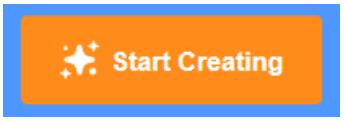
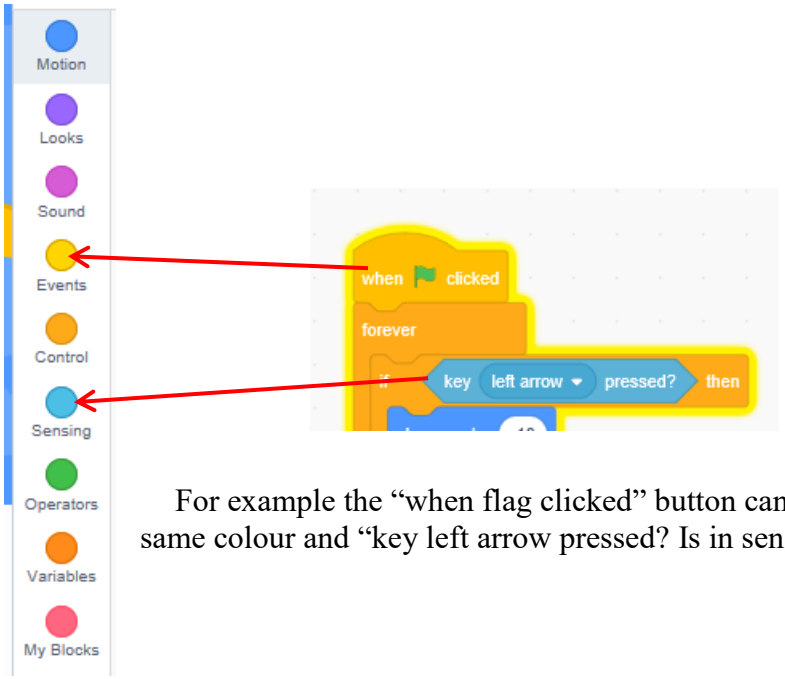
Space Invaders Tutorial

Go to www.scratch.mit.edu and click on the “Start Creating” button.



A warning message *may* pop up asking if you would like to enable Adobe Flash Player. If it does, click either “yes” or “enable”. You should then get to the normal Scratch programming screen.

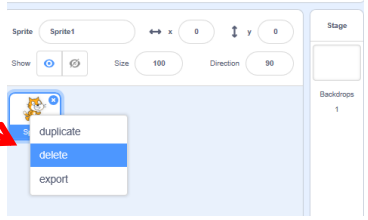
On the left hand side of the screen you will find the categories that the coding blocks are split into. These are colour coded to make it easier for you to copy the code in this tutorial.



For example the “when flag clicked” button can be found in “events” as they are the same colour and “key left arrow pressed? Is in sensing, as it is light blue.

Making Space Invaders!

You should be looking at the initial Scratch Coding screen, with just a cat sprite on the right hand side. Right click on the Scratch cat sprite and delete it. He won’t be going to space!



Adding a Background

You will now be left with a completely blank project. The first thing to do is to add a space background.

In the box at the bottom right hand side there is a backdrop selector. From here you can browse the backdrop library by clicking on the blue icon.

This will open the library, where you can find a selection of backgrounds. One of the them is stars, which is suitable for this project. There are others such as galaxy that could also be used. It is important to note that the choice of background will be important to your gameplay. If it is too busy then it will be a distraction from the game. If it is close in colour to the sprites or the ship then they may be difficult to see. All of these things need to be taken into account when designing games.

Adding the Ship

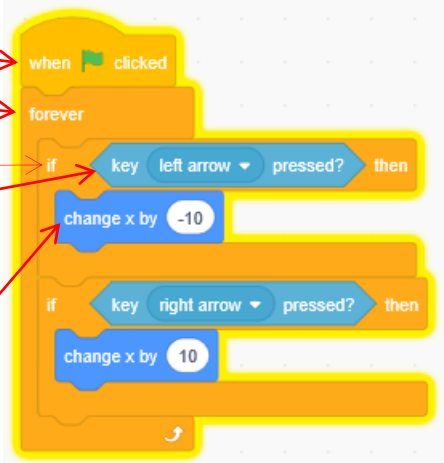
Next you need to add the ship sprite. This will be the Space Ship that you control in the game. To add it hover over the “add sprite” icon and select the top option, “upload sprite”.

Now go to the “Invaders” folder – your teacher will tell you where to find this. Open the ship.png file and your ship will appear on the game stage. Drag it to a position near the bottom of the screen.

