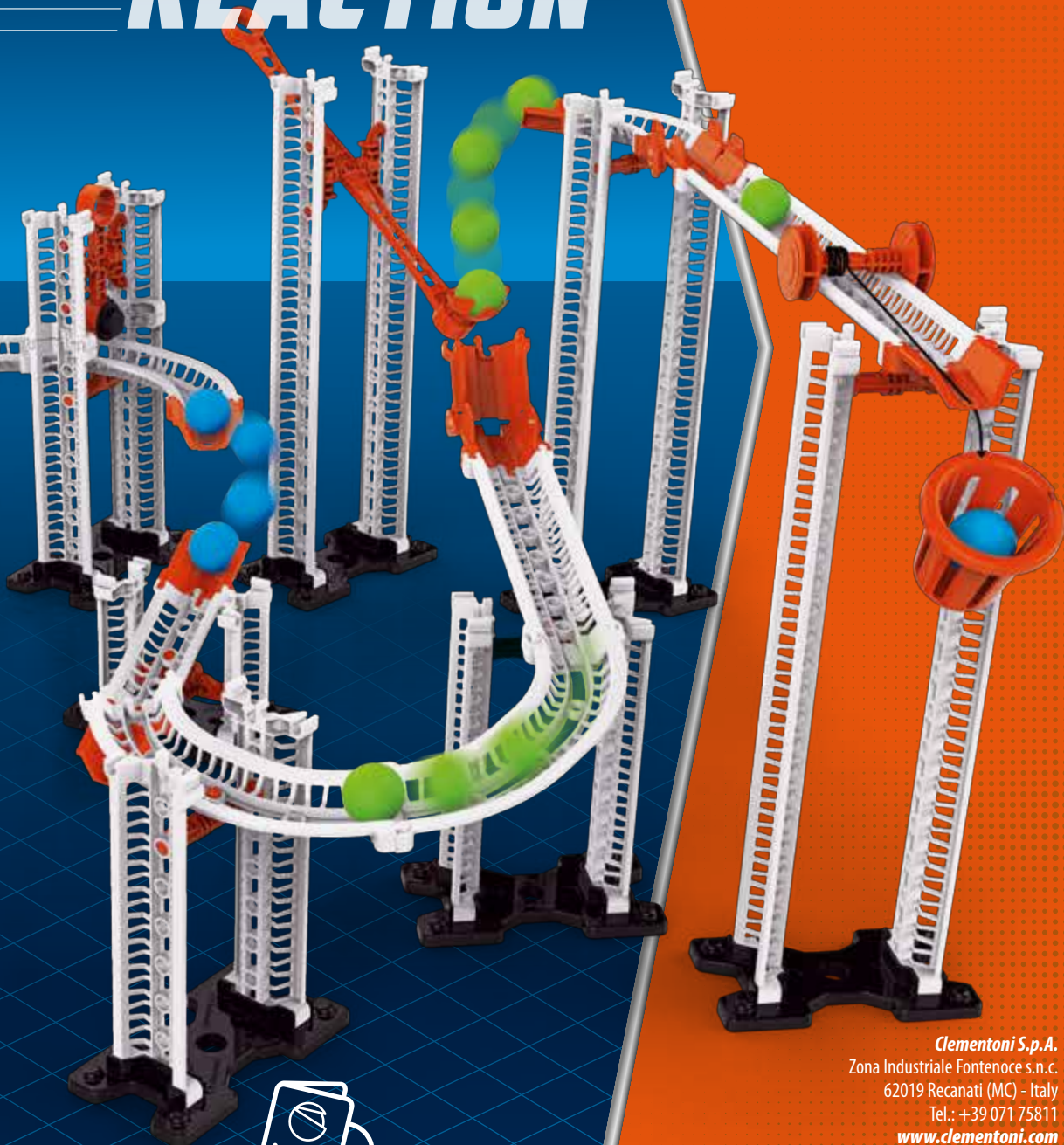


# ACTION & REACTION<sup>®</sup>

Science  
& play



Read and keep the instruction manual for future reference.

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# INTRODUCTION

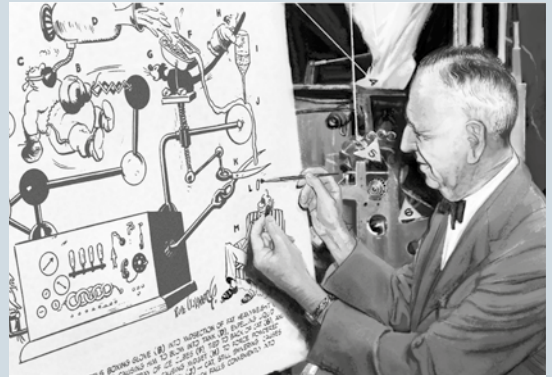
**Action & Reaction** is a complete kit allowing you to build plenty of fun circuits and experiment – through trial and error. In other words, the **action** and **reaction** principle!

