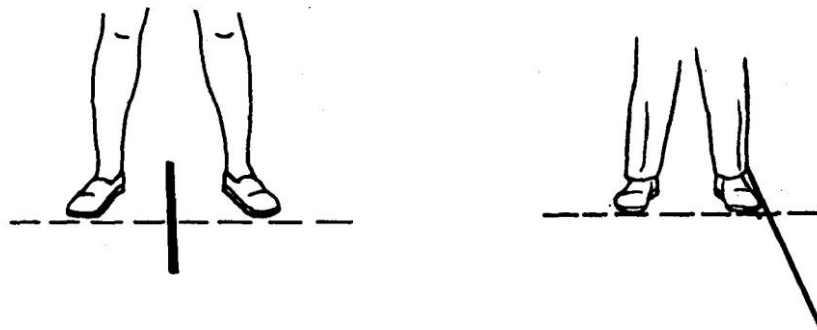
Two methods that should **not** be used are the **push-pull method** and the **step-through method**. The push-pull technique is fairly gentle to the bow but has too many dangers for your eyes. The step-through method is less dangerous, but potentially damaging to the bow.

Do not draw and release the bow without an arrow on the string! Dry firing a bow is dangerous both to the bow and to the shooter.

6. Range Procedures

Like other forms of shooting, archery operates under controlled conditions to ensure the safety of all members. Everyone, not just the range officer or line captain, is responsible for safety. Any unsafe condition must be reported **IMMEDIATELY**. All range commands, whether verbal, visual or whistle must be obeyed immediately. Small groups may be controlled with simple voice commands, but larger groups, or tournaments are better addressed with whistle, horn or light commands. To avoid confusion, keeping the commands as close to those used in other shooting sports is best.

Several modifications apply in **field shooting**. Rather than straddling the line like in target archery, the shooter toes the shooting line or stake, in addition, when retrieving an overshot arrow, the archer should place their bow directly across the face of the target to let following archers know that someone is down range and possibly in the line of fire. Some archers use an arrow stuck upright in the target butt as an indicator, but the bow is a surer sign.



In both types of shooting, archers should be far enough apart to ensure they do not interfere with one another, about 6 feet apart for beginners. Later, as you become more skilled at handling your equipment, the spacing between shooters can be reduced to about half that distance. At that point, the arrows will be placed on the string while the bow is held more or less vertically. Arrows are never nocked until the command to shoot is given, and bows are never drawn except during live firing or on command.

Verbal Command	Whistle Command	Action
Shooters to the line.	One blast.	Shooters come to the shooting line and straddle it.
Make ready.		Shooters prepare to shoot.
Is the line ready?		"Ready" or "Not Ready"
Commence firing.	One blast.	Shooters begin firing.
Round is complete.	Two blasts.	Shooting is complete.
Prepare to score arrows.	Two blasts.	Move forward to score arrows.
Cease-fire!	Multiple blasts.	Immediately STOP shooting - unsafe condition.
Retrieve your arrows.	Two blasts.	Follow line captain to the butts, wait for scoring or pull arrows.
<p>NOTE: the line captain ensures that all shooters have returned to the ready area before returning from the butts. In tournament shooting the archer must remain at least arm's length away from his or her arrows until they have been told to pull them by the scorer.</p>		

Section 2 - Developing Proper Archery Shooting Form

1. Introduction

Successful archery shooting is easy, but people tend to make it hard. Intense concentration and good muscular development are essential. The ability to remain relaxed is also very important.

Like other types of shooting, archery requires the shooter be relaxed and comfortable. Since concentration on the target is critical to success, the tasks required to fire a shot must be practiced until they can be done without conscious effort. Once they become routine, the mind is free to focus on hitting the mark. This process involves developing consistent form from shot to shot, as the consistency in form improves, consistency in shot placement improves. By focusing on the elements of good form we will make consistently good shooting easier to develop. Some steps will feel strange or even uncomfortable at first. However, archers from all over the world have proved them successful.

No matter what kind of archery you select, the basics of proper shooting form are the same. By developing sound, consistent form early in your shooting development, you can reach higher levels of achievement in the chosen sport.

2. Archery Form Basics

Only a few steps are required to shoot an arrow successfully. You must take a proper stance, grip the bow properly, nock an arrow, grip the string properly, raise the bow arm to shooting position, draw, anchor, aim, release and follow through.

That seems simple enough, but the mind cannot cope with that many things all at once. These steps must become established, well-practiced habits. Once you have a fixed shooting routine and good shooting form, the mind can be set free to concentrate on the target for more precise shooting.

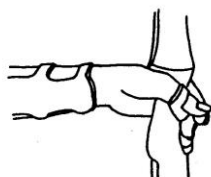
Stance

A good shooting stance involves a relaxed erect posture. The feet should be straddling the shooting line, shoulder-width apart. A line drawn across the tips of the toes should point to the center of the target. Some people find that moving the bow-hand foot back a few centimeters (up to about 6") is more comfortable, but that may cause some problems in keeping the rest of the body in line. It forces muscles to work, increasing the potential for fatigue and inconsistency. Lines drawn through the hips and through the shoulders should also point to the center of the target. The head should be erect, relaxed and rotated toward the bow-hand side.

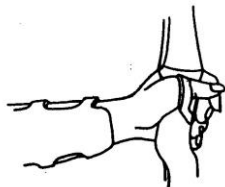
Pick a point as a target, establish an imaginary shooting line and try getting into this stance with your partner's assistance. Once you are comfortable, switch roles, repeating the exercise until both of you feel comfortable.

Bow-hand Grip

The majority of archers use two types of grips. Both of them are relaxed, allowing the bow to move freely on the release. If you are afraid of dropping the bow, either use a sling or lightly touch the tip of the thumb to the tip of your index finger. The grips share several common elements. Both are begun as if extending the hand in a handshake. The hand is held vertically, and the bow fits into the U-shaped opening between the thumb and the fingers. The wrist remains in direct alignment with the forearm. The elbow is rotated out, so that the forearm can move readily toward the center of the chest when the elbow is flexed.



A high-wrist grip allows the bow's handle to seat only in the web between the thumb and the forefinger. In this grip the wrist remains straight, aligned with the forearm both horizontally and vertically.



The low-wrist grip allows the muscles controlling the hand to relax. This causes the hand to rise above the forearm and the bow handle to seat against the palm of the hand. This grip is similar to having a completely bedded rifle barrel. Like this situation, perfect and consistent bedding of the bow's grip gives very consistent shooting performance. Slight changes from shot to shot, however, produce changes in the point of impact.

One the other hand, the high-wrist grip is similar to using a free floated rifle barrel. The only point of contact is well established, and the bow does its own seating in the hand.

Most target archers use a low wrist because they get better performance with it. Many hunting archers use a high wrist because it is less sensitive to slight differences in hand position or pressure. Try both of them with your partner, drawing the bow only one inch.

