

Building Bows

Home Crafting With Archery

This activity and archery contribute to the following badges:



My Adventure Challenge Badge (Beavers)



Be Creative Activity Badge (Beavers)



Our Adventure Challenge Badge (Cubs)



Adventure Challenge Badge (Scouts)



Master at Arms Activity Badge (Scouts)



Model Maker Activity Badge (Scouts)



Sports Enthusiast Activity Badge (Scouts)



Physical Recreation Activity Badge (Scouts)

Pointy Sticks!

The activities in this sheet describe different ways toy bows can be made from common household materials and tools.

Check List

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Safety First

We are about to explore the craft of building toy bows, and using them for archery games and experiments.

Before we do so, please note these **safety rules**:

- **Adult supervision is required.**
- Some of the tools we will need to use are sharp, or hot, or use glue. **Please ask an adult to use these tools, and to help you to use them safely.**
- **Bows use tension.** They may break, especially when putting the string on. Eye protection is strongly advised.
- **Sharp arrows.** Some of the experiments here use sharp arrows (cocktail sticks, skewers, pencils). Please take care not to injure yourself or anyone else.
- **All arrows.** Whether sharp

or blunt, when an arrow is shot from even a toy bow, they can hurt people. Never shoot a bow, toy or otherwise, at anyone or animals. Set targets up in a safe place, and shoot at those instead.

Archery is one of the safest sports available. Act responsibly towards the equipment you use and the people around you, and you will not risk the safety of yourself or anyone around you.

What Is Archery?

The story of archery is the story of humans. The bow is one of our most ancient of tools, and has helped us to feed, protect, and entertain ourselves for thousands of years.

The sport of archery is actually a huge variety of related sports, separated by the type of equipment used by the archer. From shooting traditionally with a basic longbow, to the high-tech world of compound bows and

laser sights, the umbrella of archery covers a very broad base.

Bow Fundamentals

A bow is a device used to store elastic energy (energy stored in something bendy or stretchy, when it is bent or stretched) that, when released, transfers that energy to a projectile (usually an arrow) in the form of kinetic energy (moving energy), to shoot the projectile towards a target.

That all sounds a bit science-y, but when we're building bows it's a good thing to know what we're trying to achieve, and how a bow works.

A bow is made of several basic parts, as shown below (this is a simplified picture – it's not quite the same for a longbow, pictured left; but to compare for our craft purposes, these names will be helpful).

Shoot or fire?

One of those wonderful arguments people get into in the archery world is shooting vs. firing a bow. Simply put, "firing" is a term that came with firearms (guns and so on), and makes sense – they involve fire and explosions.

You shoot a bow. There's no fire involved. At least, not in what you're doing to make the arrow fly.

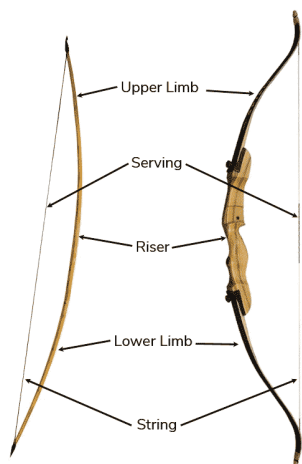
Archers have their own set of terms – technical and historical – for everything to do with archery!

Traditional Archery

Traditional archery is, like it sounds, the practice of archery in a more historically traditional way. This broad form of archery eschews the mechanics, sights, and technological advances of modern archery for the simpler era of wood and feather.

That is not to say that traditional archers are luddites! Far from it. Many bows that are considered traditional make use of modern materials, such as fibreglass, and manufacturing processes.

But there's still nothing quite like a good piece of hand-crafted wood!



The "bendy bits" that store the elastic energy are the *limbs* (the whole bow staff for a longbow), and not the string. But when making toy bows, we can switch this to make the string our elastic energy store, and not have the limbs bend at all – we have options!

(The *riser* is where we hold the bow – simply grip for a longbow – and the *serving* is the part of the string where we put (nock) our arrow, wrapped to make the arrow fit better and to protect the string from wear and tear at the point it is handled and used most).

When the string is drawn by an archer, the limbs (or staff) bend, storing the energy the archer puts in with his muscles as elastic energy. When the string is released, the stored elastic energy in the limbs is transferred to the string and arrow as kinetic energy.

A point of safety and equipment care: Never draw and release the string of a bow without an arrow. If the bow does not have an arrow to pick up the kinetic energy, all of that elastic energy will get transferred straight back into the bow. This is called *dry firing*, and can cause damage to the bow, with potentially very serious consequences.

This won't be an issue for our toy bows, but when you get to shoot real bows, please remember this!

Now we know how bows work, and what we need our bow to do – store elastic energy in a manner that makes it possible to release that energy into an arrow as kinetic energy – we can try and build some working designs.

