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| **Lesson Four: Bronze Working** | |
| Lesson Four is all about bronze working. The lesson focuses on a few different elements in creating bronze, beginning with a video demonstration of how bronze objects are made. It then moves on to discussing alloys - both what they are and how they are created - and finishes with a chocolate casting exercise as an experiential learning task to mirror the process of casting bronze. It is an enjoyable session and so if time allows, it is worth having a go at chocolate casting. | |
| **Curriculum Links - Social Subjects (People, Past Events and Societies)** | |
| Experiences and Outcomes | Benchmarks |
| I can evaluate conflicting sources of evidence to sustain a line of argument. SOC 4-01a  I can present supported conclusions about the social, political and economic impacts of a technological change in the past. SOC 4-05a  I can evaluate the changes which have taken place in an industry in Scotland’s past and can debate their impact. SOC 4-05b | * Demonstrates the ability to provide a valid argument on a historical theme. * Provides at least two valid opinions to support  the argument. * Identifies the impact of a technological change with at least one of each: social, political and economic impacts and gives a reason for the conclusion. * Suggests at least three changes which have taken  place in Scotland’s industry. * Provides at least two positive and negative impacts of one of these changes. |
| **Wider Curricular links** | |
| **Social Studies (People and the Environment):**  I can use specialised maps and geographical information systems to identify patterns of human activity and physical processes. **SOC 4-14a**  **Technologies (Awareness of Technological Developments; Past, Present and Future):**  I can analyse products taking into consideration sustainability, scientific and technological developments. **TCH 4-05a**  **Technologies (Exploring Uses of Materials):**  I consider the material performance as well as sustainability of materials and apply these to real world tasks. **TCH 4-10a** | |

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| **Learning Objectives** |
| To identify how different properties of materials can affect the development of technologies. |
| To describe in detail the method of bronze casting. |
| To assess the impact of scientific and technological developments on ancient society. |

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| **Resources and Suggested Reading** |
| **Required Resources - Supplied in the boxes** |
| Objects: Box 1 and Box 2 objects, particularly those of bronze  Information Sheets: CT Bronze Casting, Timeline  Lesson Resources: Object Summaries, Object Picture Set, Colour Mixing Resource Sheet, Bronze Casting Quiz Questions  Other Resources: ARCH Bronze Age Metalworking video ([link](http://www.archhighland.org.uk/experimental-archaeology.asp)) |
| **Additional Required Resources** |
| Red and yellow poster paint, paint pallets, paint brushes, chocolate, brown sugar, containers, objects for mould impressions, map of the British Isles, map of Europe. |
| **Essential Reading - Information sheets supplied in the box or from ARCH website** |
| CT Bronze Casting |
| **Suggested Additional Reading - Information sheets supplied in the box or from ARCH website** |
| Object sheets: Bronze Halberd - as cast, Bronze Flat Axes (Box 1) Bronze Swords, Bronze Sickles, Bronze Gouges, Bronze Spear, Bronze Sunflower Pin (Box 2)  When? Bronze Age |

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| **Introduction** | | **15 minutes** |
| **Timeline** (10 minutes) | Resources:  Objects: All Box 1 and Box 2 objects  Other Resources: Timeline, Object Summaries | |
| * This task is completed with objects from Box 1 and 2. * It can be revisited as a recap if this activity has been completed as part of a previous lesson. | | |
| Arrange the students into pairs. Have the pairs draw out a rough timeline based on the one supplied in the box. Display the objects clearly around the room.  Students are to look carefully at the objects and write the name of each on their timeline.  Draw out a timeline on the board and have the students feedback their answers. Alternatively, using the timeline from the box, physically place the objects on the relevant space on the timeline. | | |
| **Materials** (5 minutes) | Resources: Objects from Box 1 and Box 2 | |
| * This activity can be used as a recap if already completed within a different lesson. | | |
| Form the pairs into small groups of three or four. Hand out the objects so each student has at least one each.  Ask the groups to answer the following questions ***What is the object made from?******What was it used for?*** And ***What else do you know about it?***Give the groups time to discuss all the objects and then share their answers with the class.  Ask the class ***What is bronze?***The studentsshould identify it as an alloy (metal created by combining multiple metallic elements). | | |