## FUNCTIONAL ELEMENTS AND CIRCUITS

The components of this toy are **modular**, which means that you can fit them together in various ways. Follow the instructions of the A3 sheet supplied with the toy, you will learn how to **combine** the components together and **assemble** the most important **functional elements** which you can use to obtain the chain-reaction effects to be inserted along the various points of the circuit. After completing these “exercises”, you can start assembling the **6 circuits** proposed below, which have different levels of complexity. Unleash your imagination and have fun finding new and fun ways to combine the elements and **create new and thrilling chain reactions!**

## CONTRAPTIONS

Some of the tracks illustrated below are special, as they will introduce you to the **concept of contraption**. This idea, invented in the early 20th century by the ingenious imagination of cartoonist **Rube Goldberg**, consists of creating “household” mechanisms in which an element’s movement triggers seemingly impossible effects and **ordinary objects**, such as boxes, plastic cups or pencils, can become an integral part of complicated and fun chain reactions that are only limited by your imagination! In addition to the routes proposed below, therefore, you can create “mixed” routes by combining the toy’s elements with household objects.



**Rube Goldberg** (San Francisco 1883 – New York 1970)



### SAFETY TIPS

**WARNING:** Do not aim at eyes or face.

**NOTE:** the models cannot be constructed simultaneously.

**Warning:** when you build the routes, follow the advice given in the instructions and do not force the assembly of components that are not

compatible with one another. Always consult the list of **functional elements** supplied with the toy.

**Warning:** use the balls supplied with the toy only for the activities suggested in the instruction manual. Do not use different objects. You might risk getting injured!

## CONTENTS

Introduction to the kit.....	Page 2
Safety tips.....	Page 2
Components of the kit.....	Page 3
Assembly tips.....	Page 4
Medium-difficulty routes.....	Page 5
Difficult routes.....	Page 21

# COMPONENTS OF THE KIT

Track L 280

**12 pcs**



Long hammer pendulum

**1 pc**



Track L 140

**8 pcs**



Short hammer pendulum

**1 pc**



Track L 70

**6 pcs**



Support for pendulum

**1 pc**



Curved track

**6 pcs**



Stamp

**4 pcs**



End piece

**6 pcs**



Joining piece A

**6 pcs**



Joining piece B

**6 pcs**



Joining piece C

**2 pcs**



Feet

**16 pcs**



Felt pad

**1 pc**



Suction cup

**2 pcs**



Cup

**8 pcs**



Blue ball

**2 pcs**



Green ball

**2 pcs**



Bridge

**8 pcs**



Beam

**16 pcs**



Spacer

**4 pcs**



String

**1 pc**



Hook

**1 pc**



Basket

**1 pc**



Barbell

**1 pc**



Glove

**1 pc**



Base

**8 pcs**



Domino tile

**10 pcs**



Finish

**1 pc**



Finish flags

**3 pcs**



## ASSEMBLY TIPS

To work comfortably and assemble the circuits more easily, find a **stable and clean surface free of objects**, for example a table or a part of your room that has a smooth and even floor surface. It is important to find a smooth surface to **improve the stability of the routes** and ensure **proper adhesion of the feet**, which you can place under the bases, if you wish.

## THE GOLDEN RULE

**Action & Reaction** is a kit for making experiments. As you gradually assemble the routes and make the balls move through them, you will notice that a successful outcome **depends on very slight variations in corners and distances**. The kit's components are specially designed so that, once assembled, they can be **adjusted, tested and then readjusted**, allowing you to complete the route successfully only after several attempts. So, **don't be afraid to experiment!** You can freely change the track attachment points, adjust the inclination of the pieces as you wish, switch one ball with another... and you will see how the most insignificant details can trigger the most amazing effects! This is the aim of **Action & Reaction**: to teach you to create your own chain reactions!

## GETTING STARTED: SYMBOLS AND COLOURS

To assemble the circuits correctly, first observe the **overview of the completed circuit** with the list of **all the pieces**.

Next, the circuit has been divided into **blocks** of different colours, which are highlighted in the small boxes on each page.