Lolly Stick Longbow

The lolly stick longbow follows an American flatbow design, using the springiness of lolly sticks to create the limbs, and doubling up lolly sticks to form the central riser.



Materials and Tools

- Four large lolly sticks
- A sharp craft knife
- Non-stretchy string
- Hot glue gun

Method

1. Cut notches into the end of one lolly stick, about 1-2cm down from the tip.



2. Repeat this for a second lolly stick.
3. Take one of the non-notched lolly sticks and glue a notched lolly stick to it, using a glue overlap of about 2cm. Keep the lolly sticks as in-line as possible. The notches should be away from the end you've glued!



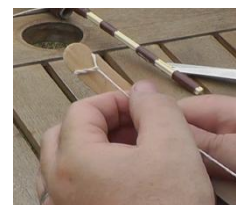
4. Repeat for the other notched lolly stick, glueing it to the other end of the same stick.
5. Take the fourth lolly stick, and use hot glue to glue this on top of the lolly sticks assembled so far. The notched lolly sticks should be sandwiched between the two centre lolly sticks.



6. Take your string, and tie a bowline at one end. Loop this over the notches at one end of your bow.



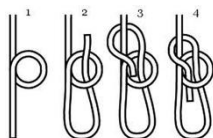
7. Carefully pull the string towards the notches at the other end of the bow, so that the end lolly sticks (your bow limbs) bend to form an arc.
8. Loop the string over the notches at the other end of the bow, and tie off so that the string remains taut and the arc stays in the lolly sticks. Use a bowline, series of overhand knots, or an archer's knot.



And – you're done! See the **Arrows** section for making arrows.

Tying a Bowline

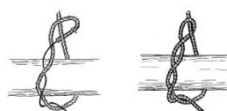
A bowline is a knot used for tying a standing (non-slip) loop. It's often used in climbing and by rescue workers. And, of course, archers!



Tying a Timber Hitch

A timber hitch – or archer's knot, or bowyer's knot – is usually used to tie a rope around logs to drag them. It is also the starting hitch for a diagonal lashing.

In traditional archery, a bowyer's knot – which is the same as a timber hitch – is used to tie off one end of a bowstring. It is useful for this, because it can be easily loosened to allow adjustment, and it can be placed so that it pulls the bowstring to line up perfectly with the centre of the bow.



It is really easy to tie. Loop around the pole (or bow notch) you are hitching to, loop the string back on itself, and add a few twists. When kept under tension, it stays tight.

Kebab Crossbow

A lot of bows, like the skewers used for kebabs at barbecues, are made using bamboo. It's a relatively cheap, eco-friendly resource. But, most importantly, it's bendy and springy! Perfect for bows.

Crossbows work in the same way as upright bows – a string is pulled back that puts elastic energy into a set of limbs. The difference is, they lie horizontally. This makes them more compact and easier to shoot.



They could also be made to be quite powerful. For example, warbows used by the English ranged from about 100 to 180 pounds (give or take) in draw weight, while a crossbow from the same historical period could have a draw weight of 1,000 pounds or higher. You wouldn't be able to pull that back with your hand, though – crossbows of that kind of draw weight used special devices to draw the string.

Materials and Tools

- A bundle of bamboo BBQ skewers (6 for the bow, plus a few for arrows)
- Tape (duct tape, electrical tape, or clear tape)
- A piece of card, about 2cm/1 inch wide and 10cm/3 inches long
- Non-stretch string
- A sharp craft knife
- Scissors or cutters

Method

1. Cut the points off six skewers, ensuring that all six end up about the same length.
2. Take four of your blunted

skewers, and form them into a bundle. Tape the bundle at both ends to keep it together tightly.



3. Take the two remaining blunted skewers, and tape them together at the ends and in the middle. The tape at the ends should be about 1cm in.



4. Open up the bundle of four in the middle, so there are two skewers to the top and two to the bottom. Insert your bundle of two into this opening.

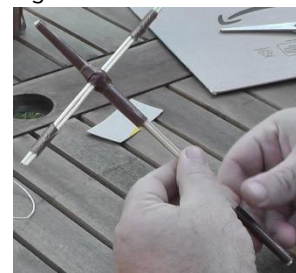


5. Move the bundle of two up inside the bundle of four, until the four grip the two and the two bundles form a cross-shape. Adjust the bundle of two so that it is centred to the bundle of four.



6. Tape the bundle of four to either side of the bundle of two, so that the bundle of two is tightly pinched into place.
7. "Lash" the cross with tape, so the whole is held firmly

together.



8. Add more tape to the bundle of four down from the bundle of two, binding the four as tightly as possible.
9. Insert one end of your string into one end of the bundle of two, in between the skewers. Wrap the string around the skewers a few times. You can add a small piece of tape over your wraps to make sure the string won't slip.



10. Insert the other end of your string into the other end of the bundle of two, pulling the string so that it is taut. Wrap the string around a few times, and tape off.