Nocking an Arrow

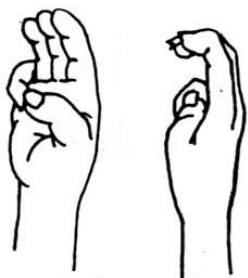
You will learn two ways to nock an arrow. The first is only for leaning ease. The second is for accepted target shooting etiquette. We will practice both styles without placing the arrow on the string. Be sure you are standing at least 2-3 meters (6-10 feet) away from other groups and that the arrows are never pointed toward another person. Rotate the upper limb of the bow toward the string hand so that the sight window is up. Using the sight window as a shelf, slide an arrow forward. Rotate the arrow until the index vane (cock feather) is up (facing away from the sight window). Draw the arrow back to the string. Although we will not actually nock the arrow, the nock is positioned below the single nocking point indicator (toward the lower limb tip) on the middle serving. Some shooters prefer to use two nocking points, placing the arrow on the string between them. Try this several times with each partner.

Next, hold the bow almost vertical, canted slightly toward the string hand. Rotate the string slightly (just enough to allow hand to clear it) toward the string hand side. Grasp an arrow near the fletching and reach forward, placing it on the arrow rest.

With the arrow on the rest, draw the nock back to the string. Again, be sure the index vane or cock feather is positioned away from the sight window. ***The tip of the arrow should be pointed down range during the entire nocking process.***

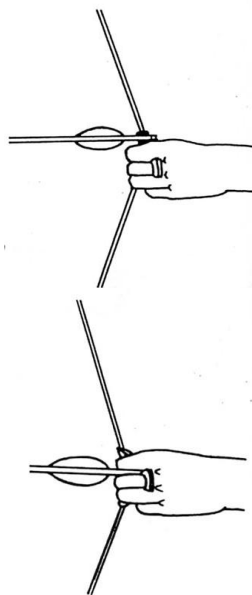
Setting a Hook

The string hand uses hooked fingers to draw the string and the arrow into position for a shot. The back of the hand should remain flat throughout the drawing and shooting sequence. An easy way to ensure this is to use a three-fingered salute. Hold the hand upright, palm forward. Bring the little finger of the drawing hand toward the center of the palm and hold in place with the tip of the thumb. That keeps the hand flat. Next, bend the remaining three fingers into a hook. This approach is used with either a tab or a shooting glove.



The fingers may be placed on the string several ways. The most commonly used is to place the index finger above the arrow, and the nocking point indicator and the remaining two fingers below it (*split-fingered* or *Turkish* draw). Another common approach is to place all three fingers under the nock (*Apache* draw). It is very effective for short range shooting, but carries some risk because the nock is placed very close to the dominant eye. In either case, the fingers are placed on the string at about the last joint of the fingers. A slightly deeper grip, almost to the second joint, is quite acceptable when using a tab. Tabs give more consistent results than gloves with most shooter.

The problem known as “finger pinch”, where the arrow lifts away from the rest, is commonly caused by curling the hand during the draw. It can be cured by taking a slightly deeper grip on the string (almost to the second joint) and/or by folding the little finger and the thumb into the palm of the drawing hand.

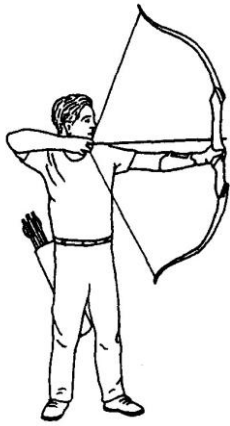


Extension to Shooting Position

Once the stance and hand positions are established with a nocked arrow, the entire unit is brought into shooting position at the same time. Start with the bow arm extended about 15 degrees from the body and on a line toward the target. The forearm of the string hand should be aligned with the shaft of the arrow, and the finger hood should be set on the string. Moving the arms from the shoulders, bring both arms up to shooting position. The bow arm should be fully extended and pointing at the target. The forearm of the string hand should be in line with the shaft of the arrow, and the arm should be extended forward. Many instinctive archers will extend and draw in the same motion, coming to their anchor point as the bow arm settles at full extension. Use two steps here to avoid developing form fault.

Draw

Pull the string back toward the anchor point. At beginning of draw, the upper arm muscles flex the elbow. Then the elbow is drawn back using the muscles of the shoulder and back. The draw should be a smooth motion, keeping the forearm in line with the arrow shaft.



Anchor

We will use a high-anchor point in this session. Most archers anchor the tip of the index finger against the corner of the mouth or the canine (eye) tooth on the dominant side. Often a secondary anchor point is used. The thumb may be placed along the angle of the jaw or behind the ear, or it may be nestled against the back of the jawbone. Since the anchor point establishes the location of the "rear sight" even for instinctive shooters, it is essential that the anchor point be consistent. Later we will establish another type of high anchor and a low anchor for use with sights.

Aiming

Aiming is simply an intense concentration on the target. Pick a tiny spot and concentrate all your attention on it. As in rifle shooting, releasing before you are satisfied with the hold or waiting too long during the aiming phase will lead to inaccurate shooting. Experienced archers pause briefly, perhaps a second or two, to be sure of their hold before releasing the string. Although this is not a true sight picture, the archer does form a mental image of the proper relationship between the bow and the target. Throughout the aiming sequence, the string hand should remain firmly locked to the anchor point. Try coming to an anchor point without equipment.

Release



A proper release is achieved by simple relaxing the fingers of the drawing hand while pulling the string-hand elbow back slightly. To feel a live release, hook the fingers of one hand into the hooked fingers of the other hand. Holding the hands across the center of your chest, pull with both hands. Note that this requires you to use your back muscles, just as in drawing a bow. Relax the fingers of the drawing hand. The elbows rotate back quickly for a few inches. This is exactly what should happen in a live release. The fingers of the shooting hand should flow along the side of the face. The bow should rock forward at the same time. Your partner will be watching for a live release by observing the position of your hands during the follow through.

Follow Through

A proper follow through is essential to consistent, accurate shooting with all types of equipment. Archers must pay particular attention to follow through. The bow arm and string arm should maintain their positions until the arrow is in the target. Fatigue is the prime factor in improper follow through.

Note: Members should first practice these steps individually without equipment, or use an airbow. Once they are practicing good form with each step, assemble the steps into a shooting sequence. When the sequence is fixed in the shooters' minds, take them to the line for live shooting. Leaders need to be involved here - adult or junior leader assistance is extremely important. Be sure the range is short enough that members are hitting the target right away.

3. Shooting the First Arrow

For now, the emphasis should be on shooting consistent groups using proper shooting form. We are not using a target face because scores are not important at this stage. In fact, they may distract from our real purpose. Let's have the first flight of shooters and their leaders to the line. Space yourselves about 8-10 feet apart, with the leaders holding the arrows and standing on the string-hand side of the shooter. Shooters should be wearing their arm guards and finger tabs and be straddling the shooting line. We are going to shoot the first arrow "by the numbers."