For each block you will find the assembly specifications indicating:

- the **list of pieces** used to assemble the respective block
- the **position of the holes** where the elements will be slotted.  
The dotted circles with the numbers inside indicate the assembly hole, starting from the beginning or end of each single piece

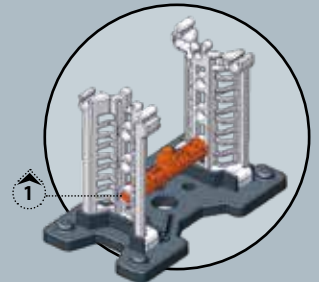
- **symbols**



**start:** indicates which ball to push in order to activate the route.



**balance:** when the elements are not slotted together but are either resting on others or capable of tilting.



At the end you will once again find the complete circuit with the following information:

- the description of the **operating steps**
- the graphic **simulation** of the route taken by the balls, of the moving elements and the arrows indicating, respectively, the **route's direction** (→ / →) and the **change of status** (- ->).

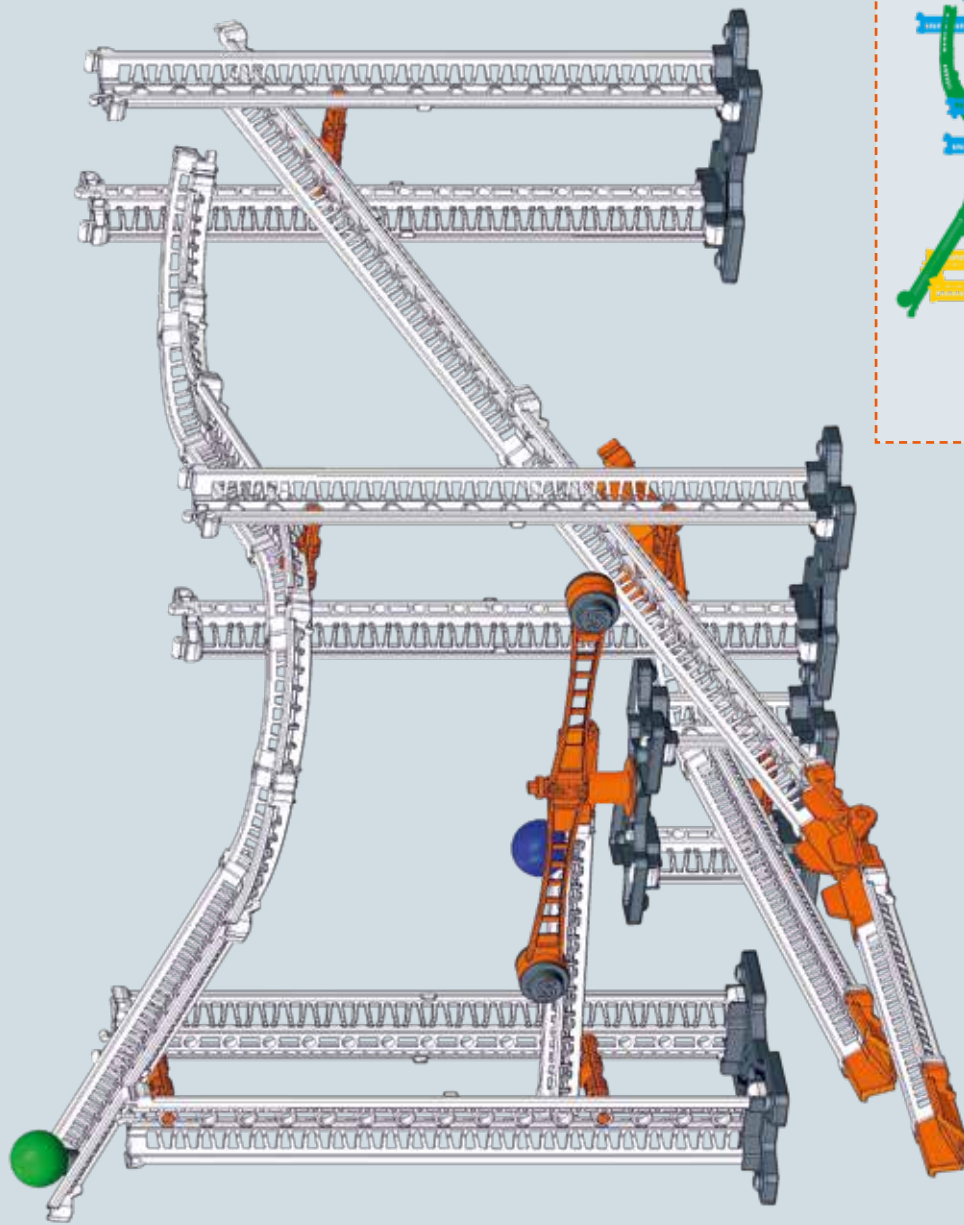


**MEDIUM -  
DIFFICULTY  
ROUTES**

**CIRCUIT NO. 6**

**LIST OF PIECES**

	x 10
	x 3
	x 6
	x 2
	x 4
	x 1
	x 1
	x 6
	x 1
	x 5
	x 1
	x 3
	x 2
	x 2
	x 3
	x 1
	x 2
	x 4
	x 1
	x 5
	x 1
	x 3



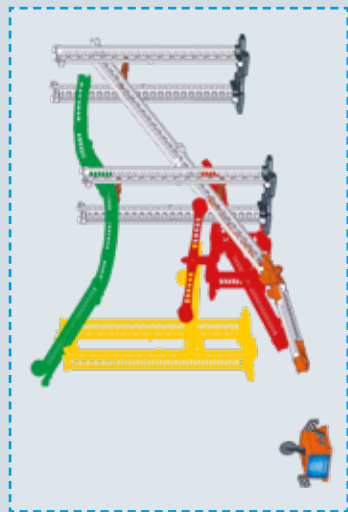
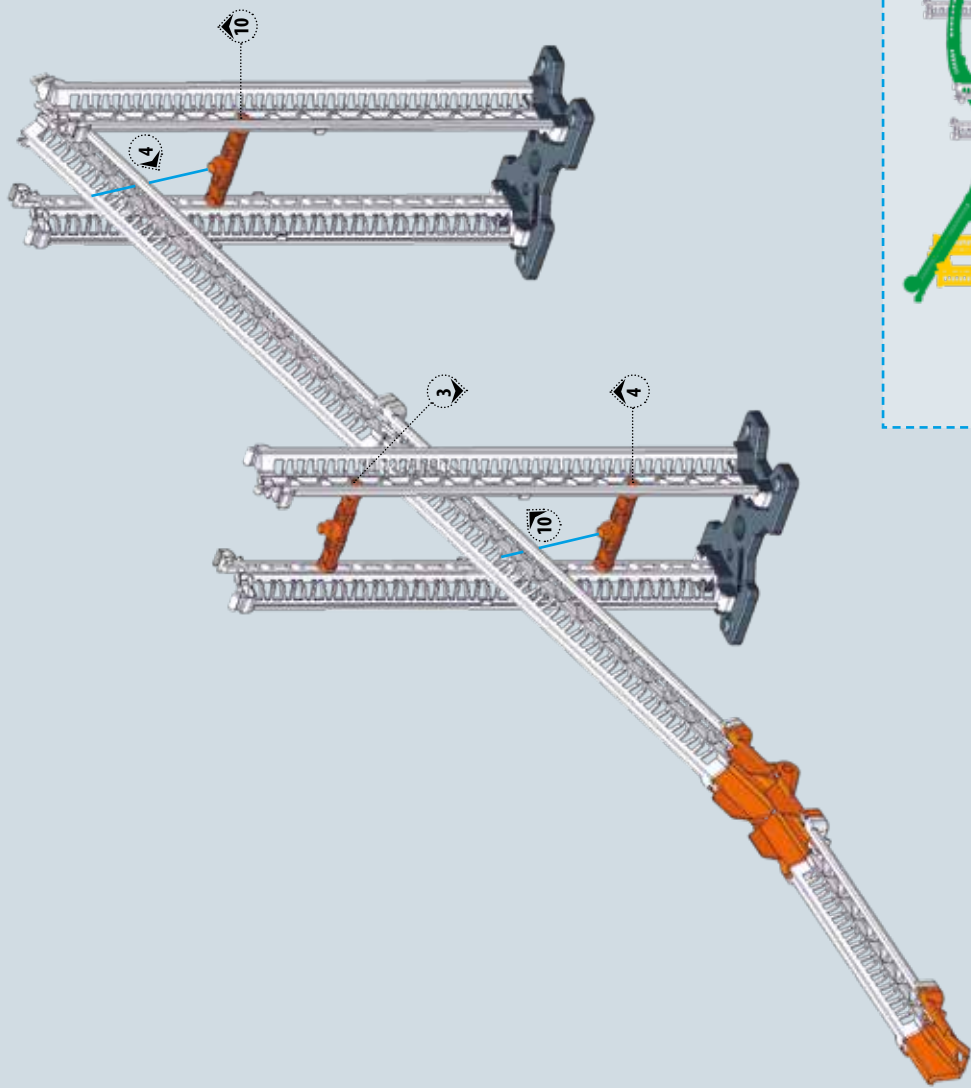
MEDIUM -  
DIFFICULTY  
ROUTES

