chapter 1

introduction to 2D-animation working practice

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chapter summary
During this chapter I will take you through two things – the equipment needed to make a basic animation studio and some simple animation. We will look at x-sheets and how they help timing, flipping, flicking and rolling, how to use a line tester and how to put the lessons learnt from your drawn exercises onto a 3D-computer program. By the end of the chapter you will have learnt how to organize yourself and how to plan a piece of animation.

I make no apologies for taking you right back to basics. Many of you may know much of this but bear with me – it is worth refreshing your knowledge and reinforcing the basic principles behind animation.

**how animation works**

**the basics**

2D drawn animation consists of a series of drawings shot one after another and played back to give the illusion of movement. This animation can be played back in a number of ways.

- In the form of a ‘flipbook’ (basically a pile of drawings in sequence, bound together and flipped with the thumb).
- The drawings could be shot on film one drawing at a time with a movie camera and played back using a cinema projector.
- They could be shot on a video camera and played back with a video player.
- They could be shot with a video camera attached to a computer and played back on the same computer using an animation program.
- Or they can be scanned into the computer and played back.

**frames per second**

Animation shot on film and projected is played at 24 frames per second.

Animation for television in Europe, Africa, the Middle East and Australia is played at 25 frames per second. In these countries they use a television system called PAL which plays at 50 fields (frames) per second and 25 frames per second is compatible with this. If we played an animated film at 24 frames per second on the television, we would see a black bar rolling up the screen. The Americas, the West Indies and the Pacific Rim countries use NTSC, which runs at 60 fields per second. This means you should be animating at 30 frames per second (60 is divisible by 30). Quite often some sort of digital converter is used to transfer one speed of film to another speed of video, allowing 24 frames per second film to be shown on a 60 fields per second (NTSC) TV. If you stop frame through a video of an animated film, you will find there are points at which one frame will blur into another. This is how they overcome the incompatibility of the two systems (stop framing through animated movies is a very good way of learning about animation). The most important thing to find out when animating something is at what speed the animation will be played back. All the animation taught in this book will be played back at 25 frames per second.
what you need for your studio

In order to complete all the drawn exercises in this book you will need the following things (all of which are available from the professional animation equipment suppliers listed at the back of this book):

- animation paper
- peg bar
- light box
- x-sheets
- line tester
- pencils

animation paper

When animating, you often find that you are working with four or more layers of paper. A level of translucency is necessary to see all the drawings. Professional animation paper is made with this in mind.

It also comes in different sizes. These are referred to as field sizes – 12 field and 15 field are the most popular; 15 field is 15 inches wide, 12 field being 12 inches wide (I'll explain this in more detail later in the chapter when I refer to field guides, the grid that measures field sizes).

Most professional animation paper comes with three punched holes. It is possible to buy this paper with no holes. (This is cheaper but you will need a specialist animation punch, which is very expensive). Used with a peg bar, the holes allow accurate placing of each piece of paper with the next. This is important, as the slightest movement in a drawing will show when the sequence is shot.

It is possible to use A4 paper with standard ring binder punched holes and a peg bar with two pins that fit the holes. This will work out far cheaper than professional animation paper.

peg bar

Professional peg bars are a strip of steel or plastic with three pins. These are industry standard and are used with professional animation paper. These are used to register each piece of animation paper against the next.

It is possible to buy two pin peg bars – these are often called junior peg bars.

It is equally possible to make your own using a strip of wood with two pieces of dowel that correspond to the holes in your paper, or even to tape two 5 mm countersunk bolts onto your
light box. These can then be used with ring binder punched A4 paper.

As with the paper, bear in mind that if you want to use your animation professionally, it is advisable to buy a three-pin peg bar.

**light box**

In its most basic form, a light box is a flat sheet of opal Perspex over a light. Professional light boxes use a rotating disc. They should also have the ability to change the angle of the drawing surface. This makes drawing easier both on the wrist and on the back.

Simple light boxes are relatively straightforward to make. You could use a wooden storage box with the top part cut off at an angle with a neon bulb mounted inside. A piece of 6 mm opal Perspex is then fastened to the top with screws.