Making the Ship move

You will now need to add code to make the ship move. Words in brackets are the categories you will find each button in. (See picture below)

When the green flag is clicked, start the code. (Events)
Forever loop – keep doing this until the game is stopped. (Control)
If Loop – if this happens, do this. (Control)
Key Left Arrow pressed? Then – tells the if loop what to look for. (Sensing)
Change x by – tells the code what to do when it detects the button press. In this case move 10 pixels left. (Motion)



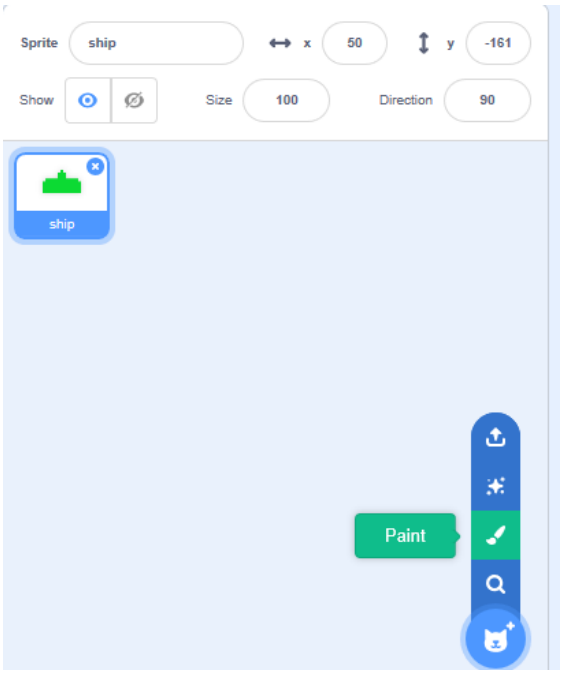
The rest of the code does the same thing for the right arrow.

Note that this script is for moving the ship. Left or right arrow is selected from the drop down box and x changed by -10 or 10. A negative x value means move left and a positive means move right.

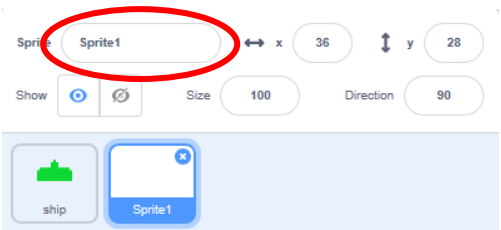
You can test your code by clicking the green flag above the stage. You should be able to move your ship with the arrow buttons on your keyboard.

Create and add a laser

Now we need to add the ship's laser. The laser will be a separate sprite, as we want to be able to add code to move it. Click on the paintbrush to design your own laser.

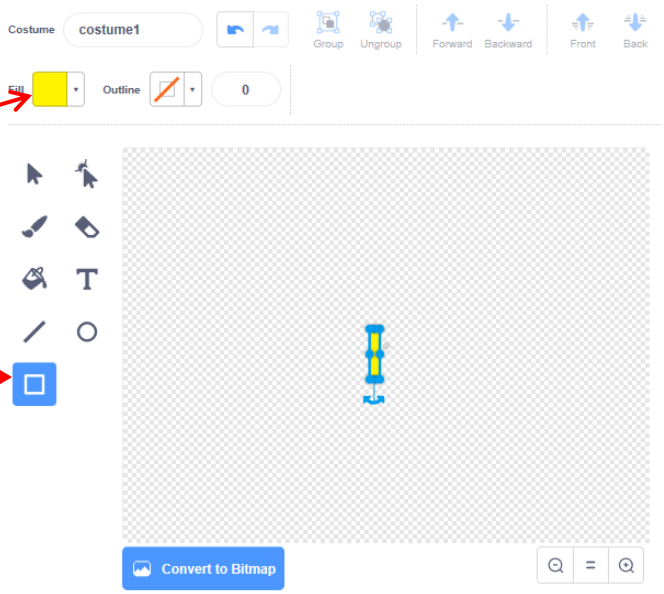


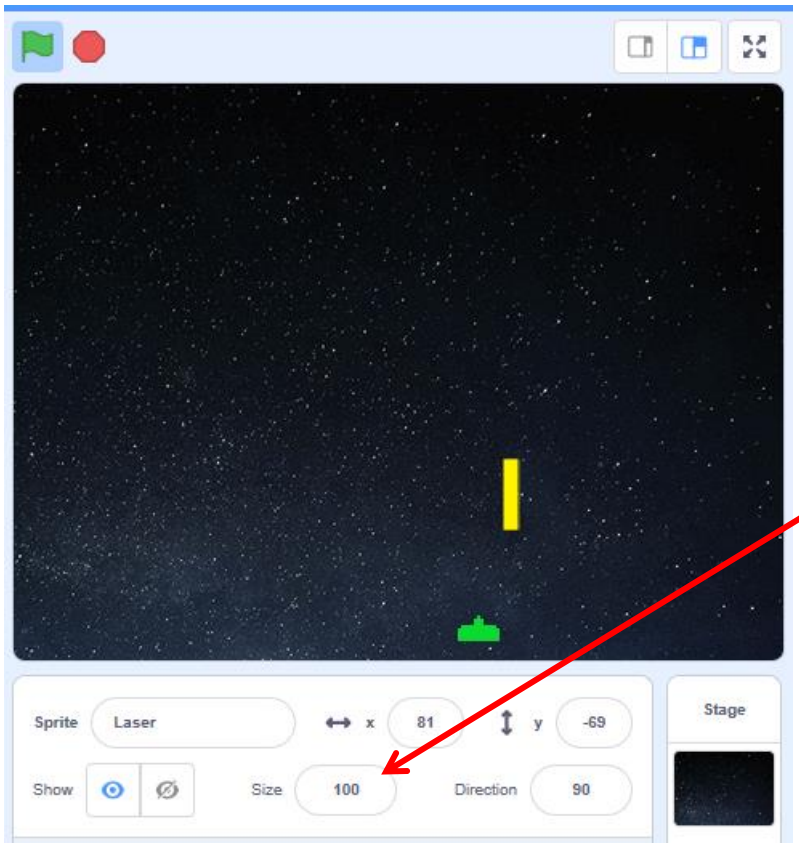
This will create a sprite which will be automatically named "Sprite1". Rename it "Laser" by clicking in the name field and typing the new name.