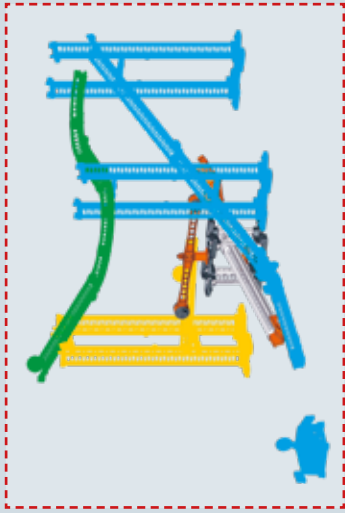
# CIRCUIT NO. 6

## BLOCK A

### LIST OF PIECES

	x6
	x7
	x1
	x1
	x3
	x4
	x2
	x1
	x3



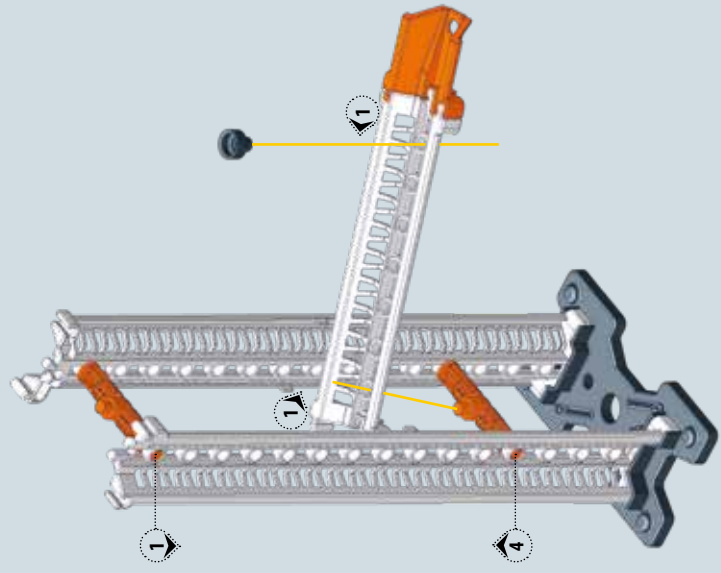
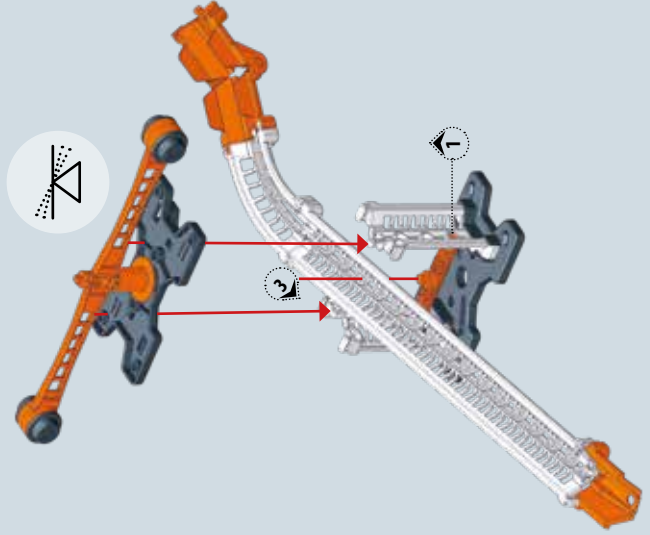