**x-sheets**

X-sheets are also referred to as dope sheets or exposure sheets. They are used by the animator to record all the necessary information relating to how the animation should be shot. A standard x-sheet consists of several columns that run from top to bottom and 100 rows that run from left to right. Each row represents one frame of animation. If the animation is to be played back at 25 frames per second, 100 frames will equal 4 seconds of animation.

The columns on an x-sheet mean the following things.

1. **sound column**

This contains the sounds that are relevant to the animation. Very often this is the dialogue spoken by the characters. For animation the dialogue is recorded first. It is then ‘broken down’. This means that someone, usually an editor, will go through the sound track frame by frame. They work out where each word starts and ends and where each of the major vowel and consonant sounds are. These are then marked on the x-sheet in the sound column, frame by frame. You then know that at a certain frame in a scene a particular sound is made.
This blank x-sheet can be photocopied or you can print up an x-sheet from the folder X-SHEETS in chapter001 of the CD-ROM.

2. **action column**

This contains the instructions on when a given piece of animation will start and end. An experienced animator will fill out this part of the x-sheet before they start animating. Sometimes the director will fill this out. The process is often referred to as 'slugging out'.
3. the frame numbers column

As the heading suggests, this is where the number of each frame is inserted. One of the main ways of ‘cheating’ in drawn animation is to do your animation on ‘twos’. This means that each of your drawings is shot for two frames. This saves a huge amount of work. For example, if you have to animate 4 seconds you only have to do 50 drawings, rather than 100 drawings if you did a drawing for each frame (assuming a rate of 25 frames per second). You will also find that at times you will want to ‘hold’ your animation. For example, at a given point in the action a character may move into a position where they stand still for a second or so. At this point you could just have one drawing ‘held’ for however many frames are needed.

There are two ways to number your drawings. The first way is to number them by the drawing. This means that drawing number one will be numbered 1, drawing number two will be numbered 2, etc. The other way is to number them by the frame. This means that the drawing on frame one will be numbered 1. The drawing on frame three (if the sequence is shot on twos, this would be the second drawing) will be numbered 3, the drawing on frame five would be numbered 5, etc. Each method has its advantages and disadvantages. It is probably better
for the aspiring computer animator to number drawings by the frame so that when you look at your drawings in order to copy their position with your computer model you know exactly what frame that pose should be on. All the exercises done in this book will be numbered by the frame.

The columns show the order in which the levels are placed. Background at the bottom level, foreground at the top with the character in the middle.

Each drawing will have its own number. Each unit represents a frame. The drawing number is inserted to show where that frame of animation will be in the sequence. This varies depending on how many frames per second each drawing represents. The example shows a sequence that is shot on twos (i.e. each drawing is
shot for two frames). When something is on twos the first row has a number and the second is left blank. It is unnecessary to fill in every frame, if at the end of a sequence the last drawing is held for 10 frames (i.e. the drawing is shot for 10 frames) a line should be drawn for the 9 frames after the written number. This is indicated by the line that runs from the bottom of the drawing number to the last frame that the drawing is held for. If the drawing is held for more than two frames, it is necessary to insert a line to show how long the drawing is held for.

4. **the levels columns**

When a sequence is animated, even if there is only one character, the drawing for one frame of animation may be on several levels of paper. If the body remains still during the sequence, but the head and arms are moving, there will be only one drawing of the body for the whole sequence. If the head is moving at a different rate to the arms, the head will be on a separate piece of paper and the arms on another piece. If there is a background and the character is stood behind, for example a tree, this will again be on a separate piece of paper. However accurate the final drawings are, if you have to retrace exactly the same drawing 20 times or more, there will be variations between the drawings that will show when the animation is played. It also is an unnecessary use of time. Before the use of computers, the finished drawings were traced and coloured onto Cel (cellulose acetate or clear plastic sheets). This allowed for a maximum of six levels before the thickness of the cell made the colours on the lower levels look muddy. Today, each of these levels would be painted and assembled together with programs such as Soft|Image Toonz or Animo. This allows for infinite levels without any loss of quality.