Using the rectangle tool draw a tall, thin rectangle.

Use the Fill option to choose the colour you want the laser to be. (Remember to make it stand out against your background!)





The laser will appear on the stage. You can drag it into the correct position.

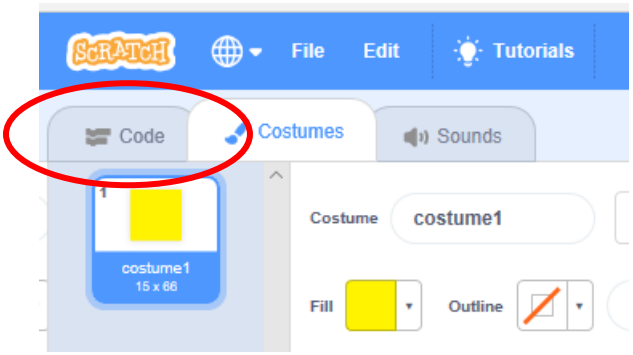
As you can see here, the laser blast is too big – it's bigger than the ship! There's no need to go back and re-draw it smaller though, you can simply make the size smaller by decreasing the **size** value.

In this case, 23 looks pretty good:

(Sometimes when you change the number in the size field the software will make it a different value. This is due to the size you entered being difficult to display effectively. If you can't get the size and shape you want, it's possible to resize it more by clicking and dragging on the handles (the blue dots) in the drawing you made.

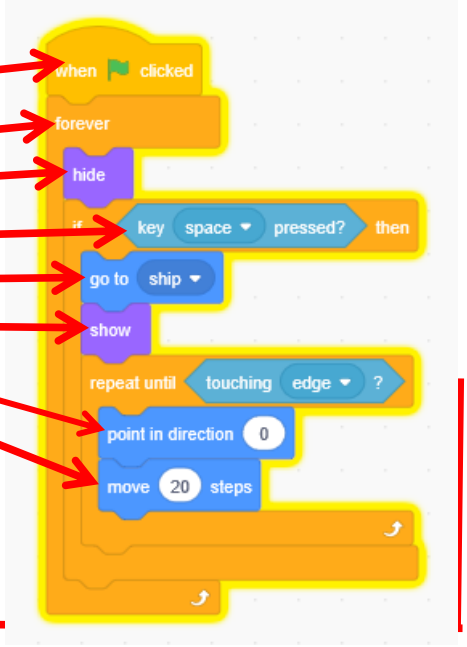
Making the laser move

When you are happy with how the laser looks, move from the “Costumes” tab to the “Code” tab.



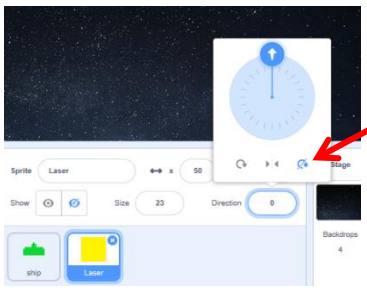
You now need to add the following code:

- Start the code running.
- Keep the code running the whole time.
- Don’t show the laser yet.
- If the space bar is pressed then:
- Go to the ship.
- Show the laser,
- Point up the screen,
- Varies the speed, how fast the laser moves up the screen.
- Continue to move up the screen until reaching the top.



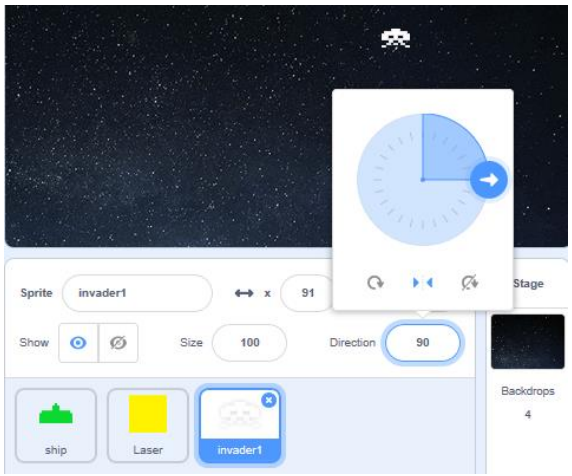
This code may look complicated, but if you take the time to read over each step described above it should begin to make sense. If you don’t understand what each piece of code does then try to change it and then run the code and see what happens.