**MEDIUM-DIFFICULTY ROUTES**  
**CIRCUIT NO. 6**

**BLOCK B**

**LIST OF PIECES**

	x1		x1
	x2		x1
	x1		x4
	x1		x1
	x1		x1
	x1		x1
	x2		x2

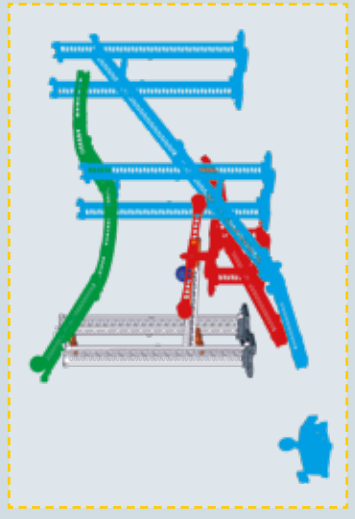


**EASY ROUTES**  
**CIRCUIT NO. 6**

**BLOCK C**

**LIST OF PIECES**

	x2		x1
	x1		x1
	x1		x2
	x1		x1



**MEDIUM - DIFFICULTY ROUTES**

**CIRCUIT NO. 6**

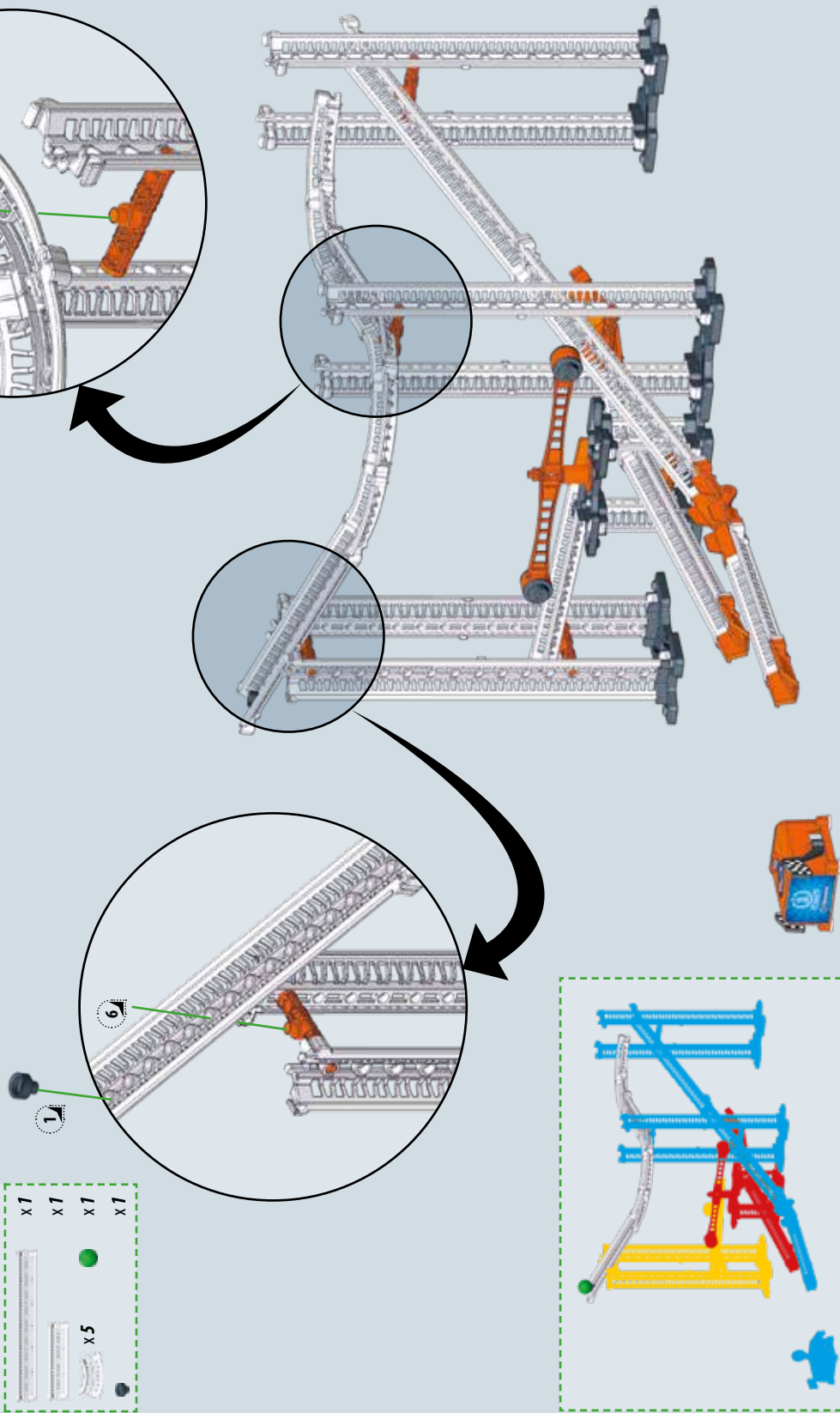
**BLOCK D**

**LIST OF PIECES**

	x1
	x1
	x5
	x1
	x1

**ASSEMBLY TIPS:**

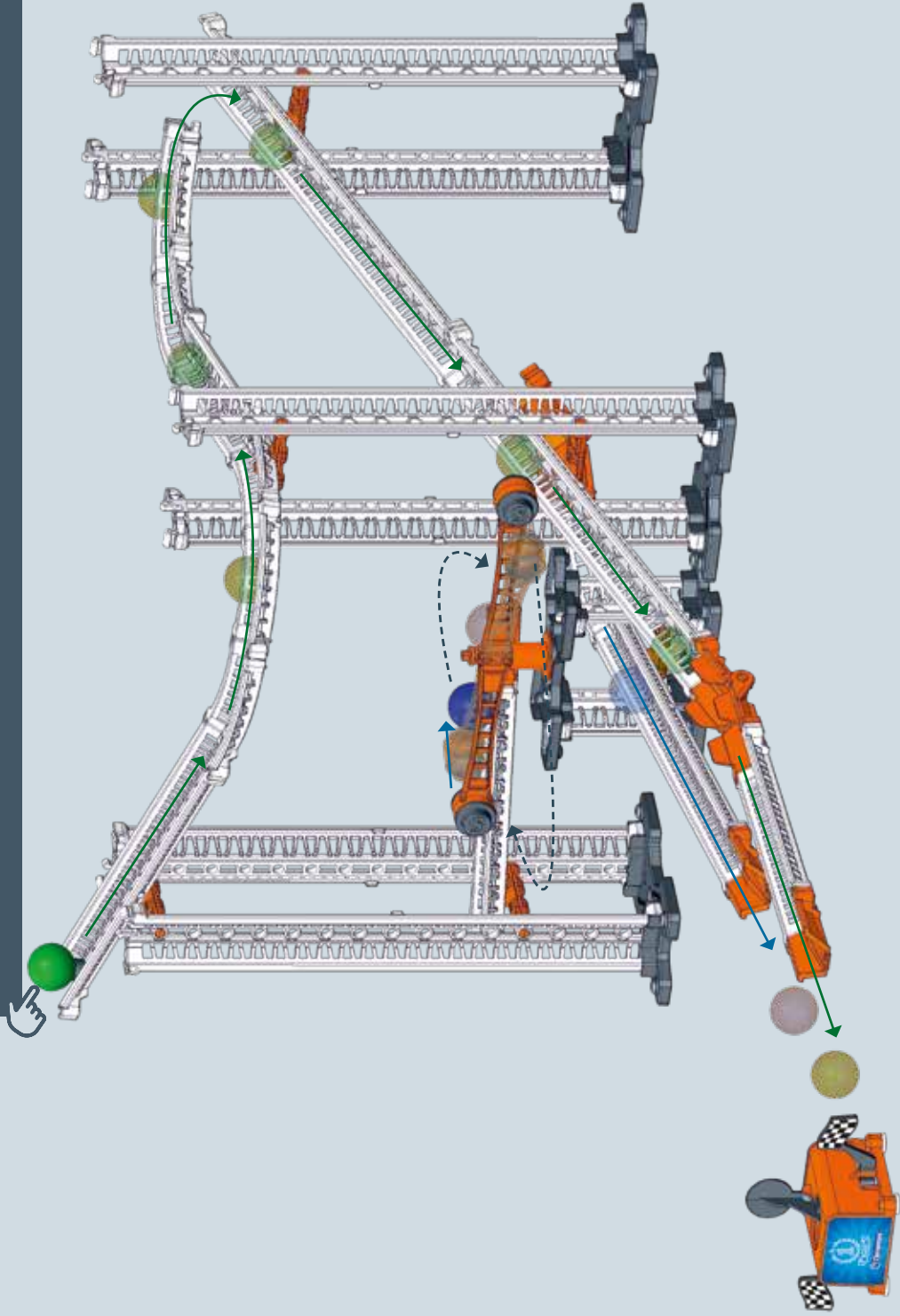
Once the six curved tracks have been assembled, make sure that the final part of the route is aligned with the **track L 280** mounted in **Block A**: in this way, the ball coming from the curved track will strike the vertical track and then fall onto the underlying downhill track.





**WHAT HAPPENS:**

1. The green track rolls along the curved track of **Block D**.
2. The ball strikes the vertical track of **Block A** and rolls down the inclined track.
3. The green ball touches the horizontal pendulum and makes it move.
4. While the green ball continues to roll and enters the **finish**, the blue ball is struck by the other end of the horizontal pendulum and falls off the cup.
5. The blue ball rolls and falls onto the track of **Block B**.
6. The blue ball rolls along the track until it enters the **finish**.