1. *Leaders, is the flight ready?*
The flight is ready.
2. *Take your stance.*
3. *Nock an arrow.*
4. *Set your hook on the string.*
5. *Raise the unit to shooting position.*
6. *Draw to your anchor point.*
7. *Focus on the aiming dot.*
8. *When ready, release and follow through.*
9. *You may shoot the other two arrows when you are ready.*
10. *When you have finished, place your bow on the ground quiver (or "ground" it) and take one step back off the line.*

Repeat this process with reversed roles before retrieving the arrows.

Only one member of each group should retrieve arrows. Follow the range officer to the butts. Be careful not to step on or hurt yourself on undershot arrows. Do not go behind the target for overshot arrows until those in the targets are pulled, then all search together.

Remember to pull all arrows straight back to avoid bending them. To remove an arrow from the matt, place one hand on the matt with the thumb and the rest of the hand supporting it. Grasp the arrow near the matt and pull straight back while twisting the shaft slightly. After all the arrows have been retrieved, return to the shooting line.

4. Shooting Groups

Now that you have all had a chance to shoot "by the number," let's see if you can shoot some tight groups. Remember to concentrate on the same point throughout the series. Do not be conscious with where the group is, but rather with its size. Consistent form produces smaller groups. Shoot about three ends of three arrows each.

5. Moving Groups to the Aiming Point

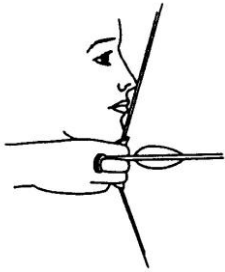
You can move the group to the center of the target once you are able to produce groups. Simply shoot a group, and then place another aiming dot on the opposite side of the original one and the same distance out. That is, if the center of your group is at 7 o'clock to the dot and about 10 inches out, place a new dot at 1 o'clock and about 10 inches out. Focus your attention on the new aiming point and see where the group hits. Use trial and error to move the hits to the center of the original target.

6. Exhibit and Sharing Ideas

1. Develop a set of posters or diagrams showing the steps of good archery shooting. Display them or use them to give a demonstration on archery technique to another group.
2. Make a ground quiver with a bow support for range use.
3. Shoot several groups using different anchor points to illustrate what happens to group size and placement. Label each group, and be prepared to discuss the reasons for the placement and size.
4. Illustrate how to move a group of arrows to a new point of impact.
5. Start a shooting journal to help improve your shooting. Include it in your record book. List some of the things you learned today.

Section 3 - Instinctive Shooting with a High Anchor

1. Introduction



We learned the fundamentals of good shooting form in Section 2. This time we will apply those fundamentals to instinctive shooting. Instinctive archery shooting is similar to throwing a ball. The ball is not aimed; it is merely thrown while concentrating on a target. Sometimes it is thrown with amazing accuracy and speed. The instinctive archer uses a similar style. Intense concentration on the exact spot he or she intends to hit, along with experience, results in hitting the mark without obvious aiming.

The hands and eyes work together during the concentration phase of the shooting sequence to point or aim the arrow at its target. This is similar to a shotgun shooter pointing at the intended target without obvious sight awareness. Unlike the shot gunner, however, the archer cannot be satisfied with simply "being close". For a good hit, the single projectile needs to strike precisely where it is intended. Practice is the key to success with instinctive shooting, and members should be shooting fairly well after a short period of time.

Let's review the elements of good shooting form from the last section. The archer needs to take a comfortable and relaxed stance. Feet should be about shoulder-width apart with a line through the tips of the toes point to the target. Both the hips and the shoulders should be in line with the target as well. The head should be erect and turned toward the bow-arm shoulder.

The bow hand holds the bow very lightly, with a handshake-like grip. The elbow of the bow-arm is rotated outward. The string hand is flat and the fingers are hooked at the first and second joints. The nocked arrow is situated with its index vane or cock feather facing away from the sight window. The nock is located between the index finger and the ring finger on the drawing hand.

Both arms are rotated into shooting position from the shoulders. The drawing hand is pulled back by flexing the elbow, then drawing it back with the shoulder and back muscles until the fingers are firmly locked to the anchor point.

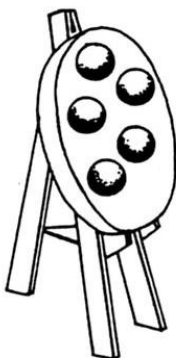
After a brief pause a full draw to check alignment, the string is released by relaxing the fingers while pulling the elbow back. The fingers flow along the side of the face and the bow rocks forward slightly. The shooting position is held until the arrow is in the target.

Consistent form produces consistent groups. Changing the point of concentration on the target face can move groups. Let's limber up by shooting a few groups on a target that has only an aiming dot on it.

2. Conduct Active Shooting Sessions

- *Put up a target face and see if you can shoot some reasonable scores at this distance.*

How many had groups that increased in size when you went to the larger target face? Why do you think that happened? One of the reasons is that you have a larger aiming point than when only the small dot was used. Another is that you tried to move your point of impact during the shooting session, sometimes before you had established a group for reference. Remember to concentrate on only a small spot and to keep that spot consistent through each end. Once a group placement has been established, you can move your group to the gold rather easily.



Remember that practice alone does not make perfect. Perfect practice make perfect. Every archer needs to concentrate on consistent and proper form until those elements become fixed. Even then, they should be reviewed frequently. Those principles of good marksmanship apply to all sorts of shooting: target, hunting or just for fun. Go ahead and shoot one more end. Leaders should record scores on this one.

- *Shoot a couple more ends to see if you can improve your score. Look for personal improvement, not the highest gross scores.*
- *Now, let's try shooting just for fun. The object is to see who can break the most balloons. Start back at a distance and work your way forward after every rotation. Each shooter gets one arrow at each station.*
- *Try a little wing shooting. These special arrows are called **flu-flus**. They are designed to limit the flight distance of the arrow, and they are sometimes used in shooting small game or game birds. If you can, shoot at a disc target called a **bow bird**. Shooters stand on the shooting line, called the **toss**. Try to hit the target at the peak of its climb (it is almost still for a split second at that point). Be sure to take only shots that are completely safe. Non-shooting participants should be alert for any dangerous situations and call out "**Cease Fire!**" or "**No!**" if they see any potential for a dangerous shot. (This target can also be rolled to simulate a rabbit. Balloons released on the ground in a light breeze do the same thing.)*
- *Try **clout shooting** - this is a target about 50 feet in diameter. It is a long way away and it is flat on the ground. The object is to see how close to the stake with the flag on it you can shoot an arrow.*

Continue to practice good form each time you shoot. Remember that perfect practice makes perfect and that consistent form brings consistent results. Next time try a different anchor point and a different shooting style, using pin sights to help in aiming.