11. Roll the length of the card around a pencil, to form a 2cm long tube, and tape it together.

12. Tape the tube to the bundle of four, just behind the string level with the bundle of two. Pull the string over the tube, so that it rests against the back.

And... you're done! The tube is a guide for your arrows (for crossbows, known as quarrels or bolts). To load, push your bolt into the tube from the front, and pull the string and bolt back together. Then – just like any other bow – let go to shoot.

Types of Bow

There are lots of different types of bow in archery! Here are some common ones (there are many more):

Longbow – in England, a longbow is a long staff with a roughly D-shaped cross-section, and also makes a D-shape when strung, with the string going from nock to nock and not touching the bow except for those points. In America, a longbow usually has flat limbs, but also makes a D-shape when strung (in England, we usually call these bows "American flat bows"). The difference in design comes from the materials available to bow makers.

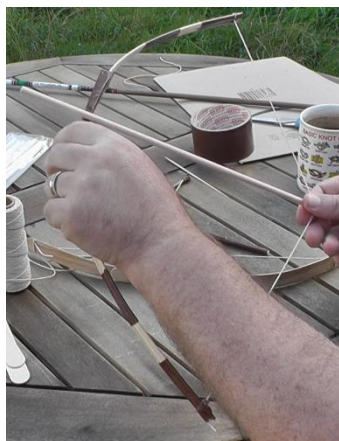
Recurve – a recurve bow has additional curves in its limbs. They enable the bow to store more elastic energy, and to release it faster, than a longbow. When a recurve is strung, its string rests on the additional curves in its limbs.

Compound – a compound bow uses machine energy to, at the same time, assist the archer in using the bow, and allow for even more energy to be imparted to arrows on release than a recurve. It does this by using cam-and-pulley mechanisms. The cams roll over when the bow is drawn, meaning the archer doesn't have the full tension of the bow string at full draw to hold on his fingers. This means that the archer has a more comfortable time in holding and aiming the bow while at full draw.

Compounds are usually fitted with sights, making them even more accurate.

Skewer Longbow

This is a different version of the lolly stick longbow. It uses a similar idea – and the same basic idea used in many bows – using a central anchor for two springy limbs, and shooting through the anchor.



Materials and Tools

- Two large lolly sticks
- Ten bamboo skewers (and some for arrows)
- Duct tape
- Non-stretch string

Method

1. Take five bamboo skewers, and tape them together flat at their pointed ends. Use the full width of the duct tape.

2. Tape the skewers together at the other end, about 1-2cm in.



3. Tape the skewers about halfway between the two areas you've taped already.
4. Repeat steps 1 to 3 for five more skewers.
5. Tape the pointy ends of

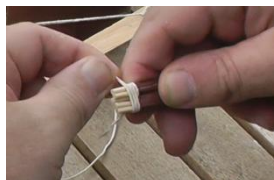
your skewers to each end of a lolly stick, so that the tape used to tape the sticks together is level with the top of the lolly stick. Repeat for both of your skewer bundles.



6. Take your second lolly stick, and tape it to the first, so the two are directly on top of each other, sandwiching the skewer bundles between them.



7. Wrap more tape around the skewers and lolly sticks, so that the lolly sticks are completely wrapped with an overlap over both skewer bundles.
8. Optionally, wrap tape around each skewer bundle, leaving the ends free.
9. Insert one end of your string in between the edge skewers at one end of your bow. Wrap the string three or four times around the bundle.



10. Bring the string down to the other end of the bow, bend the bow to form an arc, then insert and wrap the string at this end as you did in step 9.
11. For safety, add tape over the string at both ends of the bow to stop the string

from slipping.

And... you're done! This bow is very similar to the lolly stick longbow – you have a central handle (riser), and with two separate limbs attached to it.

You may wish to add a small piece of tape to the centre of the string, to make it easier to bring the arrow to it, and a paperclip arrow rest to the riser. These steps are not necessary, though.

3D Printing

If you have access to a 3D printer, there are plenty of model and toy bows you can find on 3D sharing sites such as Thingiverse. From recurves, to takedown, even to fully functional compound bows.



When you do print a toy bow to use, pay particular attention to the instructions given. Often, wall thickness and fill percentages are given to make sure the bow is strong and safe.

Arrows

Before we start on some how-to advice about crafting arrows, let's remind ourselves about safety.

Some of the arrows we are going to be making have pointed ends. **Never, never** shoot these – or any arrows – at another human or animal. Make a target (see **Shooting Your Bow**), and shoot at that.

To absolutely ensure safety, **never point a loaded bow in the direction of another human or**

Arrow Tech

Arrows can be just as technologically demanding as bows! From the material they are made of (wood, aluminium, carbon-fibre, and more), to their weight, their size, length, points used and their length and weight, fletchings, and nocks – all parts of an arrow have been looked at and worked on over the many, many centuries bows and arrows have been with us.