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| **Main** | | | **35 minutes** | |
| **Bronze Casting Workshop** (10 minutes) | Resources:  Objects: Bronze objects from Box 1 and 2  Other Resources: ARCH Bronze Age Metalworking video ([link](http://www.archhighland.org.uk/experimental-archaeology.asp)) | | | |
| * This video was created from footage taken of a bronze casting workshop organised by ARCH as part of the *Experimental Archaeology:* *Learning about Technologies in the Past* project. It is a demonstration of how bronze casting works. Neil Burridge is the speaker and is very experienced working with metal. * You can watch the entire video as part of the lesson. However, timestamps have been provided as a guide to the information essential to this lesson. * Producing high quality sound in the venue was difficult so it may be worth warning students that they will need to concentrate to catch all the information and recap as necessary. | | | | |
| Start the video at **1:29** explain that Neil is discussing how the technology of metal working took thousands of years to travel from Syria - its point of origin - to the British Isles and then to Scotland.  Pause the video at **2:05** and ask the class ***What is the man in the blue t-shirt doing behind the speaker?***He is using the bellows to provide oxygen to the fire and in doing so is controlling the heat of the fire (his name is Matt Knight, the curator of Bronze Age at the National Museums of Scotland).  Finally pause the video at **5:10**. As another *think-pair-share*exercise ask the class to summarise what they have just heard. The key points are:   * Bronze is made from copper and around 12% tin. * It took a long time for the technology of metal working to progress across Europe. * Casting blades began with short daggers, progressed to longer dirks and then eventually progressed to rapiers.   Some of the bronze objects included in the boxes were produced during this workshop. Therefore it is worth sharing them with the class during the video, especially the bronze swords. I was at the session and seeing a sword cast in person was very impressive.  Continue the video from **5:10.** This part shows the casting of a bronze sunflower pin used to attach a cloak, or secure a sword to one’s person (1 & 2) - both these objects can be found in Box 2 and are worth showing the class after the clip. There are two swords in the box; one has been left “as cast” and the other is an example of the finished product (although not sharpened) with a wooden hilt. It is worth noting the casting errors in the blade as it is likely this sword would have been melted down and made again, as the errors would have made it too weak to be used.  The video finishes with a demonstration of the hafted axe from box one being used.  After the clip it is worth recapping the following information:   * The bronze is heated to 1200 degrees centigrade. * It is poured, in its molten state, into a mould usually made of clay, stone or compressed sand. * The mould is then broken open and the object cooled. | | | | |
| **Tracing the Spread of Bronze** (15 minutes) | | | | Resources: Map of Europe (photocopied)  Other Resources: ICT access |
| * The spread of bronze seems incredibly slow when its usefulness is taken into consideration. This visual representation is a good way of clarifying the spread of bronze over time. * The interpretive questions the task finishes with could draw some interesting debate into factors that affect the spread of technology. | | | | |