5. **the camera column**

Information in this column instructs the camera how you want the scene to be shot and pinpoints the area within the artwork.
The most important piece of information is the field size. The most popular paper is 12 field, which means that the camera at its maximum setting will shoot an oblong area that is 12 inches wide.

Traditional 2D animators use a field guide, also called a graticule, to work out the position of the shot. For example, to shoot your animation using the full size of the paper it is marked on the top of the camera column as 12-field centre. As a 3D-computer animator, you won’t be using field sizes. However it is worth understanding how they are worked out.

The field guide has North, South, East and West printed at the top, bottom, right and left. It consists of 24 columns and 24 rows in a grid. The columns are half an inch wide. By using these compass points and grid references you can specify any area on your paper that you want to be shot.

The illustration below shows an oblong area at the top right of the paper that is 5 inches wide. This would be 5 field at 7 east/7 north of 12-field centre. Using the field guide you work out where the centre of the oblong is in relation to 12-field centre (the centre of the field guide). To find the centre you would count along 7 lines east and 7 lines north from the centre of the field guide (12-field centre). See illustrations over page.

Using this method, you can place a field of any size in any area.

All exercises in this book are at 12-field centre (or if you are using A4 photocopy paper, 10 field at 2 south of 12-field centre).

**line tester**

A line tester is a device that captures your drawings and plays them back. It is a quick and easy way to see if the roughly drawn sequence works. There are a number of ways to set up a line tester. You could use a film camera, a video recorder that can record
single frames or a line testing software program and a computer. The movie examples on the CD-ROM were produced using a program called ‘Digicel Flipbook’ (there is a demonstration copy on the CD-ROM with instructions). Other alternatives are available. I would suggest looking for a program that contains anim-sheet, as this is best for working out timing.

The simplest and cheapest way of setting up a line tester is to use a web-cam together with a computer and the line testing software. Set the camera to point down onto the table. The camera could be mounted on a tripod or even stuck to a steel rule that is then attached to the top of your computer. Stick your peg bar to the table, put a piece of your animation paper onto it and align it under the camera. The peg bar is important for the accurate placing of drawings. It is also possible to scan drawings into the computer using a flatbed scanner, but it takes an awful lot longer than using a camera.

Now would be a good time to load the demo copy of Digicel Flipbook onto your PC and familiarize yourself with its operation.
pencils

When doing drawn animation it’s always best to work in rough with a Col-Erase blue pencil and then ‘clean up’ your drawings afterwards with a graphite pencil. This means you can define the correct lines of the character and add details in graphite pencil on top of the rough Col-Erase lines. Also, when you line test your animation the graphite line will show up more distinctly than the blue lines underneath.

An HB or B pencil is needed for the clean drawing whilst a coloured pencil is used for roughing out the animation. Sold under the trade name of Col-Erase, these are coloured pencils that can be easily erased and are great for drawing with. You can work rough with a graphite pencil but it can get very confusing when it comes to cleaning up the drawings.

let’s get animating

There are two ways to animate a sequence using traditional 2D animation. These are animating ‘key to key’ (also known as ‘pose to pose’) and ‘straight ahead’.

key to key animation

‘Key drawings’, also referred to as ‘keys’, are important drawings that sum up the essence of the action during a scene.
Key to key animation is when the ‘key positions’ or ‘poses’ in a sequence are drawn before completing the sections between them (‘in-betweening’). I always like to think of the key positions as being the plot or a précis of a scene. They give a rough overall feel of the animation. The in-between drawings (‘in-betweens’) provide the characterization or detail.

Animating key to key allows for a large degree of control over your animation. It can prevent the character or object from changing size or distorting where you don’t want it. It also means you have control over the timing of your animation and can more easily predict what action will happen when and where. By line testing the keys you can see the basic movement of a sequence before completing the full animation.

In the end all the frames of your animation are important and if you put too much emphasis on the key positions the animation can look clunky and stiff.

Below is an example of key to key animation.

A man sits at a table with a glass of liquid on it. He picks up the glass and drinks from it.