Depending on how your laser was drawn, when you run the code it may shoot up the screen on its side. It is not immediately obvious how to fix this. You need to tell the software that it is not to be rotated. To do this click on the **Direction** field and a compass will show up. Click on the **Do not rotate** icon on the right. It will now fire correctly.



Adding a Space Invader

The invader sprites can be found in the "Invaders" folder. There are 3 to choose from. Pick 1 to begin with and add it the same way as the ship sprite. (Hover the cursor over the add sprite icon then choose **Upload Sprite**). Repeat this to add all 3 sprites. We can set up the rules and code for 1 Invader and then copy it. This saves us from coding every Invader separately.

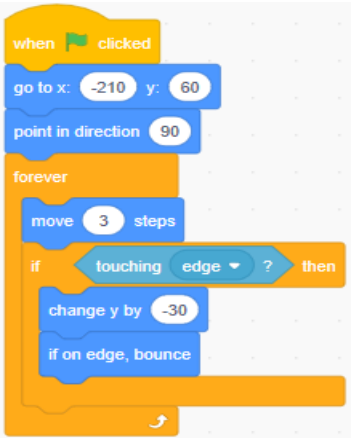


Click on each sprite in turn and then, as we did with the laser, click in the direction field. This time pick the middle icon, **Left/right**, this means the Invader can turn to face left or right but cannot flip upside down as he moves.

Making the Invader move.

Now we need to make the invader move. The invader should move across the screen. Each time he reaches the edge he should move down the screen and then go back the other way.

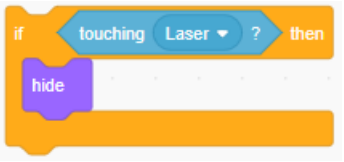
- When we click the green flag the invader needs to go to his start position.
- His movement is initially from left to right, so he points right (90).
- For the duration of the game
- he will move in small steps.
- If he reaches the edge of the screen he should drop down,
- and then change direction.



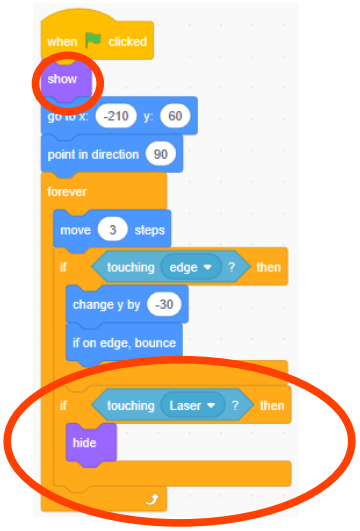
Click the green flag on the game screen to make sure that the invader moves as expected. It is important that these blocks are placed in the right order. If you tell the invader to bounce before he has dropped down a level then he will remain at the same height throughout the game, as bouncing first means the sprite is no longer touching the edge and the game will ignore the instruction to change y by -30.

Make the Invader interactive!

We now need to make the invader disappear if he is shot with the laser! This is very simple to do. We only need to add the instruction to hide if the laser touches the sprite.



Since the invader should hide when he touches the laser at any point during the entire game, we can place this code inside the "forever" block we already have. Any time a sprite is told to hide, it must be told to reappear. Since we want the invader visible at the start of the game, it makes sense to put the show command there.



Now try running the code and see if you can shoot the Invader! You now have a basic game.

Invader and ship crashes

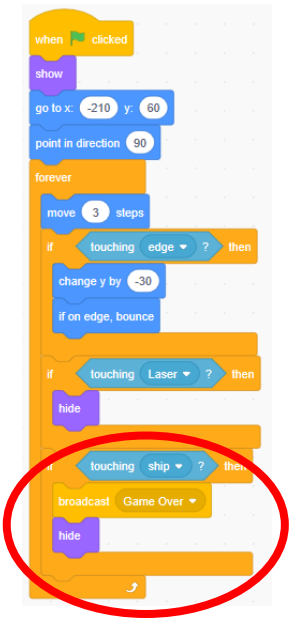
If the invader crashes into the ship, both the invader and the ship will be destroyed. We need another "if" command. This time we will tell the Invader to "broadcast" a message if he hits the ship. This tells the other sprites that something has happened, and they can be told to respond.

This code is also very simple.

When using the broadcast block you need to add the message you want the sprite to broadcast.
Do this by clicking on the small drop-down arrow and selecting "new message". You can then type what you want the message to be.

Again, this block should be added inside the "forever" loop we have already created.

The code simply says if the Invader ever touches the ship to shout game over and hide!

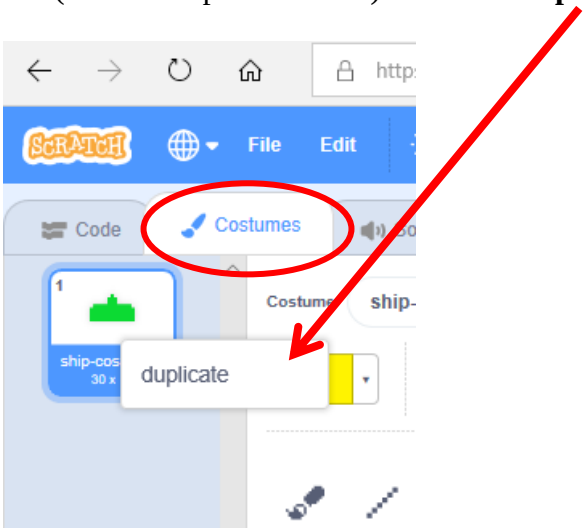


This completes the code for the Alien!