| Using a map of Europe, have the students research the spread of bronze across the continent. Preferably this would be completed using individual access to ICT. However, it can be completed by displaying the relevant information (detailed below) on the white board/projector for the class to work from.  A simple search of a phrase such as “spread of bronze through Europe” will bring up a range of maps tracing the first evidence of the use of bronze through history. Have the students trace the spread onto their map either using colour coding or through labelling etc. As long as the information is clear the methodology for recording it doesn’t need to be prescriptive.  Ensure the students label the map with the date bronze was adopted in each part of Europe. Ask ***How long did it take the technology to pass from the Middle East through to the British Isles?*** And ***Why was the spread of information so slow given the usefulness of bronze as a crafting material?*** | | | | |
| **Copper, Tin and Trade** (10 minutes) | | Resources: Map of the British Isles, Google maps | | |
| * This is a quick activity to show the distances involved in getting the materials to make bronze. | | | | |
| Display the map of the British Isles on the white board or use a print out. Have the class find Inverness on the map. Display google maps and click on Inverness and then click on St. Just near Lands’ End in southwest England - this is where most of the British tin came from.  This will display how long it would take to travel there with modern transport. If you click the little figure it will show you many hours it would take to walk the same distance. You could have the class work out how many days that would equate to as a quick maths exercise.  Repeat the process for Ross Island, in Lough Leane, Killarney, Co. Kerry, Ireland explaining that this is where copper ingots were sourced from although there are copper deposits in Scotland.  As a *think-pair-share* exercise ask the class: ***As people are unlikely to travel extensive distances, what are the most likely processes of trade in the Bronze Age?*** This could also be completed as a research based question where the students need to submit written answers. However, in brief, long distance trade was taking place during the Neolithic era and continued to develop throughout history. As the Bronze Age progressed trade became even more extensive. Archaeologists have found similar objects and technologies throughout the British Isles and Europe which shows widespread trading networks. | | | | |
| **Practical Activities** | | Resources: Chocolate, brown sugar, containers, objects for mould impressions. | | |
| * There are two practical activities – creating alloys and the process of casting - that are part of the bronze working crafting lessons for Early to Third level. They are not included in detail in this plan as they are optional additions to the lesson. However, they are a good way of offering practical learning. Therefore, a brief description of the activities is included for you to decide whether they may be something you want to try with your class. | | | | |
| **Chocolate casting**: This activity focuses on the process of casting a metal. Using brown sugar as a mould and melted chocolate as the casting substance, the class can create a range of shapes using objects such as chess pieces etc. to make an impression in the sugar and then pour melted chocolate into the mould to make a “cast”. The casting process shows the potential problems as the chocolates will inevitably end up with flaws (as would happen with bronze). Also, if the chocolate is not at the correct temperature when poured it can cause the cast to go wrong mirroring the process of casting bronze.  **Alloy painting**: This activity uses the principal of mixing paints to show the effects of altering the ratios of metals within an alloy. The bronze objects in the box are 12% Tin and 88% Copper which seems to give the best results. Colour mixing is a visual representation of this concept. If the above activities seem worthwhile they can both be found in the Lesson Four - Bronze Working (3rd) lesson plan. | | | | |