3. Exhibit and Sharing Ideas

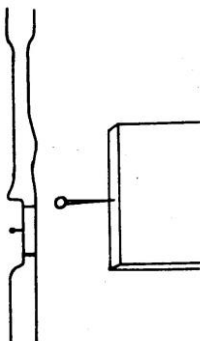
1. List some of the things you learned today in your shooting journal.
2. Record your scores at various distances and in all the activities you tried today. Enter them in your shooting journal with the date, location and any comments you might want to add.
3. Tell someone who is not in the 4-H archery project about your experiences with instinctive archery shooting. Record their reactions and your own feelings about the sharing time in your shooting journal.

1. Fundamentals of Sight Shooting

The fundamentals of shooting with sights are the same as for any other type of archery. Although they are the same, most archers change anchor points when shifting from instinctive to sight shooting. Usually the new anchor point is below the chin. This raises the rear sight (the eye), giving the shooter more room in the sight window to adjust the front sight. Hunting archers sometimes keep the high anchor because it is familiar and they shoot at short distances. Target archers competing in events usually cannot set their sights for longer distances without using the low-anchor point.

The under-the-chin anchor has additional advantages. It usually requires a slightly shorter and lighter arrow than the high anchor, producing a potential advantage in arrow speed. In addition, the low anchor provides three ready checkpoints for consistent shooting. The string should touch the center of the chin (that is why many chins are slightly cleft - to accept a properly drawn bowstring), the center of the lips and the tip of the nose. The string is drawn to the center of the chin with the head raised very slightly. Then the chin is lowered until the string meets the other two anchor checkpoints. As with instinctive shooting, the ideal position for the drawing arm places the forearm in direct line with the shaft. On release, fingers of the drawing hand should flow backward along the shooter's throat and side of the neck. Other form elements are like those in previous sections. Be sure you check each other on following the basics.

2. Making a Simple Sight



Elaborate and expensive sights can be used, but a good teaching sight can be made from masking tape, duct tape or weather stripping foam and a dressmaker's pin. Pins with enamel heads in white, yellow, orange or red are easy to see and use. Stick a strip of tape or foam on the back of the bow at the sight window. Stick the pin into the foam or under the tape, leaving the enamel head in the sight window. A good starting point places the pin about the same distance above the arrow rest as the eye is above the anchor point. The head of the pin should stick out into the sight window about as far as the edge of the arrow is from the dominant eye, about $\frac{3}{4}$ inch. This arrangement should place the arrows close to the point of aim at close range (15 to 25 yards). The sights can be adjusted by trial and error to place the group center on the point of aim.

3. Adjusting the Sights

When adjusting rifle sights, the rear sight is moved in the direction the hits are to move. In contrast, archers adjust the front sight. In front sight adjustment, chase the point of impact with the sight.

Before making adjustments, the archer must know where the arrows are hitting relative to the point of aim. That means that the ability to shoot tight groups is essential.

A minimum of three arrows should be shot to establish the point of impact. Use the same sight setting, anchor point and point of aim. If the sight setting places the first arrow completely off the target and your form was good, adjust the sight after that arrow to get on the target. Using the "chase the arrows with the pin" approach, move the sight to the left if the hits are to the left, upward if they are high, and so forth.

With the simple tape and pin sight, adjustments may need to be made by trial and error. With sights having a screw adjustment, **windage** (lateral right or left) adjustments can be made by counting the number of turns in any given change and noting the resulting change. Then calculate the approximate number of turns needed to reach the desired setting. That reduces the amount of trial and error during the beginning stages of sight set-up.

Once the sights are set to your satisfaction, mark the pin and the tape with the distance and your initials. Ideally, every shooter should have a personal bow for this exercise. Several shooters can use a single bow if different pin colours are used. Repeating the entire process for each distance desired will have the bow set up for the shooting situations you are using. The rest is up to the shooter and adequate practice.

4. Using Sights for Targets and Hunting

Using sights for either target shooting or hunting involves the same principles, but with some practical differences. Target archers often extend the sight out from the back of the bow, giving themselves a longer sight radius. The longer sight radius aids in precision sighting. Almost all target shooters use a single sight pin that is adjustable for elevation with marked locations on the sight bar for different distances. Where permitted, they may use aperture rear sights known as **string peeps**, levels or other devices to aid in precision sighting. Some field archers use similar techniques.

Most field archers and hunters use slightly different techniques. Hunters use the extended sight bar much less frequently. The improvement in sighting precision does not equal the disadvantages in the field. The longer sight bar is easily entangled in vegetation and the sight is more prone to damage or being knocked out of adjustment in field handling.

Many archers in these sports opt for a protected sight with a guard to protect the pin or pins. Considerable difference of opinion exists among hunters and field archers about the number of pins that should be used. Some use multiple pins that are colour coded and pre-set for selected distances. Others use a single pre-set pin and hold over or under targets at other distances. Those using multiple pins like the precision of holding the pin on the point of aim after selecting the proper pin for the distance. Those using a single pin feel it is less confusing and requires the same amount of accuracy in judging distances. Generally, more experienced hunters choose the single pin, while target shooters who do a considerable amount of shooting use multiple pins and often a string peep.

5. Other Gear

An aperture rear sight or string peep can improve sighting precision. The string peep can force a shooter to develop consistent form in some phases of shooting. String peeps may make sighting more difficult under low light conditions, and they may require one-eyed shooting for some archers.

Release aids are popular. The mechanical release has several advantages. They produce a clean release with a single point of contact with the string. They may help shooters attain consistent form if the drawing hand position or finger tension is a problem. Those who elect not to use a release often look at the device as excess baggage or another artificial element in archery shooting. Others find them confusing or fear they might release a shot unintentionally.

The best advice for young shooters is to keep your shooting as simple as possible while learning. Once the fundamentals are established with and without sights, the shooter can experiment with other devices and styles.

6. Exhibit and Sharing Ideas

1. Make a model or illustration and discuss arrow trajectory.
2. Display targets shot using instinctive and sight shooting techniques. Compare advantages and disadvantages in your journal.
3. Exhibit a model, poster or diagram of proper sight shooting form or sight adjustment. Explain the processes on labels in your shooting journal.

1. Introduction

Although the fundamentals of archery have remained the same, archery equipment has changed a great deal in recent years. Centuries ago archers used self-bows, bows made from a single stave of wood. Some bows were reinforced with sinew, horn, bone or other materials; but native woods were the main bow materials. Designs varied in both shape and length. The long, straight or slightly reflexed English long bow was quite different from the short, recurved bows used by the Mongols and the Turks. The function of the bow was reflected in its form.

As composite materials, like fiberglass, were developed, they found use in the bowyer's trade. Laminated limbs, recurved designs and the use of stiffer, stronger materials increased bow cast and speed. The compound bow introduced a major change in bow design. The use of eccentric wheels and cables altered the mechanics of drawing the bow. That eased the drawing process and reduced the force needed to hold the bow at full draw. The mechanical advantage also allowed more of the energy stored during the draw to be transferred to the arrow during the shot. The result was a faster arrow at the same draw weight. Also, the less abrupt, longer acceleration reduced stress on the arrow. This made the use of lighter, "softer" spined arrows possible, adding to the increased speed. Archers, particularly bowhunters, were quick to take advantage of the new technology.