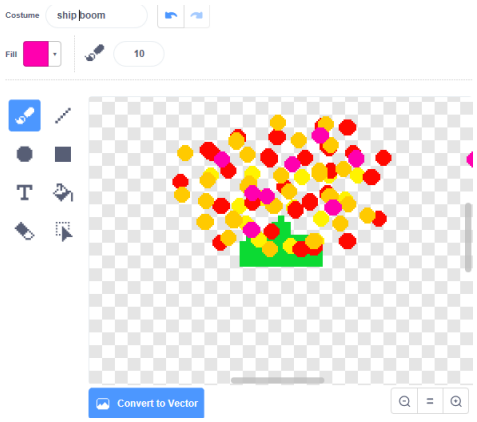
Adding the ship explosion

We now need to edit the code for the ship, to tell it to "listen" for the Game Over message if the Invader touches it. Select the ship sprite from underneath the game window.

We need to make a new costume for the ship which shows it has been destroyed. To do this right click on the ship in the **Costumes** tab (NOT the Sprite section!) and click **Duplicate.**

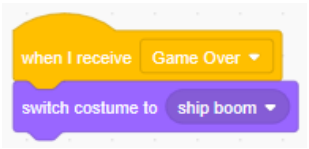


You will now have a second ship costume that you can edit.



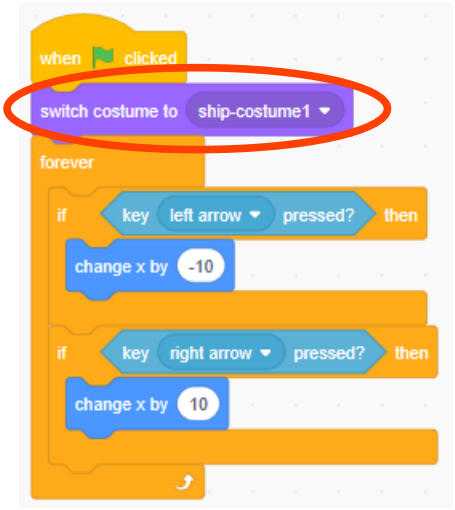
In the example above the paintbrush tool was used to add an explosion effect on top of the ship. The costume was then named "ship boom" for easy identification.

Now we add a short code to tell the ship that if it is touched by an invader to change to this costume.



This small code tells the ship that when the Invader sprite broadcasts "Game Over" then it should change costume to ship boom. It is important to remember that the ship needs to be in the normal "ship" costume at the start of the game, so we will also add code to do this.

It can be placed into the existing code with the green flag.

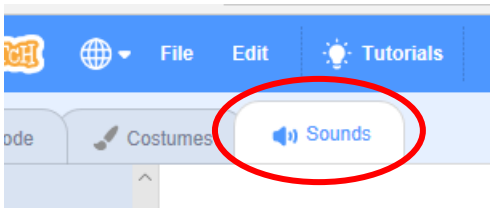


Adding Sounds to the game

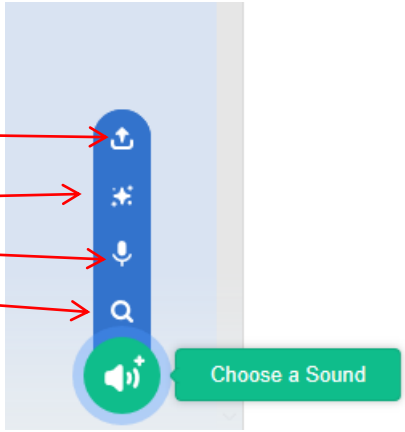
There are a few options for adding sound. You can:

- add sounds from Scratch's sound library;
- import sounds from your computer;
- record your own sounds with a microphone.

These options are all available in the "sounds" tab.

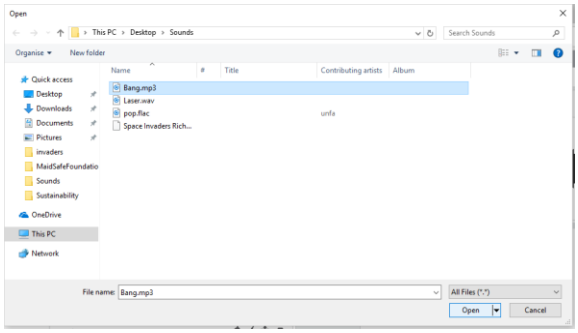


- Upload from your computer – you can use your own sounds from your Computer.
- Surprise – add a random sound.
- Record – record a sound using your microphone.
- Choose a sound – open the sound library.