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| **Plenary** | | **5 minutes** |
| **Favourite Fact** (5 minutes) | Resources: None | |
| * The following is a quick activity to allow the students to reflect on the lesson they have just completed. | | |
| Ask the class to think, in silence and independently, about the following questions:   1. **What question would you ask Neil Burridge if you could?** 2. **What facts can you recall from the lesson?**   Share and collate the class’s responses. | | |

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| **Total Lesson Time: 55 minutes** |
| **Teaching notes** |
| 1. The bronze swords are objects that always go down well with any class and they may want to spend longer on them than planned in the session. It is worth having a really good look at the objects as they have some great examples of casting errors, mostly caused by the molten bronze cooling too quickly while being poured and not filling the mould correctly.   (2) The Bronze Age pin is a gorgeous object that would have been an impressive possession and a sign of status. It is in the box in both its “as cast” and completed form - the final object being highly polished. Handling this object will cause the bronze to dull and lessen its impact so it is worth handling it with the cotton gloves provided, as genuine archaeologists would do, to preserve its shine and impact. |
| **Links and Further Information** |
| Further information is available on the ARCH Experimental Archaeology project webpages <http://www.archhighland.org.uk/experimental-archaeology.asp>. The Bronze Age Metalworking section of the ARCH website has links to a video and a blog with further information and links. Books The results of the North Kessock project have been published in 2017 in Feats of Clay. Bronze Age metalworking around the Moray Firth, by Graham Clark, Trevor Cowie and Susan Kruse, available from the North Kessock and District Local History Society, and available in the Highland Library system. This includes an illustrated catalogue of known metalwork from the southern Highlands (bounded Auldearn to Glenurquhart, Dornoch Firth to Aviemore). Bronze Age metalworking is also featured in Trevor Cowie’s 1988 publication Magic Metal: Early Metalworkers in the North-East, Aberdeen. Objects on display in Highland Museums A number of museums have Bronze Age metalwork on display, particularly Inverness Museum and Art Gallery and Dunrobin Castle Museum. The Poolewe hoard is in Gairloch Museum, joining other single finds on display. Images online A number of images of Bronze Age metalwork from the Highlands is available on the internet, particularly on the SCRAN website [www.scran.ac.uk](http://www.scran.ac.uk), with free access for schools and many library users. Other images are on the ARCH website [www.archhighland.org.uk](http://www.archhighland.org.uk) in the Find of the Month archive.   * Late Bronze Age hoard from near Dingwall, with a sunflower pin, axeheads and neckring. Details on [SCRAN](http://www.scran.ac.uk/database/record.php?usi=000-000-142-177-C&scache=2qfvq1nt0j&searchdb=scran) and [ARCH](http://www.archhighland.org.uk/news.asp?newsid=37) websites * Dail na Caraidh, near Fort William hoard of early Bronze Age axes and daggers on display at Inverness Museum and Art Gallery. Details on [SCRAN](http://www.scran.ac.uk/database/record.php?usi=000-000-597-582-C&scache=1107w1xfo3&searchdb=scran) * Bronze Age sword from Inverbroom. Details on [SCRAN](http://www.scran.ac.uk/database/record.php?usi=000-000-577-395-C&scache=210al1xfoz&searchdb=scran) * Anvil with scrap hammerhead and spearhead from Auldearn on display in Inverness Museum and Art Gallery. Details on [SCRAN](http://www.scran.ac.uk/database/record.php?usi=000-000-597-561-C&scache=510c61xfoi&searchdb=scran) * Stittenham Late Bronze Age axehead mould. Details on [SCRAN](http://www.scran.ac.uk/database/record.php?usi=000-100-034-219-C&scache=210xp1xfou&searchdb=scran) and [ARCH](http://www.archhighland.org.uk/news.asp?newsid=170) website * Knockgrainish Early Bronze Age axeheads, on display at Inverness Museum and Art Gallery. Details on [ARCH](http://www.archhighland.org.uk/news.asp?newsid=140) website * Early Bronze Age axehead from Auldearn. Details on [ARCH](http://www.archhighland.org.uk/news.asp?newsid=57) website * Early Bronze axehead from Culbin near Evanton, now on display in Dingwall Museum. Details on [ARCH](http://www.archhighland.org.uk/news.asp?newsid=27) website * Decorated axehead from Nairn. Details on [SCRAN](http://www.scran.ac.uk/database/record.php?usi=000-100-034-224-C&scache=510c61xfoi&searchdb=scran) * Poolewe late Bronze Age hoard with axeheads, rings and cup-shaped ornament. Details on [SCRAN](http://www.scran.ac.uk/database/record.php?usi=000-100-034-434-C&searchdb=scran) * Heights of Brae gold hoard (on display at the NMS in Edinburgh, with replicas in Inverness Museum and Art Gallery). Details on [SCRAN](http://www.scran.ac.uk/database/record.php?usi=000-100-043-981-C&scache=2qgb61nt0p&searchdb=scran)  Other Videos [Ewart Park Bronze Age Sword](http://www.youtube.com/watch?v=qGqPnzkRZp4) (13:40) www.youtube.com/watch?v=qGqPnzkRZp4 Neil Burridge makes a Bronze Age sword  [Liquid fire to metal](http://www.youtube.com/watch?v=eEWIuyeNp2k) (3:13) www.youtube.com/watch?v=eEWIuyeNp2k Neil Burridge demonstrates bronze casting  [Bronze Age Casting – Axe heads](http://www.youtube.com/watch?v=MI14SjbiEdM) (3:28) www.youtube.com/watch?v=MI14SjbiEdM James Dilley, who did the ARCH flint knapping workshop, demonstrates making axeheads Websites Neil Burridge’s website: [Bronze Age Craft](http://www.bronze-age-craft.com) |

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