The most important factors for arrows have remained the same over all of that time: first, your arrow must be long enough for you to use with the bow that you use; and second, the arrow must be able to work with your bow. That latter point is a simple sentence, but covers a lot of ground, which we won't go into here. Just suffice to say – when you're getting your first set of arrows, make sure you ask what you should be looking for!

Archer's Paradox

One of the more scientific aspects of traditional archery and arrow choice comes when trying to overcome a phenomenon known as "archer's paradox". The problem goes like this:

When you shoot a traditional bow, your arrow is sitting off to one side of the bow staff. When you release the string, the string travels towards the centre of the staff. So, the arrow has a force placed on its rear in a different vector to its shaft.

To overcome this, we use bendy arrows. Literally. The aim is to get the arrow to bend around the bow, so that it ultimately goes in a

animal. You may accidentally release the bow and hurt someone.

Archery organisations and clubs take safety very seriously for very good reasons, and there is no reason why you should not do the same. Even toy bows and arrows can hurt and injure – **use all bows with common sense and care for yourself and those around you.**

All that being said, on to some ways you can make arrows for your home-crafted bows.

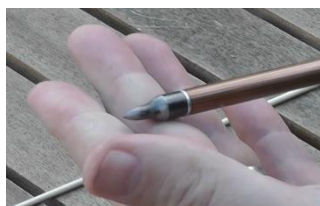
Arrow Basics

An arrow is made up of a shaft, with a point at one end, and a nock at the other. Feathers or vanes can be attached to the shaft in the form of fletchings to help to give the arrow stability as it flies.

Shaft: It is vitally important that the length of the arrow is correct for the bow to be used with it. Too short, and it will flop around inside the bow – this can be hazardous. Too long, and the arrow might not be stable when it flies, tumbling instead of following a path.

To find out how long your arrows must be, draw the bow to the point you wish to use to shoot it, and measure the distance from the string to the bow. Add one or two centimetres for safety. This will be a good length for your arrows.

Point: If you are going to use the bow generally, and don't need it to stick into targets, don't make your arrows pointy. A soft rubber tip is better.



If you do need them to be pointy, then add points – but remember that special care must be taken when using and storing them.

Consider using plasticene, or packing foam, or something similar to cover the points of your arrows when they are not in use.

In either case, you will want some weight towards the point of the arrow to help it to fly, in a similar way to adding more folds or a paperclip to the nose of a paper aeroplane. There are methods of doing this under each type of arrow.

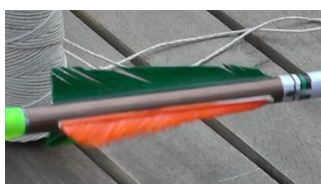
Nock: An arrow's nock is the part of the arrow that connects to the bowstring. Usually, it is a groove or clip that matches the diameter of the string.



For our bows, you don't really need a nock – the diameter of the arrows in relation to the bow string means that there is a lot of arrow at the back for the string to connect to.

For thinner arrows (skewers and cocktail sticks, for example), you can help improve the arrow's connection to string by squashing the nock end flat with pliers. This gives a wide section at the back of the arrow for the bow string to connect to.

Fletching: For the toy bows we show you how to make, fletchings are not really necessary. Most of the mechanics and distances where fletchings become important are not applicable to our small bows – in fact, adding fletchings can put too much weight at the back of the arrow, making it tumble instead of flying neatly.



If you do want to add fletchings, then use thin paper or foil. That

way, you can achieve the look of a real arrow, without affecting how your model arrows fly too much.

Pencils

Pencils make good arrow shafts, and often have a point. They do come in a limited number of lengths, so if you are going to use pencils you will need to make sure your bow is designed to pencil-length.

Pencil-top erasers make nice, soft, safe points, and can be used to cover up pointy pencil ends when you're using them as arrows – safety, and protecting the pencil's point when you come to use it as a pencil again.

Dowel

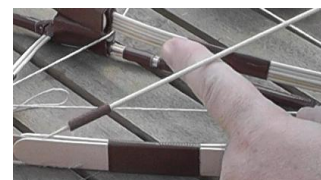
Dowel comes in a variety of diameters and lengths, and is great for making arrows for bows such as the coathanger bow.

Pencil-diameter (about 6mm) dowel makes a good substitute for pencils, with the added benefit of being able to cut exactly the right length for your bow. Pencil erasers will also fit these, and if you need to make a point, you can use a pencil sharpener.

Skewers

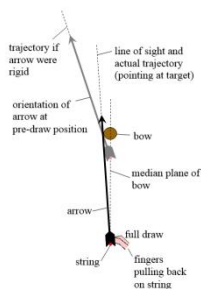
BBQ skewers usually come in sizes that are longer than the bows we've talked about need, so they are good for cutting down to the correct arrow size.