- Key number 1 – He looks at the glass.
- Key number 2 – He grasps the glass in his hand.
- Key number 3 – He raises the glass to his lips.
- Key number 4 – He tips the contents of the glass into his mouth.

How many in-betweens and where they are positioned (the timing) depends upon the character and the mood of the man.

If he was thirsty, he would quickly grab the glass (only a few in-between drawings and spaced far apart) pull the glass up swiftly to his lips (maybe spilling some liquid), pulling back his head and tipping it straight down his throat.

To create the illusion of speed you have less in-betweens with larger gaps between each drawing.

If he was an alcoholic he may pick up the glass carefully to avoid spilling any liquid (a lot of in-between drawings, positioned closely together). Just before the glass reaches his lips he might dip his head, so as to avoid spilling any liquid in case his arm fails. He would then drink long and slowly.

To show slower movements there are more in-betweens and smaller gaps between the drawings.

If the man were hesitant about drinking the liquid, he may pull his hand back just before grasping the glass and, holding it with the tips of his fingers, bring it slowly and delicately to his lips so he could take a small sip.
animating straight ahead

This is when images in the sequence are drawn directly one after the other. It can produce a more vibrant form of animation with more energy and exuberance. Unfortunately there is far less control with straight-ahead animation and distortion and changes in size are more likely. It is also more difficult to work out the timing because you can only check the animation with a line tester when it is all done and then it may be wrong and you have to throw away a lot of drawings and redo it.

flipping, flicking and rolling

There are three skills that are invaluable when animating with pencils and paper. These are flipping, flicking and rolling. These allow you to see the drawings moving while you are animating. To practise these skills, we are going to animate a ball bouncing into the screen, hitting the ground and then bouncing out of the screen. Each of these bounces describes an arc, which is referred to as a parabola.

This is a good example of timing in animation. To create the dynamics of the movement of the ball, the drawings are spaced at different intervals. As the ball bounces, it accelerates towards the ground in an arc, pulled by the force of gravity. At the fastest point the drawings are furthest apart. At the highest point of the bounce (the apex) the ball is travelling more slowly. Here the drawings are closer together. To create acceleration as the ball falls to the ground, the drawings of the ball are placed further and further apart. As the ball hits the ground, it squashes down, absorbing the energy of the fall. It then un-squashes and accelerates into the next bounce, slowing down as it reaches the apex of this next bounce.

This principle of animation timing is relevant to all animation. The closer the drawings are together, the slower the movement, the further apart they are then the quicker the movement.

flipping

Grab an old exercise book, sketchbook or block of Post-It notes. With these we are going to make a flipbook. We are going to use this flipbook to bounce a ball across the page using straight-ahead animation.

With the spine furthest away from you, lift the pages until the bottom page is facing you. Draw the ball in the top left-hand corner of the bottom page of your flipbook. Following the illustration draw one ball on each subsequent page. When the ball hits the ground remember to squash it so that it is almost flat. As it leaves the ground, stretch the ball along the arc it is following.

When you have completed the sequence, hold the flipbook at the spine with your right hand, place your left thumb at the bottom of the flipbook, with the left-hand index and forefinger at
the top page of the flipbook. Bend the flipbook up towards you with your left hand and allow the pages of the flipbook to slide away from your thumb. All being well you should see your ball fall in an arc from the top left of the page to the centre bottom of the page where it squashes and bounces up to the top right of the page (open flipbook.avi in chapter001 of the CD-ROM for a demonstration of how to do this).

You have just created a piece of straight-ahead animation, i.e. where images are drawn one after the other.

This exercise should have given you an idea about timing and spacing. Try experimenting with the distance between one ball and the next (e.g. if the balls are very close together they will move slowly and appear to float).

Flipping is a good way to see how your animation is working when you are using animation paper. Arrange your drawings with the first drawing of the sequence at the bottom of the pile and the last drawing at the top. This is called the flipping order. Hold up your drawings with your right hand at the top of the pile and your left hand at the bottom. As with the flipbook, pull the drawings towards you and let the drawings slide off your left-hand thumb one at a time as they fall flat. If this is too awkward (your pile of drawings is too thin), try putting some blank pages on top of these drawings to make the pile thicker (open up flipping.avi in movies001, chapter001 of the CD-ROM).