Recent years have seen further advances. Development of better materials, like graphite and boron fiber composites, has added stiffness to limbs with reduced limb mass. Design change, like the introduction of tuned cams or cam limbs, have increased speed and/or "feel" for archers. As a result, the modern archer has choices that were beyond the dreams of archers' only decades ago.

2. Basic Compound Bow Design

Compound bows and "stick" bows have the same basic components. Both have limbs, riser, handle, arrow shelf, arrow rest, arrow plate, a sight window and a string. Compound bows also have cables and eccentric wheels of some sort to provide the mechanical advantage. The cables transfer the drawing forces to the limbs, which are usually shorter and stiffer than those of recurve bows. The eccentric wheels or cams alter the shape of the draw force curve. It changes from one that rises uniformly or increases in slope with increasing draw length to a flat-topped curve with two "valley" - one at the resting state and the other at full draw. That change is the key to the efficiency of the compound bow.

Compound bows have several advantages over recurve bows of similar draw weight. First, they transfer a greater proportion of stored energy to the arrow. More work done in drawing the arrow to the anchor point and bending the limbs becomes kinetic (moving) energy in the arrow.

Secondly, the reduced stress on the arrow permits the use of a lighter arrow with fewer spines. That, too, increases arrow speed. Finally, fatigue-induced errors in shooting form may decrease because of reduced holding weight. Hunting archers find this an advantage when waiting at full draw for their quarry to move into a better position.

Disadvantages of the compound bow are related to their moving parts or the same features that yield advantages. Reducing the holding weight, for example, makes variations in release more critical. Relatively minor errors may produce serious changes in arrow flight. The bow's mechanics require a more complex tuning process and cause more difficulty in noise reduction. In addition, the extra moving parts and the greater stress placed upon the limbs, cables, strings and other bow parts increase the potential for breakage during use. Compound bows tend to be heavier than recurve bows of the same draw weight. The increased weight may make them more stable, but it may add to fatigue as well. Many archers feel that the mechanical appearance of the compound bow makes it ugly, too. Beauty, it seems, remains in the eye of the beholder.

Wheeled bows, those with round eccentrics, and bows with cam limbs tend to have smoother draw force curves than cam bows. Cams store more energy and shoot faster arrows than wheels.

The quest for more arrow speed has produced further technical changes in bow design. Overdraws, devices that shorten the draw length from rest to anchor point, permit the use of a shorter, lighter and softer spined arrow. At full draw the tip of the arrow is actually located inside the handle (and the bow hand) of the bow. The Archery Manufacturer's Organization (AMO) recommends a minimum arrow weight of six grains per pound of draw weight for safety. Increases in speed are offset somewhat by the demand for greater consistency in shooting form. Since the arrow rest is not directly over the pivot point of the bow, small changes in bow-hand position can cause substantial changes in impact location. Bow-hand form is critical when using an overdraw. Arrow speed cannot compensate for poor form.

3. Shooting Compound Bows

Compound bow shooting uses the same basics of form used in shooting recurve bows. Compound bows are less forgiving of form faults, so consistent form is essential to precise shooting. Poor form results in more noise, erratic grouping of arrows and faster arrows hitting in the wrong places. Extra care with form and equipment is necessary. The rest is practice, practice, practice.

4. Exhibit and Sharing Ideas

1. Display a model or diagram of a compound bow labeling all its functioning parts.
2. Compare trajectories of several bows with equal draw weights but different designs. Present the results as graphs and discuss them in your record book or put them in poster form. Sample targets may be included.
3. Make a compound bow from a kit and display your finished bow.
4. Exhibit a series of targets illustrating a change in skill level using a compound bow.
5. Complete a trajectory experiment. Exhibit the results of your experiment in an appropriate form with full documentation in your shooting journal or record book.
6. Exhibit an item you have made for use with compound bows, for example a bow scale, string jig, compound bowstringer, bow rack or similar item of your choice.

1. Introduction

Today's archer can increase shooting enjoyment by making some of his or her own equipment. Making personal equipment also can promote safety, understanding and even shooting skill.

An archer can make simple equipment or more complex items that require a great deal of time and skill. Many accomplished archers have tried their hand at making bows. The increased popularity of the longbow has resulted largely from a sense of history and interest in making bows. The bowyer's art is complex and will not be covered in this lesson.

We will concentrate on making bowstrings, arrows, a string jig and a couple of types of bowstringers. Along the way we will learn some of the skills needed to maintain archery equipment.

2. Making Arrows

Many archers enjoy making their own arrows. It is easier to match the arrows to your size, shooting style and other equipment when you make your own. The arrows may be customized to fit personal desires as well. Those custom touches may be as simple as nock or fletching colour. They may include customized fletching, a personal crest and individual identification of shafts. The starting point is selecting shafts with the proper spine and length in the desired material.

Shaft selection is discussed in the bow-tuning lesson. Use a table of potential shaft sizes from a manufacturer as a guide, but also use your personal experience. Shafts for target or field use may be cut to the actual draw length as determined by using a draw-check arrow. Those for hunting purposes should be cut a few centimeters (3/4 to 1 inch) longer than the distance from the string to the back of the bow. This provides adequate clearance for the broadhead and a margin of safety for the shooter.

Dealers will cut the shafts to length for a small fee, or they may be cut with an abrasive cut-off wheel. Pipe cutters, hacksaws and similar cutting tools should not be used. The slight burring at the cut areas should be removed to provide a uniform tube diameter for inserting points or screw-in adapters.

After the shafts have been cut to length and de-burred, the points or adapters can be inserted. On fiberglass arrows, the nock inserts can be installed at the same time. Most archers prefer to use an epoxy for fiberglass and similar types of arrows. Heat set or meltable adhesives are used for installing inserts on aluminum shafts. Wooden shafts need not be cut to length or tapered until they have been completed. If screw-in adapters are used, a few precautions can increase your satisfaction with the installation. Place a small amount of petroleum jelly on the threads of a field point.

Screw the point fully into the insert before it is installed. That keeps excess glue from getting into the threads and fouling the insert.

Melt a small amount of glue on the insert. Twirl the insert to spread the glue evenly over its surface while preheating the end of the shaft. Insert the adapter with a twisting motion to spread the glue evenly. Hold it tightly in place for a few seconds to let the glue set. (Some people twirl the tip of the shaft under cool water to hurry the process.) Once the glue has set, the arrow can be spun on its tip to check for proper insert alignment. If necessary, reheat and adjust the insert so the arrow spins without wobbling. Once the insert is aligned and the glue has set, the field point can be removed. The arrow is ready for the next step.

Before the shafts are used to construct arrows, they must be cleaned. Manufacturers make special solvents for preparing arrow shafts, but other solvents or home cleansing techniques can be used effectively. The shafts can be scrubbed with a cleanser, wiped clean with alcohol or cleaned with lacquer thinner or remover. Once they are clean and dry, they should not be touched with oily fingers. The bases of the fletching should also be cleaned with a thinner or alcohol to remove any remnants of the release agent from the molding process.