Their downside is their weight. They are very light. You can add small nuts to the front of a skewer, by screwing the nut onto it so that it cuts its own thread. In this way, you can find the perfect weight by adding, removing, and adjusting the position of the nuts used.



Archer's Paradox cont...

straight line,
perpendicular to the
string.



The trick comes in picking the right bendiness – spine – for the bow you use. To bendy, and the arrows will bend around the staff too much. Not bendy enough, and they won't overcome the archer's paradox at all.

Archery is fun, but it can have you scratching your head in puzzlement now and again!

Of course, archers that use shoot-through bows and sight windows cut into the bow riser don't have quite as much to work out, as far as archer's paradox goes. But where's the fun in that? You might as well put sights on your bow, too!

Oh, wait...



You can also add weight using hot glue or tape.

Cocktail Sticks

For the smaller bows, especially the lolly stick longbow and other bows of similar size, cocktail sticks are idea.

Cocktail sticks are very light, so you will want to add some weight to the front of them. Tape is often enough to give them some balance.

Most cocktail sticks are pointed at both ends. Be aware of this! For your arrows, you'll want to cut the rear point off – and likely flatten that rear part of the stick to make a nock, too (see above).

Shooting Your Bow

All of the bows we have talked about making here are too small to get too clever with the many different grip styles archers use to draw bowstring and arrow back. Just bear it in mind that there are different types of grip, and one that works with your toy bows at home won't necessarily work with full-size bows out on an archery range. When using a full-size bow, pay attention to the instructor, and use the grip he will teach you to use, and not the one that seems to work for you to make toy bow shots with!

The easiest and best grip for our toy bows is the "pinch grip". That is, you use your thumb and pointy finger to grab arrow and bowstring together, pull back, and let go to shoot.

Make sure your arrow's nock end is against your bowstring before you draw. The pinch grip should ensure they stay together, at least until you let go.

Targets

A good target for a toy bow is a small box – around shoebox size. It doesn't matter if you go larger, and it only matters if you go smaller if you can't hit your

chosen target at all.

For added enhancement, you can print out the target faces at the end of this booklet, and tape them to your target box. There is one standard target face (the white/black/blue/red/gold one), and a couple of black and white field archery target faces, which you may not be as familiar with. Try printing them out at different sizes – smaller faces for greater challenge!

Resources and Ideas

With the basic understanding of how a bow works, you can experiment with your own designs. Try different materials in different ways, or build on the designs outlined here.

You can try out alternative ideas to storing elastic energy – for example, using an elastic bands with limbs that do not move.

You can find more ideas for building toy bows on the internet, particularly WikiHow (wikihow.com) and YouTube (youtube.com).

Always remember to ask a parent or guardian about any bow or arrow designs you find – not all of them will be appropriate and safe.

Always remember to ask a parent or guardian for help when constructing bows.

Especially where using sharp knives or scissors to cut materials is required.

Safety always comes first.

Taking Archery Further

Building toy bows is a first step into the wider world of archery. From enthusiastic amateurs to professional athletes, and across a broad spectrum of equipment and shooting styles, archery is one of the most engaging sports out there.

There are two main governing bodies for archery in England, and most archery clubs have affiliation to one of them. These are **ArcheryGB**, who belong to the body responsible for the styles of archery you will see at the Olympics; and the **English Field Archery Association** (EFAA), who, as the name suggests, focus more on field archery than target archery.

Field archery is a lot more varied and mobile, often requiring archers to take into account gradients and obstructions when shooting. Target archery focuses more on consistency and accuracy, by largely removing environmental aspects.

No style of archery is exclusive. You can shoot field and target using one or more equipment styles, or specialise in a narrower style – it is up to you.

If you are not sure if archery is for you yet, book a "have a go" session. Clubs and companies such as those mentioned above also put these on, and Scout activity centres often have the facilities to run these.

Please remember that a "have a go" session is not a substitute for a beginner's course.

Once you have decided to take the plunge, have a look at the clubs that are nearby. ArcheryGB has a Club Finder (archerygb.org/clubs-facilities-development/clubs/find-a-club), and the EFAA keeps a directory of clubs (efaafieldarcher.com/club-directory) to help you. Once you have found a club you like, contact them, and they can advise you regarding beginner's courses and so on.

You **must** take a beginner's course if you wish to take up archery as a hobby or sport. This is to ensure you understand

Governing Bodies



ArcheryGB is the governing body most competitive archery in the UK.



The English Field Archery Association (EFAA) focuses on the promotion of field archery.



World Archery is the governing body for most international competitive archery. ArcheryGB is affiliated with World Archery.



The IFAA is the international association, to which the EFAA is affiliated

how to shoot safely – for yourself and other archers around you – and have a basic level of understanding about your equipment. Some clubs have the capacity to put on beginner’s courses, and archery companies such as Indoor Archery in Northampton (indoorarcheryltd.co.uk) and Aim4Sport in Sandy (aim4sport.com) run regular courses. Google “archery beginner courses”, and you should find one near to you.