**flicking**

Flicking is a technique used to look at your animation while you are sitting at your light box. When mastered it means you can see how your animation is moving and you can adjust your animation accordingly by re-drawing.

For this next exercise we will use our punched paper, the peg bar and light box. Put your light box on the table in front of you in a comfortable position.

Always animate with the peg bar at the bottom of your piece of paper. It’s much more difficult to flip and flick with the peg bar at the top.

We are going to animate a piece of key to key animation using the same sequence as for the flipping exercise. We will be numbering these drawings by the frame and each drawing will be shot for two frames (twos).
Place your first sheet of paper onto the peg bar. At the bottom right-hand corner of the paper, label this drawing no.1. This is our first key drawing.

Place a second sheet on top, using the peg bar to register it. Draw a squashed ball and label it drawing no.11. This is our second key drawing.

Lastly place a third sheet over the previous two and draw a ball at the top right-hand corner and label this drawing no.21. This is our third and final key drawing.

Remove drawing no.21. We will in-between drawings no.1 to no.11. This means we will draw the drawings that go between no.1 and no.11.

The first in-between we draw will be no.9. This is half way between no.1 and no.11. This may seem rather odd, but it will help give the impression of the ball speeding up as it hits the ground. If we look at the timing chart, we see that, because the ball was at its slowest on the apex, there are more drawings closer together at this point. As the ball falls out of the sky the drawings get further and further apart. This is why the drawing half way between no.1 and no.11, is drawing no.9.

The first drawing you do as an in-between is often referred to as a ‘breakdown’ drawing. This is the major in-between.
Timing charts (also known as breakdown guides, in-betweening guides or telegraph poles) are used to show where the in-between images should be drawn. They are generally placed at the bottom of the key drawing and should relate to the drawings between that key and the next. They consist of a horizontal line with a vertical line at each end representing the key drawings. The breakdown (major in-between) drawings are indicated by a vertical line with a couple of arcs between it and the key drawings. The remaining in-between drawings are represented by shorter vertical marks.

This illustration shows the breakdown guide for drawings no.1 to no.11.

Drawing no.7 is half way between no.1 and no.9, drawing no.5 is half way between no.1 and no.7 and drawing no.3 is half way between drawing no.1 and drawing no.5.

When we in-between our sequence, we need to ‘flick’ our drawings. Place drawing no.11 over drawing no.1 and a clean sheet over these. Label it drawing no.9. Hold drawing no.9 with your left thumb and forefinger. Slip your index finger underneath drawing no.11. Leave drawing no.1 flat on the light box.

Now draw the ball on drawing no.9. Remember the ball is moving through an arc and that it should be half way between the balls on drawings no.1 and no.11.

In order to see how the ball is moving, fold back drawings no.11 and no.9 towards you.
(while still attached to the peg bar) and look at drawing no.1.

Fold drawings no.11 and no.9 flat against the light box and look at drawing no.9.

Then fold drawing no.9 up towards you and look at drawing no.11.

When this is done in quick succession the ball will move along the arc. You are now flicking. Sometimes it helps to put a rubber band over the pins on the peg bar to stop the paper slipping off. If the ball in drawing no.9 doesn’t appear to be in the correct position, rub it out and re-draw it. Keep flicking and drawing until it looks right. (See flicking.avi in movies001, chapter001 of the CD-ROM.)

Repeat the in-betweening process for drawing no.7 (between drawing no.1 and no.9), drawing no.5 (between drawing no.1 and no.7) and drawing no.3 (between drawing no.1 and no.5). Once you’ve drawn all these you can have a go at rolling.

rolling

Place the first five drawings of the sequence onto the peg bar with drawing no.1 at the bottom and no.9 at the top. Interleave each of these drawings between the fingers of your left hand. You can only ever roll with five drawings.