Once the shafts are cleaned, most arrow makers apply a thin coat of lacquer to the area where the crestring and fletching will be applied. Some adhesive manufacturers recommend their lacquers for providing a good base for the adhesive. The lacquer base tends to promote excellent bonding. Lacquer colour is a matter of choice. Drawing a very light line around the shaft where the lacquer should stop is a good practice for consistent results. Lacquer is most easily and consistently applied by using dip tubes.

Merely insert the shaft to the line, allow it to drain briefly, and hang it up to dry. The lacquers used for archery applications are tough and difficult to remove, so protect your work area. Adequate ventilation is also essential.



After the shafts dry completely, remove the lacquer from the nock area or remove any irregularities in the lacquer from that area. Place a drop of glue on the tapered portion of the shaft, and insert a nock with a slight downward twisting motion. The nock should fit tightly and evenly on the nock taper. Refer to the shaft maker's materials or another chart of nock sizes to select the proper nock for the shafts used. Care in applying the nocks will ensure the nock is properly aligned with the shaft.

The next step is to apply the fletching. Wet up your fletching jig according to the manufacturer's instructions. Select the fletching style you prefer. Set a shaft in the jig, being sure the nock engages properly in the nock receiver. Position a feather or vane as you want it on the shaft, and mark the clamp where the end of the fletching crosses it. Apply an even bead of glue along the base of the fletching material and slip the clamp into the jig.

Follow the manufacturer's advice on the length of time each vane or feather must remain in the clamp. Usually 3 to 4 minutes is adequate. Remove the clamp. Rotate the nock receiver to bring a new area of the shaft into position. Repeat the process until all the fletching has been applied. Finally, place a small drop of fletching cement on the leading and trailing edges of the base of each feather or vane.

If no crestring is desired, the arrow is complete. All you need to do is screw in a point of your choice and head for the range. If the arrow is to be crested, a few more minutes' work is required. The crest is your signature. Design one that is pleasing to you. Remember that light colours should be applied first, they are easily covered by darker ones. Use an assortment of brush sizes to get the effect you want. Having a junked shaft to use as a practice area is often very helpful as is keeping your lacquer rather thin.

Congratulations! You have just finished your first set of arrows.

3. Making a Bowstring

There are many advantages to making your own bowstrings. You can easily adjust length, string weight and thickness of the servings, making it easier to fine tune your equipment. Making bowstring requires a few tools and materials: a string jig, a serving bobbin, nylon serving thread and monofilament for the center serving. The techniques are easily mastered and the process is relatively quick. Let's go through them one step at a time.

Establish the proper length for the string. If you have a string that has been working well on your bow, use it for a pattern. With Dacron strings, you may want to shorten the string slightly (perhaps as much as ½ inch) to compensate for the initial stretching when the string is put on the bow. Mark the base of the string jig to indicate the ideal string length for your bow. That will make duplicate strings easy to produce later. Remove the old string from the jig and, following the directions on the string material, wrap the required number of strands around the ends of the jig. Leave a little extra material on both ends of the thread for knotting and finishing. Both of these should be on the same end of the string.

Pivot the end of the string jig on the end having the two tied-off strands. Following the directions with your serving bobbin, serve the middle portion of the end loop with nylon thread. Once that middle portion is served (the part that will become the end loop), rotate the end of the jig back into line. Adjust the string position slightly so that the serving thread will conceal the end of the other side of the serving and begin to form the loop. Either wind the loose ends of each strand around their side of the serving or wind the strands in a crisscross pattern over the area to be served. Serve the remainder of the end loop area (about 4 to 6 inches) and whip finish the serving thread.

While the string is in this position, mark the loop area on the other end of the string with wax pencil or chalk. (Note: some inks damage some types of string materials.) Once the loop area is marked, rotate that end of the string jig, serve the loop and finish off the other end of the string as before.



At this point, many archers like to "set" the string. Place the string on the bow, wax it completely and rub it vigorously with a small patch of leather. This process conditions the string and settles the strands into place. Many manufacturers recommend that the string be twisted slightly in the same direction that the individual strands are twisted to increase its strength. Note that all servings should be made in the same direction.

Once you have established the proper length for the string, mark the top and bottom of the center serving with chalk. Generally the top of the center serving should be about 2 to 3 inches above the arrow rest. The bottom should be about 5 to 6 inches below it. The main functions of the center serving are to protect the string from abrasion, to provide a smooth area aiding release and to provide a snug fit for the nock. Feel free to build yours to fit your shooting style.

On recurve bows the center serving can be applied while the string is on the bow. The cables of compounds complicate the matter a bit. In either case, the string could be removed from the bow and replaced on the jig for serving the center. Although nylon can be used in the center of the string, most archers prefer to use a monofilament center serving. Mono comes in several diameters and colours.

Select a combination that is pleasing to the eye and one that fits your nocks snugly. Starting at the top mark on the string, insert the monofilament through the string and leave several inches of the free end protruding through the string. Hold that free end along the string and wind the start of the serving over it. Continue winding in the same direction as the twist in the string (and the same direction in which the string will roll on release) until most of the area to be served is covered. As you near the end of serving, insert a loop of monofilament (loop side toward the unfinished end of the serving) and continue to wind at least 12 to 15 additional turns of serving material. Keeping the serving tight, snip off the monofilament and insert the loose end through the loop. Pull the loop through, drawing the free end under the wrapped monofilament; and pull it up tight. Trim the end and apply a drop of fletching cement.

In order to have the string function properly, it must have a nocking point indicator of some type. Some archers wrap one of dental floss or a similar material. Others use metal/plastic nock sets. Place the string on the bow and position the nocking point as desired. If you have found the best location for your bow's tuning, simply repeat the placement (you should have that noted or marked on your bow square). If not, try various locations until the bow is tuned properly. Hunters and target archers alike should have extra, pre-stretched conditioned and tested strings with nock sets available in their field gear.

4. Making Tree Climbing Blocks

While the target archer may not appreciate climbing blocks, the tree stand hunter will find them very helpful. Ethical hunters avoid damaging trees by using non-invasive ways of climbing trees. The climbing block is an excellent way to do that, and it can be made from scraps of 2 x 4 construction lumber. Each block should be about 5 to 5 ½ inches long and cut square on both ends. Approximately 1 ¾ inches from one end of the block, drill a centered ½ inch hole through 2 inch side of the block. Sand off all eight corners of each block slightly.

At this point, you may want to paint the blocks with a dark paint or camouflage paint to preserve and conceal them. Using 400 to 600 pound test nylon or Dacron rope that has been dyed a dark colour, pass one end through the hold, around the wide side of the block and back through the hole again. Make a small loop close to the edge of the block using a bowline knot. Cut the opposite end of the rope to a length suitable for the trees you are likely to be climbing (about 15 to 20 feet long). About 6 to 10 of these blocks will get the hunting archer into most tree stands.