Archery and Scouting

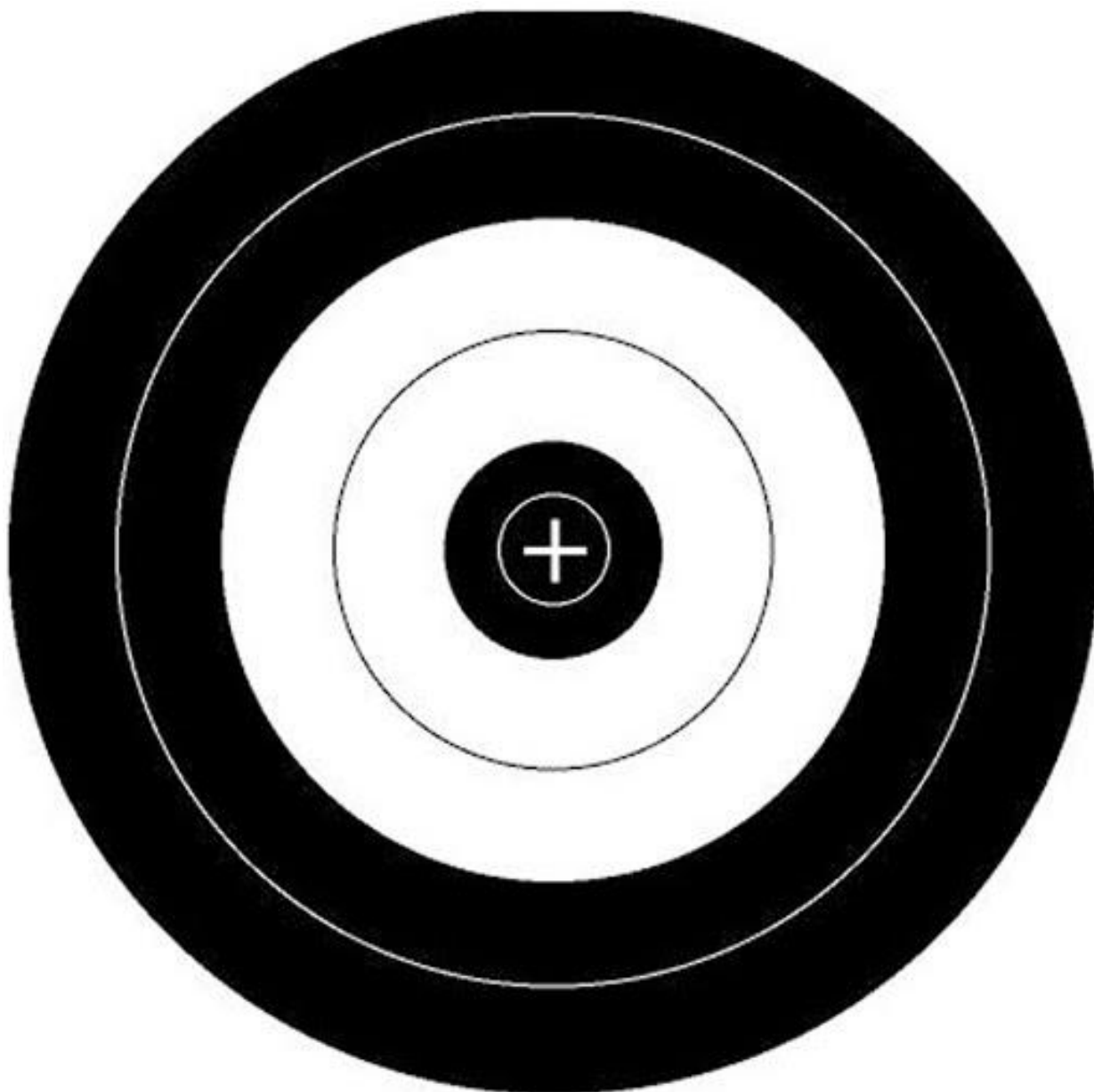
When you are participating in archery as a Beaver, Cub, Scout, or Explorer, or on property owned, leased, or used in the name of the Scout Movement, certain rules apply:

- Targets may not be in the form of or depict human beings or animals. This means you cannot engage in sports such as 2D and 3D archery, where Scouting rules are in effect.
- The activity must be led by an adult with the appropriate permit, according to the type of equipment used and the number of people engaging in the activity.
- Archery permits issued by The Scouts are not equivalent to ArcheryGB Instructor licences. A Scout archery permit will not cover running archery activities away from Scout property, nor will it cover running activities for other youth organisations (e.g., Guides).
- Archery games that involve shooting at people (e.g., Archery Tag) are not permitted.
- More on archery activities within Scouting can be

found on The Scout’s website (members.scouts.org.uk/fs120406)