Fold all the drawings towards you and look at drawing no.1. By moving your little finger forward allow drawing no.3 to fall flat over drawing no.1 and look at this. See top illustration on p. 18.

Let drawing no.5 fall flat over drawing no.3. Look at this. Let drawing no.7 fall flat over drawing no.5. Look at this. Finally allow drawing no.9 to fall flat onto drawing no.7 and look at this. Bring your hand back and repeat the process. Make sure your fingers stay interleaved with the paper at all times. When this is done in quick succession, you will see the ball falling from the top left of the
page and hitting the ground, accelerating as it falls. You are now rolling (see rolling.avi in movies001, chapter001 of the CD-ROM).

Complete the exercise by in-betweening drawings no.11 through to no.21.

This is the timing chart for drawing no.11, showing how you should in-between the drawings between drawing no.11 and no.21.

The X in the chart shows that the distance has been divided into three. The first in-between you will do is drawing no.15. This is the breakdown drawing. It is one-third closer to no.21 and two-thirds further away from no.11. (The X is there to show the relative position of drawing no.15.) The next drawing to do is no.17. This is half way between no.15 and no.21. Then do drawing no.19. This is half way between no.17 and no.21.

There is no drawing at the position X. The next drawing to do is no.13. This is half way between X and no.11. By using this spacing, the ball will accelerate from drawing no.9 and decelerate as it reaches no.17. Make sure the ball follows the arc through the sequence. When you have completed all the drawings have a go at flipping them. Pick up all the drawings you’ve animated with the first number at the bottom and the last at the top. Hold them up with the right hand and flip with the left.

Finally shoot the sequence with the line tester to see accurately how the animation moves. Each drawing should be shot for two frames each. If you haven’t worked out how to use a line tester yet, never fear! I’m going to take you through how to use one in the next section (see ball_bounce.avi in animations001, chapter001 of the CD-ROM).

**how to use a line tester to help your animation**

In the last exercise we looked at the timing for a ball bouncing across the screen. Learning the timing for the key positions is one of the hardest things in animation to do. Using a line tester enables you to see how the timing is working and will hopefully help you to learn timing skills more quickly.

For the next exercise we will make a ball drop into screen, fall straight to the ground and bounce a few times before coming to a halt.

The first thing to do is to animate and shoot the key drawings on the line tester. The resulting movie is called a pose test or a key test. The number of frames that each of the key drawings
is played back for can be adjusted on the x-sheet part of the program. When this is working satisfactorily, the drawing numbers are marked onto a paper x-sheet and from this the timing for the in-between drawings are worked out. Work out timing charts for where the in-betweens will go. Do the in-betweens and finally the entire sequence is shot on the line tester.

how this book works

Every exercise in this book will follow the basic format below. Animate the exercise in 2D and then use the drawings as a guide to how the animation will move in 3D. Computer program specific .pdf notes will be found on the CD-ROM.

exercises

ball bouncing

Draw the following key positions onto each subsequent piece of paper and number them as shown.

Open up DigiCel Flipbook on your computer. Click Create New Scene. Specify a Frame Rate of 25. # of frames = 44. # of levels = 2. Click the radio button for PAL (768 × 576). Then click OK.
If you are going to be using a video camera, click on the Capture icon. Hopefully up will come a live screen of what your camera is seeing and a Video Capture toolbar.

We need to play the key drawings back at roughly the same speed and length as the finished sequence. (Remember that we have yet to do all the in-betweens for this piece of animation.) We do this by ‘holding’ each of the key drawings for the estimated number of frames between each of the keys. The line test helps us to work out the number of frames needed. We need to see this sequence as a series of keys that demonstrate the main positions for the correct timing. In DigiCel Flipbook you can specify how many frames each key drawing is captured for (the Hold box on the Video Capture toolbar) and you can also adjust the amount of frames the drawing is held for on the x-sheet part of the program.

We now need to capture your key drawings. For this exercise we will start by capturing each drawing for 1 frame each.

On the Video Capture tool bar set the Frame box to 1 and set the Hold box to 1. This means that when they are captured your drawings will be numbered the same as above. These are referred to as the key numbers. Set the Level box to 1.