The climbing blocks are used by wrapping the rope around the tree at the desired location, passing the end of the rope through the bowline loop and cinching it down as tightly as possible. The line is then passed back around the tree and cinched under the block (called frapping) with a couple of turns of rope before passing back around in the opposite direction and repeating the process. Once the block has been frapped in place, the remainder of the rope can be tucked under the block to keep it from blowing in the wind. The block will shift when weight is first applied to it, but after that it should remain stable.

5. Making a Hauling Line

Any archer that hunts from a tree stand should wear a safety belt or safety line every time they enter a tree stand. Safety belts can be purchased at modest cost, but you can also make one from a heavy piece of braided Dacron rope. A length of rope about 15 to 25 feet in length is adequate for most areas. The ends should be sealed with a flame. Take care not to start a fire or get burned on the molten polymer.

The safety line attaches the archer to the tree to prevent dangerous falls. Start by tying a bowline snugly around your upper body. Keep the rope fairly high on the chest. Turn to face the tree while standing at about the distance you want as your limit. Attach the line chest height or higher on the tree. Another bowline is adequate, but any strong and easily untied knot (a clove hitch for example) will do. Rotate the knot to the center of your back. Test the arrangement to see if you have enough room to shoot before hauling your equipment into the tree stand. A secure safety line can improve your shooting if it is used as a support when shooting from a tree stand.

6. Other Things to Make

Archers can find plenty of things to make for themselves, and all of them can add to your enjoyment of the sport. Some of them, like the climbing blocks or hauling line can be made quickly and simply. Some, like arrows or bowstrings, take a little more time and planning. Lots of others are complicated projects that may take many hours of work to complete. Examples include items like tree stands, bow presses, string jigs, cresting lathes or bow cases. Let your skills and your imagination be your guide, and try your hand at making your own archery equipment.

7. Exhibit and Sharing Ideas

Nearly any item that is personally constructed could be displayed as an exhibit at your Achievement Day. In addition, some of the items would make excellent demonstration topics or be potential activities for a workshop.

1. Introduction

Archery equipment must be properly tuned if an archer is to enjoy accurate, successful and safe shooting. Tuning involves balancing the bow with the other equipment used, adjusting the bow for optimum performance and adapting the equipment to the archer's shooting style. The fundamentals of proper shooting form must have been mastered to a reasonable degree, with the archer capable of shooting groups successfully. Tuning involves factors of both the arrow (material, thickness, diameter, weight, length and attachments) and the bow (nocking point location, plate or plunger adjustment and arrow rest performance).

2. Arrow Selection

Typically, tuning starts with selection of arrows. Arrows should be matched to the bow carefully, and to each other. High quality arrows are extremely consistent from shaft to shaft and are straight. Spine or stiffness of the arrow is the most vital factor in good performance. Spine is a dynamic and complex feature of arrow behaviour. It involves the type of arrow material, shaft length, shaft diameter, wall thickness, structure and mass of the arrow and its attachments. The weight and structure of the arrowhead, the type of insert and the style and amount of fletching influence the spine to some degree.

The archer's paradox is that an arrow must flex to fly straight. The amount of flexing is critical to good arrow flight. Longer arrows of the same construction and size are "softer" than shorter ones, so arrow length influences stiffness. Target archers usually cut their shafts to their true draw length. Bowhunters unusually cut the shafts $\frac{3}{4}$ to $1\frac{1}{4}$ inch longer than the true draw length to keep the broadhead away from the back of the bow and their hand. Running a simple test or consulting a spine chart will confirm the relationship between length and stiffness.

Arrow weight, and therefore speed and momentum, are influenced by shaft length, too. The longer arrow has greater mass. Although it may have somewhat greater momentum, it is more difficult to propel at the same speed or velocity as a lighter shaft. Overdraws permit use of shorter, lighter, thinner shafts, achieving higher velocity while maintaining adequate spine for good performance in heavy bows. Shooting style, arrowhead mass and other factors can also be important. The archer must determine the best combination for his or her shooting style and equipment.

Shooting form, bow tuning (set-up) and arrow spine deviations can cause impact changes. Arrows that consistently hit on the bow-hand side may be too stiff if the other factors have been checked. Those that strike to the string-hand side are likely to be too soft, or the head is too heavy for the arrow spine. Bowhunters should be particularly cautious, since performance with heavy broadheads may be quite different from that seen with field points used in practice.

3. Fletching

Fletching helps control the arrow in flight. The drag and spin provide stability to the shaft, although a properly tuned bow should shoot bare shafts equally well at short ranges. The two primary fletching materials used today are feathers (primarily domestic turkey feathers) and plastic vanes. The former are cut to length and burned to shape. The latter come in hard and soft materials, a variety of styles and thickness and a pre-cut or cast shape. In general, feathers offer more control. Archers speak of them as being "more forgiving" of minor form faults. At the same time, feathers are much more affected by weather and susceptible wear. Vanes are more "slippery" in the air. They may increase arrow speed slightly, but at the cost of being less forgiving of shooting form faults. They are also much more resistant to weather changes.

The amount of fletching required depends on use of the arrow. Normally flight arrows have the smallest amount of fletching. Target arrows are next. Hunting arrows usually have very large areas of fletching to guide the heavy arrows under uncertain conditions. Target archers may be satisfied with three 2-3 inch vanes; or they may opt for more flight stability with "spin wings," a thin, curled type of vane. Hunting archer or field archers usually use four 4-inch vanes or three 5-inch ones to adequately control the heavy arrows in heavy bows.

Fletching may be applied in line with the shaft (straight fletch), slightly offset or in a spiral (helical fletch). These styles are listed in decreasing order of speed and increasing order of control and stability. Selection of a fletching style involves trade-offs between speed and control. Usually the choice in style reflects personal experience and preference.

Some archers use strips of brightly dyed rabbit fur at the back of their fletching to increase their ability to follow the arrow. Others use either spirally wound feathers or six full-length feathers to control the cast of the arrow. These flu-flu arrows are used in shooting at flying targets or small game and game birds.

4. Point Selection

Arrowheads come in many types and styles. Target points are no longer limited to the traditional short, sharply pointed cone. Many archers do not prefer **bullet-shaped points** because they tend to be deflected less when they strike another arrow in a tight group. Each archer should try these styles of points to see which one they prefer personally. Traditional **field points** now have shorter or longer tips, and may even resemble an elongated bullet point. As with the target points, the archer should examine and experiment to find the ones that perform optimally for them. **Broadheads** come in so many styles and types that they can be confusing. NO hunting broadhead should be barbed.

Broadheads should meet these four criteria:

- Razor sharp
- Tough enough to withstand impact with bone or the ground
- Large enough to be legal and make an adequate wound channel
- True and consistent in flight

Archers will find uses for other types of heads as well. **Judo heads** or those of similar design are outstanding for roving. Blunts are used for small game. **Snaro heads** may be used for flying game. Look at an archery catalog and see which types you might want to try. Remember, size and mass of the head will affect arrow performance and tuning considerations. While the target archer may want to tune specifically for target shooting, the bowhunter may want to tune for the broadhead of choice, selecting practice points that mimic their broadhead's performance.