IFAA Field Target Face

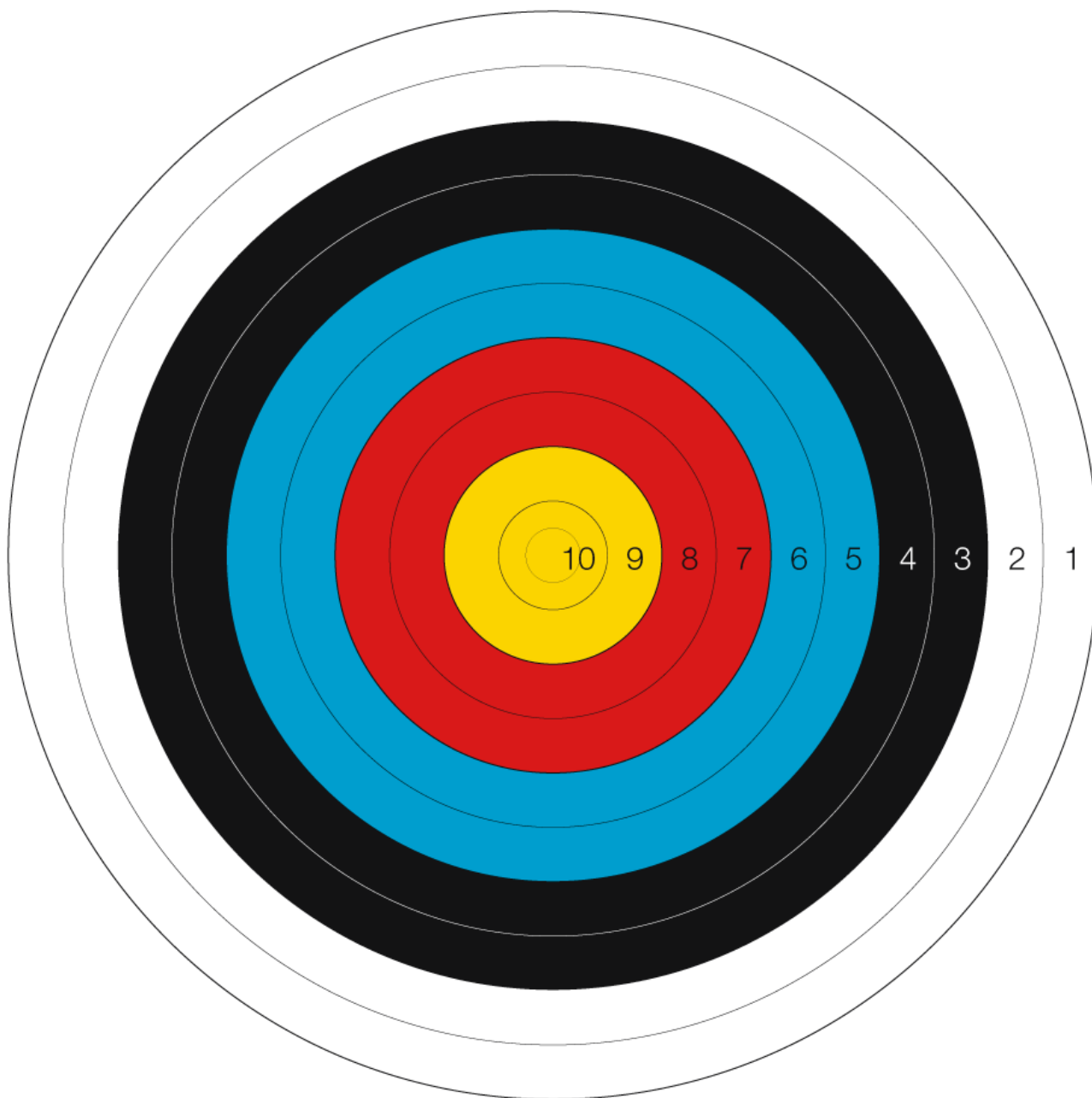


Field archer target face – scores (outside in): 1 2 3 4 5 6

This is one of the types of target face used by the IFAA (and therefore the EFAA). Another common IFAA target face is the “hunter”, which only has three scoring rings (3, 4, and 5 points), and is entirely black except for the ring markings and a white centre ring (the 5-scoring ring).

World Archery (and therefore ArcheryGB) uses field target faces that are all black, except for the scoring ring markings, which are white, and the centre ring, which is gold. The scoring is the same as for IFAA field target faces (1 through 6).