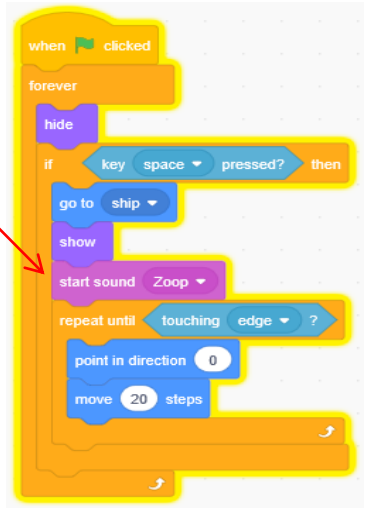
To add a sound, for example when the laser fires, you need to add it to the laser's sound bank first. Click onto the laser sprite and then can open the sound library and browse the sounds. If you find a sound you would like to use then double click on it to insert it into the laser sound bank. When it is added you can use the tools shown below the waveform to do some basic editing and to add further effects. The sound below, "zoop" from the sound library is good for laser fire.

To add a sound downloaded online click on the **upload sound** icon then browse for the file and click "open".



You can then see the sound effect has been added to your library.

Now to add the sound to the game. Click on the **code** tab. Make sure you are looking at the code for the laser. If not, click on the laser sprite in the Sprites window. In the **sounds** tab you can add the "Play Sound" command. If the sound you imported is the only sound in your library it will already show in the drop down box. If it doesn't say the name of your chosen sound effect then click the drop down arrow and pick it. Add it to the code where appropriate, for the laser this is just as it appears on screen.



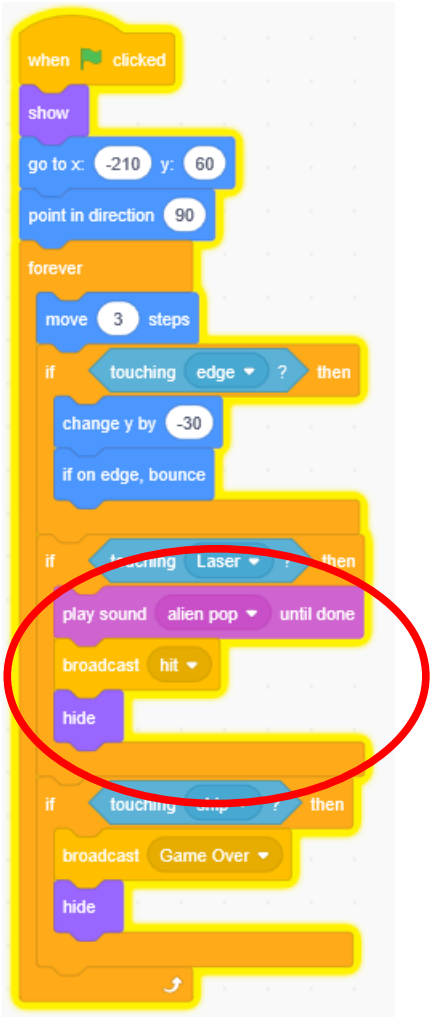
You can now repeat the process to add a noise when the ship explodes and when the Invader is shot.

Click on the green flag and check that your game behaves in the way you would expect. You might notice that when the laser hits the invader that the invader disappears as you'd expect. However, the laser keeps going up the screen. This means it could hit more than one invader. You can leave it like this but the game will be very easy. To fix it let's add a little more code.

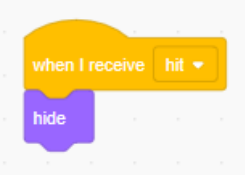
There are several ways to do this. You could:

1. Add code to the laser to say "if touching invader1, hide". This will work perfectly, but we want to add more than 1 invader. If we use this method we would need to add more code for every invader we add. This is messy and slow.
2. Add code to say "if touching colour ▯ , hide". This will also work as long as all of the invaders are the same colour, otherwise new code needs to be added for every colour of invader. There is also an issue because the invader is to hide if the laser touches it, and the laser is to hide if it touches the invader's colour. Both of these things will happen at the same time. (The invader will obviously touch the laser at the same time the laser touches the invader). The Scratch software will only execute one of these lines of code though, and it will be whichever is first in your programming. This means either the laser disappears and leaves bullet-proof invaders, or the invader disappears and the laser carries on to hit another invader, the same as above. This version doesn't work well.
3. Add code to have the invader broadcast a message when it touches the laser. The laser will then need code added to hide when it "hears" the invader's message. When the invader is cloned then this code will be copied to each invader, so they will all tell the laser to hide when it hits them. This seems like it will work. We will go with this. The invader and the laser code need to be edited.