5. Tuning Your Bow

Three major factors need to be considered when tuning bows for optimal performance. These factors are vertical stability (porpoising), horizontal stability (fishtailing) and clearance. In general, it is wise to tune the bow in the order stated.

Porpoising May be caused by shooting faults as well as by improper location of a nocking point. An arrow that oscillates up and down in flight shows porpoising. Bowhunters may refer to the same situation as "planning". Moving the nocking point up or down slightly will usually correct the situation. As a starting point, locate the nocking point about 3/8 inch above true perpendicular.

Using a target at relatively close range (about 15 yards), shoot three bare shafts and three fletched ones using the same aiming point. If all six arrows are in the same group, the nocking point is correctly situated. If the two groups are not together, move the nocking point slightly in the direction of the bare shafts and repeat the test.

Once you have located the nocking point indicator properly, note it in your record book and mark your bow square as a reference for later use.

Fishtailing Fishtailing is a lateral (side to side) oscillation in arrow flight. Shooting form faults, as well as improper tuning may cause fishtailing. Tuning to eliminate fishtailing involves adjusting either the tension on a cushion plunger or the amount of "center shot" on the bow. Initially, the string and arrow should bisect the limbs on a recurve bow and be approximately 1/8 to 3/16 inch into the sight window on a compound bow. Using the same bare-shaft technique outlined above and following the instructions with your cushion plunger (if one is installed) or your bow manufacturer, adjust the arrows for straight flight. If the bare shafts are to the bow-hand side of the fletched ones, decrease the tension on the cushion plunger or move the side plate closer to the bow. If the bare shafts are to the string-hand side of the fletched ones, increase the tension or move the side plate out from the bow. If major adjustments are necessary, it may indicate that the arrows are improperly spined for the bow. Arrows that are too stiff will impact to the bow-hand side. Those that are too soft will impact to the string-hand side. In general, if you can adjust the two groups to within approximately 4 inches of each other at 15 yards, the spine is within acceptable limits for good arrow flight.

Clearance adjustment is designed to eliminate contact between the arrow and the bow during a shot. Powder applied to the fletched end of the arrow and the area on either side of the arrow rest can leave tracks of any impact. If moving the pressure point in or out slightly does not correct the problem, a change in spine may be needed. If the nock end hits the riser beyond the arrow rest, increase the spine or the length of the pressure point. If the shaft is hitting the riser on the inside of the arrow rest, it may be too stiff for the bow set up. Any time a clearance adjustment is made, adjustment for horizontal stability or fishtailing should be rechecked.

6. Conclusion

Basic bow tuning is a complex process, but one that can be mastered using a step-by-step procedure. First, you need to determine your draw length and the appropriate shaft size at that length. Next, select a fletching style and amount that fits your needs. Third, the bow should be tuned for vertical stability by adjusting the nocking point. Next, tune for horizontal stability. Then, check the set up for clearance. After these factors have been set, a final check of all equipment should be made. The rest is up to you.

7. Exhibit or Sharing Ideas

1. Illustrate tuning problems and correction with a series of targets or illustrations.
2. Give a demonstration on tuning a bow for performance.
3. Examine the physics of arrow performance and discuss the importance of tuning to achieve optimum performance.

1. Introduction

Archery includes many different games, both formal and informal. International competitive shooting, including the Olympic Games, is governed by FITA, the Federation Internationale de Tir a l'Arc. The governing body for FITA-style shooting in Canada is Federation of Canadian Archers Inc. (FCA). You can access the Canadian website at www.fca.ca.

International shooting competitions are relatively long-range games. These events are the equivalent of high-power rifle competitions, using open ranges and relatively large, multi-coloured targets. Different courses of fire are used by men, women and youth of different ages. Cadets, kids under 12 years old, shoot at targets from 14 to 45 meters, while men over the age of 18 shoot at ranges from 30 to 90 meters. Targets for these events are either 80 centimeters (shorter ranges) or 122 centimeters (longer ranges) in diameter. The inner, gold-scoring area is worth 10 points and the outermost white scoring area is worth 1 point. International shooters must use conventional tackle (compound bows are not permitted). Nearly all shooters use sights stabilizers and similar equipment; but release aids and a number of other devices commonly seen in other types of competitions may not be used.

Field archery is more complex. Both indoor and outdoor shoots are governed by FCA, which uses smaller targets with a different scoring system at shorter ranges. Field courses are usually set up with a variety of terrain, target sizes, shooting angles and target types. Shooters may cover a course of 14 to 28 targets in a given round of shooting. Animal targets are used in some types of shoots. Usually round targets are black and white or blue and white with three scoring rings (scored 5, 4, 3 from the center out). Sometimes **silhouettes** or even steel targets with cutout "kill zones" are used. Shooters are usually classed by age, and the type of shooting equipment used, from bare bow to unlimited. Compound bows dominate the field, even though all types of equipment can be seen.

In addition to these formalized types of shooting, archers may enter other types of formal or informal shooting games. They can play golf, often using different types of arrows for different types of shots. They can shoot at huge, 48-foot horizontal targets at long range in the game of **clout shooting**.

They can try their hand at **wing shooting** using hand-thrown bow birds or even mechanically launched disc targets. Some archers rove the woods and fields shooting at safe targets, like clumps of grass, leaves or small rotten stumps. Others may play "poker" by shooting at cards on a target face or tic-tac-toe by shooting at the spaces on a target or balloons on a target butt. Any of these are appropriate shooting games for the archer.

While formal games have documented rules, the informal games you invent can have any set of rules you decide. You are only limited by your imagination. The main things to remember in games are:

1. Safety must be carefully and completely considered at all times.
2. Perfect practice makes perfect shooting (good shooting form is essential to all shooting).
3. Keep it fun by balancing skill and challenge.

Have a good time trying some archery games, competitive ones with other shooters or skill-building ones you can play alone. It is almost impossible not to enjoy yourself while shooting arrows down range.

2. Exhibit and Sharing Ideas

1. Shoot at least one type of formal target archery game. If possible try several different types of target shooting during a series of field trips where the sites and the opportunities present themselves.
2. Research different archery games and present a summary of the rules and courses of fire to your group.
3. Attend an archery shoot and observe the processes used in conducting it. Maybe your 4-H group would like to assist or co-sponsor a shoot.
4. Organize and conduct an invitational archery shoot of your choice for the members in your area or community.
5. Construct a model of an archery shooting field or range and explain the course of fire used.
6. Photograph a tournament or match and tell the story with photographs and appropriate captions.
7. Research an archery game. Write rules, course of fire and history. Exhibit in your record book.
8. Exhibit your record book with scores, comments and notes on a series of events in which you have participated.
9. Demonstrate an established game for your club.



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