World Archery Target Face

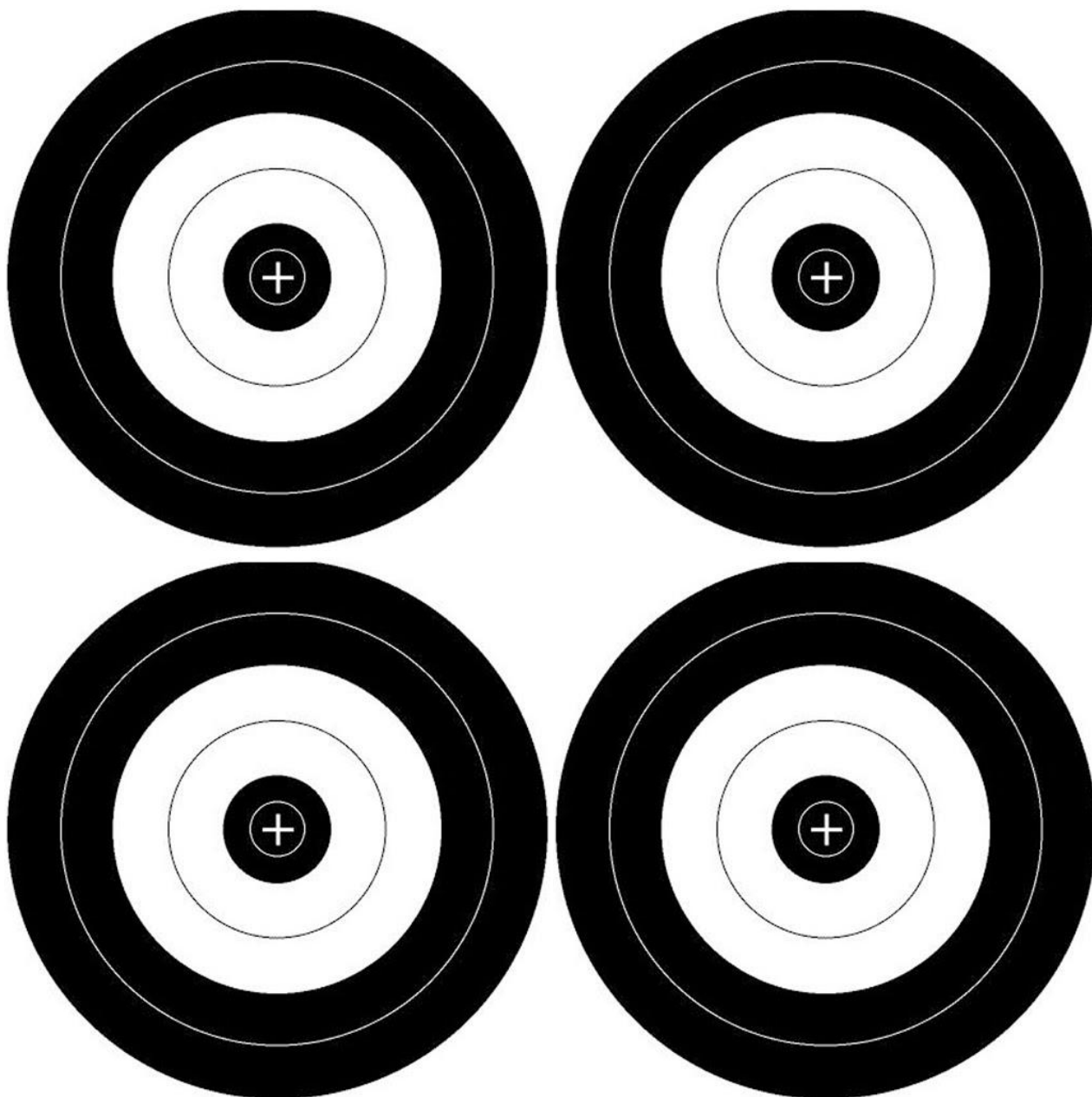


Target archery target face – scores as shown on the target (1 through 10)

Target archery competitions put greater emphasis on degree of accuracy, having more scoring rings that are generally thinner than those of a similarly-sized field or hunter target face.

You might notice that the target has eleven rings, but only ten scoring zones. The centre ring (inside the “10” zone) is used to determine ties – this is the “X” zone for this target face. When scoring, this arrows in this ring are noted as “10X”. If scores are tied, then the number of Xs can be used to break that tie.

IFAA Field Clover Target Face



Field archery “clover” (or bunny) target – scores as field archery target (1 through 6).

One arrow is shot per target face (4 arrows in total), in order – top left, top right, bottom left, bottom right.

If more than one arrow ends up in one target face, then that face scores the lowest value. For example – if your first arrow hits the 4-zone of top right (instead of top left), your second arrow hits the 6-zone of top right, and your third and fourth arrows do not land in any face, you would score 4 points (0 for top left, 4 for top right – the lowest value arrow in that face, and 0 for the misses on your third and fourth arrows).

World Archery uses a three-target vertical “bunny”. Three arrows are shot. The targets can be shot in any order, but only one arrow is counted for each. If two arrows end up in the same target, then the lowest-scoring arrow is counted, and the other is ignored.