Place key drawing no.1 under the camera and when it is positioned correctly on the peg bar, left click on the Capture button. Place key drawing no.2 under the camera and press the Capture button. Repeat this process for all eight key drawings. When you have captured all your keys, press the Quit button. Now press the Play Forward button at the bottom of the DigiCel FlipBook window. It’s running a bit fast isn’t it? That’s because it’s running on ‘singles’. This means that each drawing is being played back for one frame. The way to correct the timing and slow it down is to make each of the key drawings ‘hold’ for longer than one frame. To do this we need to drag each of the key drawings down the dope sheet for the appropriate number of frames.

If you look at the XSheet panel you will see that the drawings are called 1–1 to 1–8. This is because they are on the Back Ground level.

In the XSheet window left click onto 1–2. Left click on it again whilst holding down the Alt key on your keyboard and drag it down the XSheet until 1–2 is next to the frame number 9 on the XSheet window.
This means that key no.1 (1–1 on the XSheet window) is now held for 8 frames. This means that when it is played back your audience will see it for 8 frames.

Click on 1–3 and (while holding the Alt key) drag that down to frame 17. This means that key no.2 (1–2) is held for 8 frames.

Drag 1–4 down to frame 23. Drag 1–5 down to frame 29, 1–6 down to frame 33, 1–7 down to frame 37 and finally drag 1–8 down to frame 41.

When you have adjusted the XSheet, press the Play Forward button on the main screen. How does your animation look?

(You can compare your key sequence with the ball_drop_keys.avi in animations001, chapter001 of the CD-ROM.)

It will be jerky, but at this stage that doesn’t matter. The important thing is to work out the timing. You have to imagine what it would look like when it has all the in-between drawings included. This is a skill that comes with experience. The more you animate and look at pose tests, the more adept you become at working out the correct timing.

If any of your key drawings appear to be playing for too long or too short a period, ‘hold’ them for less or more frames. With Digicel Flipbook, highlight it on the XSheet by left clicking on the image that you want to change the frame value of. Then click on it a second time and hold the mouse button down, while holding down the Alt key on the keyboard. Drag the column up or down depending on whether you want to lengthen or shorten the amount of frames.

When you are happy with the result, mark the key positions onto a paper x-sheet (photocopy up the one I put in the book earlier or print the x-sheets found in the folder X-SHEETS in chapter001 of the CD-ROM). Use the far-left level column and use a pencil (these keys are marked here for temporary reference). If key drawing 1 starts on frame 1 of the digicel XSheet, mark it into frame one of the paper x-sheet. If key drawing 2 starts on frame 9 of the digicel XSheet mark it onto frame 9 of the paper x-sheet and so on. If the animation is on twos we need to know where these will be during the sequence. In the far right level column mark in the correct drawing numbers, i.e. drawing 1 on frame 1, drawing 3 on frame 3, etc. See illustration on p. 22.

You can now re-number your key drawings by the frame number they correspond to. Key drawing 2 corresponds with frame 9 so we re-number it drawing no.9! Key 3 is drawing 17, key 4 is drawing 23, key 5 is drawing 29, key 6 is drawing 33, key 7 is drawing 37 and key 8 is drawing 41. Draw a ring around each of the key drawing frame numbers (see top illustration on p. 23). Erase the key numbers in the far-left level column. Re-number your key animation drawings as per the frame number.

The next stage is to work out the in-between drawings and place a timing chart at the bottom of each key. Remember that to show a gain in speed as the ball is dropped, the drawings will be further and further apart.
The bottom illustration on p. 23 shows the timing charts for all the keys and the correct numbering. As the ball bounces up, it will accelerate to the optimum speed and then start to slow as gravity takes over, and it reaches the apex of the bounce. As the ball hits the ground for the second time, the squash will be slightly less (it will have fallen from a lower height). This pattern is repeated for the remaining bounces. Each bounce will be lower and lower until the ball comes to a stop.

Complete the in-between drawings for the sequence by following the timing charts and then line test it (shoot each drawing for two frames each).