Invader1



Laser



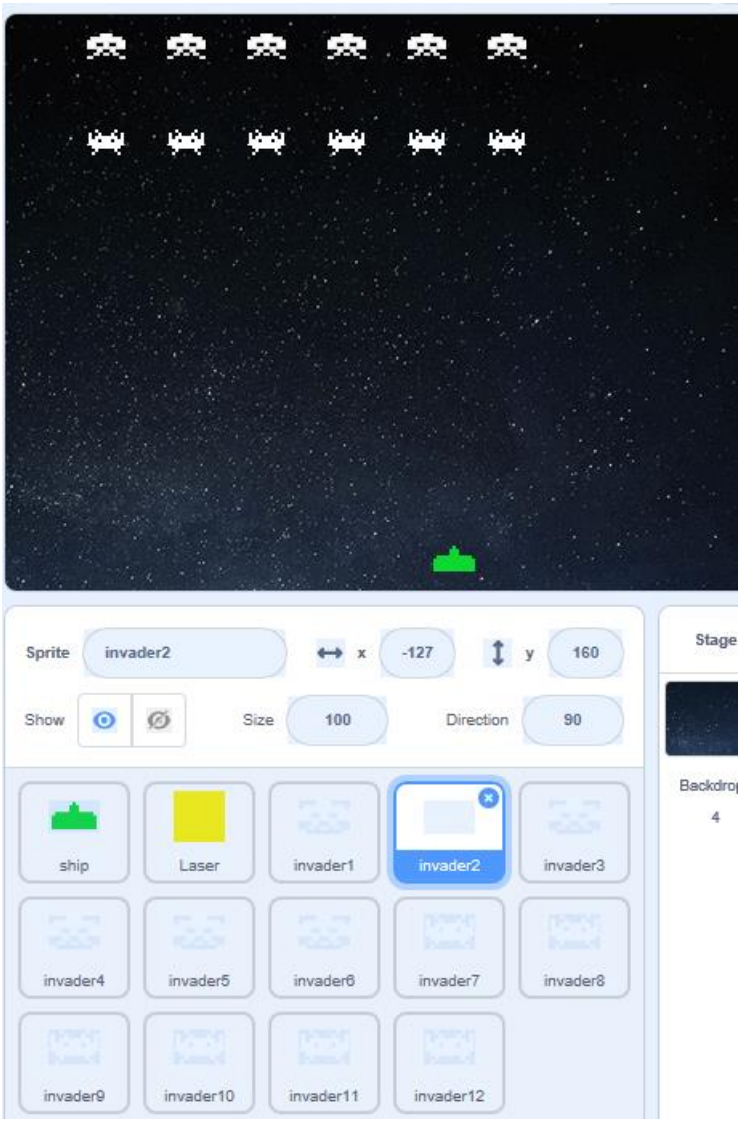
Now run the game again and make sure both the laser and the invader disappear when they collide.

Cloning the Invaders

We should now have the complete code for the invader. It's time to clone more enemies! This is very simple, just right click on the Invader sprite and select "duplicate". You will then have another sprite named "invader2". At the moment their code is identical. This means they start in the same place and move at the same speed. It will look like there is only one invader. We need to change invader 2's start position.

The invaders need to start side by side, in a neat row, so the y-value (start height) won't change. The x value needs to be increased by 50 each time we clone a new invader, so invader1 starts at x:-210 y:160. Invader2 is x:-160 y:160, invader3 is x:-110 y:160 and so on. (Be careful with negative values here!)

Clone up to invader7. Invader7 needs to make a new row, lower down so the Y value needs to decrease to 100. To start a new row he also needs to move back to the beginning of the line. So the position for invader 7 should be x:-210 y:100.



As invader 7 is a new row it would also be a good time to change the costume. Click onto the **costume** tab and click **Costume2**. The Invader will now look different. Clone this Invader until you have a complete second row. (Up to Invader12)

You can now clone this invader and change the start position each time. When you get to invader 13, change to the third costume and remember to decrease the y value in the start position by 60. You need to have 18 invaders in total. Their start positions are shown below.