You may have or may want to work out your own timing for the sequence. The finished piece of animation should be similar to the balldrop.avi in animations001, chapter001 of the CD-ROM.

**how to relate your 2D animation to your 3D animation**

There are specific .pdf files called Maya_info, XSI_info, 3DSMax_info and LightWave_info in the file, chapter001 of the CD-ROM. These show the basics of each of these programs.
It might be a good idea to print them up and stick them on the wall by your computer. (You could copy them onto any Personal organizer that will display .pdf files, I have them all on my Psion organizer!) Take a look at the .pdf file that relates to your program and then have a go at the following exercise.

overview of the ‘ball drop’ exercise in 3D

(In order to do this exercise have a look at 3DSMax_balldrop.pdf, LightWave_balldrop.pdf, Maya_balldrop.pdf or XSI_balldrop.pdf to find out how to do this in more detail.)

Open up your 3D-computer program and take out the ‘balldrop’ animation drawings and the related x-sheet (or have a look at the illustration below). Create a ball. Make sure that the Timeslider or Frameslider is at the first frame and move the ball to a position similar to drawing no.1 of your 2D animation. Set a key position.

Move the Timeslider/Frameslider to frame 9 and position the ball as in drawing number 9 (the second key position).

Copy each of the key positions from your animation onto the computer in this way and setting a key at the key positions of your drawn animation.
Play back your animation (or have a look at ball_drop_keys_3D.avi in animations001, chapter001 of the CD-ROM). It will look odd because of the way the program in-betweens the key positions. It does this by accelerating out of one key and decelerating into the next. In order to adjust this we need to manipulate the Curves (called either Animation Curves or Function Curves) that relate to the animation of the ball. In all 3D-computer animation programs the movement is broken down into a graph-like mathematical interpretation. If you take the up and down movement of the ball as the vertical value and the time it takes to do it as the horizontal value, you will end up with a series of points on the graph where you have set your key frames. The computer program will join these points together to produce a curve and this will provide the in-between movement of your object. The default type of line linking the curves is called a ‘Spline’.

You can change the way the computer in-betweens your key positions by adjusting these curves. There are a number of different options. ‘Linear’ is a straight line between each key. ‘stepped’ or ‘constant’ line continues at the same value as the first key, before jumping to the value of the next key.

The key points can also be given ‘handles’ making it possible to adjust the angle of the curve (curves with handles can be called ‘bezier splines’).

For our bouncy ball we need to ‘break’ the curve at the key position where the ball hits the ground. This means we need to make the curve ascend and descend between the keys in a nice parabola. From here we need to have a second parabola for the second bounce, a third parabola for the third bounce and so on.

Take a look at ball_drop_3D.avi in animations001, chapter001 of the CD-ROM. The ball is now bouncing more like a ball should!

Of course I don’t expect you to always work this way, but while you are learning to animate it will help you pick up timing all the quicker. By the end of the book you will only need to work out the basic key positions in 2D (in a very rough form) before animating in 3D.
A good animator (whether 2D or 3D) should be able to sketch out a pose for a key frame of animation in a simple concise form. You don’t have to be brilliant at drawing. However, drawing is the best way there is to interpret the world around you. So draw as much as possible. Drawing something means you observe it for a relatively long period
of time, helping you to understand the way it moves.

Attend life drawing classes and focus on short poses (less than 10 minutes). If the model is going to pose for an hour or two, draw them from one angle for a short period of time and then move around the room and draw them from another angle. The reason for this is that it teaches you to capture the essence of a pose with a few simple lines. Concentrate on getting the structure, weight and balance correct.

Go to zoos and sketch the animals. You’ll have to draw quickly in order to capture an animal on the move! This will be far more informative than drawing from books or from the TV.

Sit at street cafés or in parks and draw the people around you. This is a great way to find out about human nature. How do people talk to each other, how do they walk, sit, run and play?
The most important thing about drawing is that it makes you sit down and look at the world around you in detail. Things that you would not normally notice, the way people pick things up, the faces they pull or the body language that they adopt become more apparent to you. A sketchbook is valuable reference material for your animation.