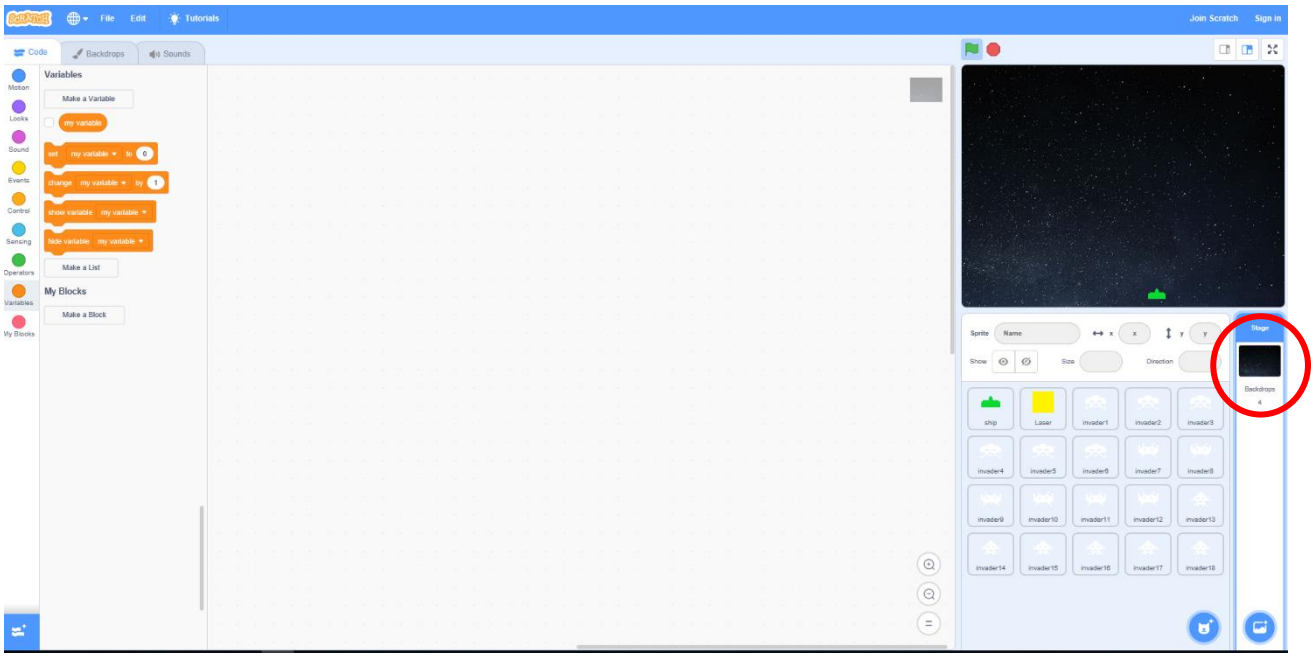
Invader1 -210 , 160	Invader2 -160, 160	Invader3 -110, 160	Invader4 -60, 160	Invader5 -10, 160	Invader6 40, 160
Invader7 -210, 100	Invader8 -160, 100	Invader9 -110, 100	Invader10 -60, 100	Invader11 -10, 100	Invader12 40, 100
Invader13 -210, 40	Invader14 -160, 40	Invader15 -110, 40	Invader16 -60, 40	Invader17 -10, 40	Invader18 40, 40

We now have all of the invaders, the laser, the ship and the sounds set up. Click the green flag and have a try! If you see any mistakes you can click on the red “stop” icon, next to the green flag and click on the sprite which isn’t behaving. You can then look at its script and check for mistakes. This is called “debugging”.

The game is now playable but in order to make it better we need to add a scoring system, game over screen and start screen.

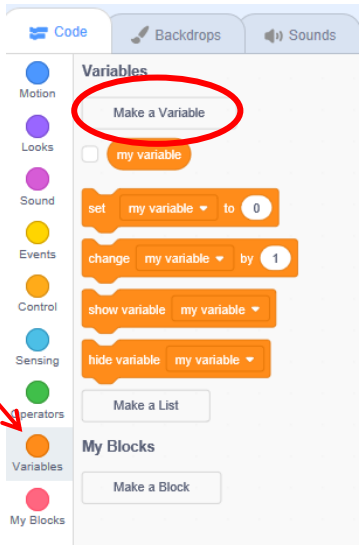
Adding a score counter

We will now create a *variable* – an item that changes when an event happens. In this case, our variable is a score counter which records the number of Invaders hit. The score is not a sprite, so we add it to the code for any of the other sprites. The easiest option is to add it to the background. Click on your background in the **Stage** area below the game screen. It will now show that there is no code attached.

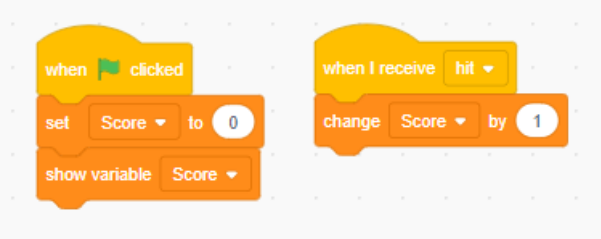


We need to select **Variables** from the code categories; and then choose the first option, **Make a variable.**

In the box which pops up **New variable name:** type **Score** and click **OK.** The score counter will now appear on the upper left corner of your game screen. We now need to add code to make it work.



Add the following code to the background code tab. This says when the game starts, reset the score to 0 then show it on screen. Notice that the score also listens for the invader's "hit" broadcast that makes the laser hide. Every time it is broadcast the score increases by 1.



Your game is now complete!

Extension Activities

Your game needs an introduction screen, instructions page, game over page and a level complete page. Each of these 4 items need to be added as backgrounds and the **broadcast** and **when space key is pressed functions** should be used.

You will need to add code to the **backdrops** tab.

Use the **Paint** function at the bottom right of the screen to create each backdrop.

The Introduction screen needs to have:

- The name of the game
- Your name(s)
- Instruction to press space to continue.

The Instructions page needs to have:

- The point of the game (what is the player trying to do?)
- Instructions on how to move the ship and fire the laser.
- Instruction to press Enter to start the game.

The Game Over page needs to:

- Be displayed if the ship is destroyed
- Tell the player "Game Over"
- Offer the chance to play again by pressing Enter.
- Return to the Introduction screen if Enter is not pressed within 5 seconds.

The Level Complete page needs to:

- Congratulate the player.
- Offer the chance to play again by pressing Enter.
- Return to the Introduction Screen if Enter is not pressed within 5 seconds.

Challenge

Currently the game only has 1 level. Can you make another, more difficult level? What would make it harder? (Aliens move faster? Ship moves slower? Can only shoot once every 2 seconds?)