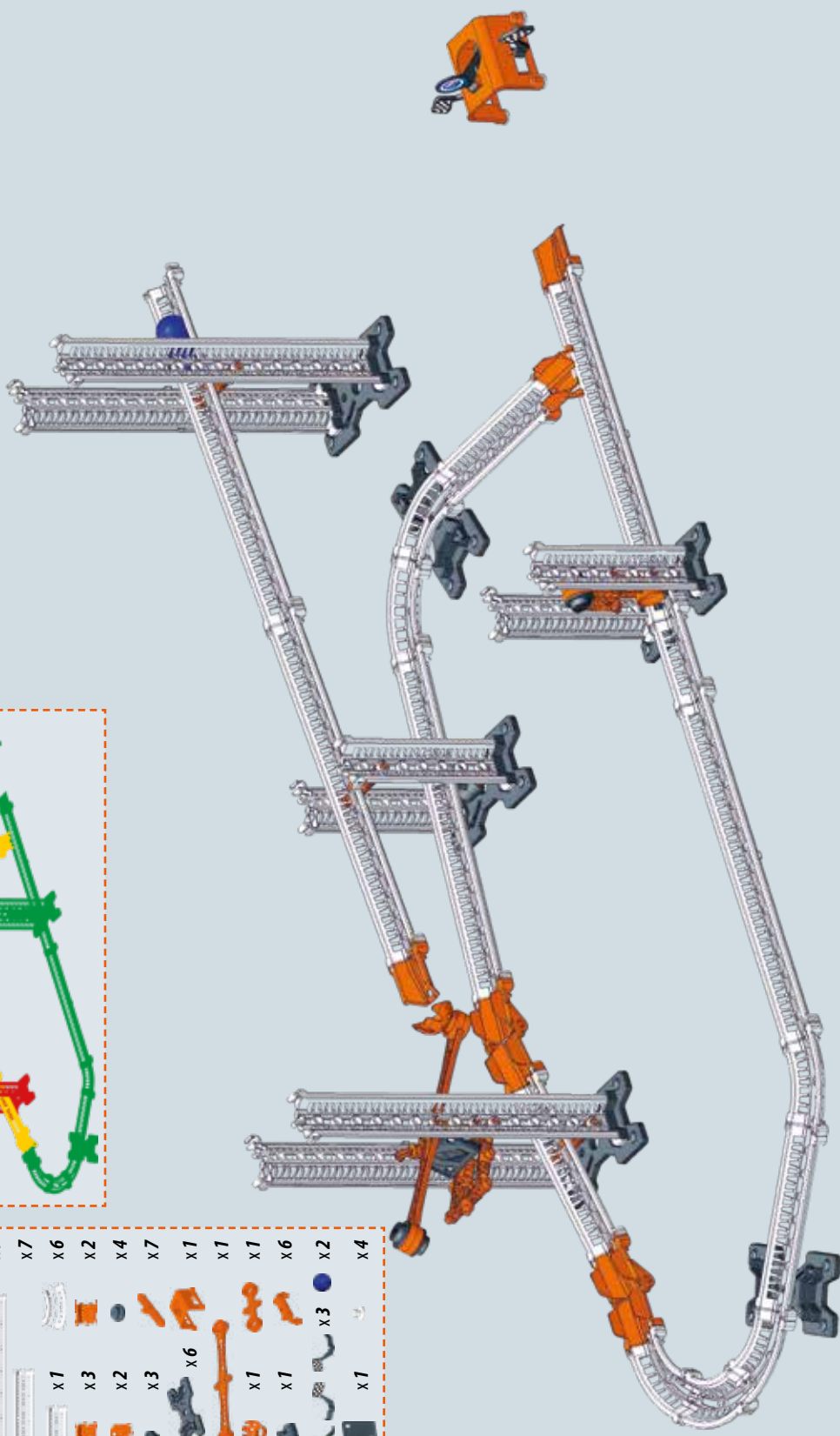
In this circuit you will use **2 blue balls**: you must make them start from the same point but at different times.



**MEDIUM - DIFFICULTY ROUTES**  
**CIRCUIT NO. 7**

**LIST OF PIECES**

- |  |    |
|--|----|
|  | x9 |
|  | x7 |
|  | x6 |
|  | x2 |
|  | x4 |
|  | x7 |
|  | x1 |
|  | x1 |
|  | x1 |
|  | x6 |
|  | x2 |
|  | x3 |
|  | x4 |
|  | x1 |





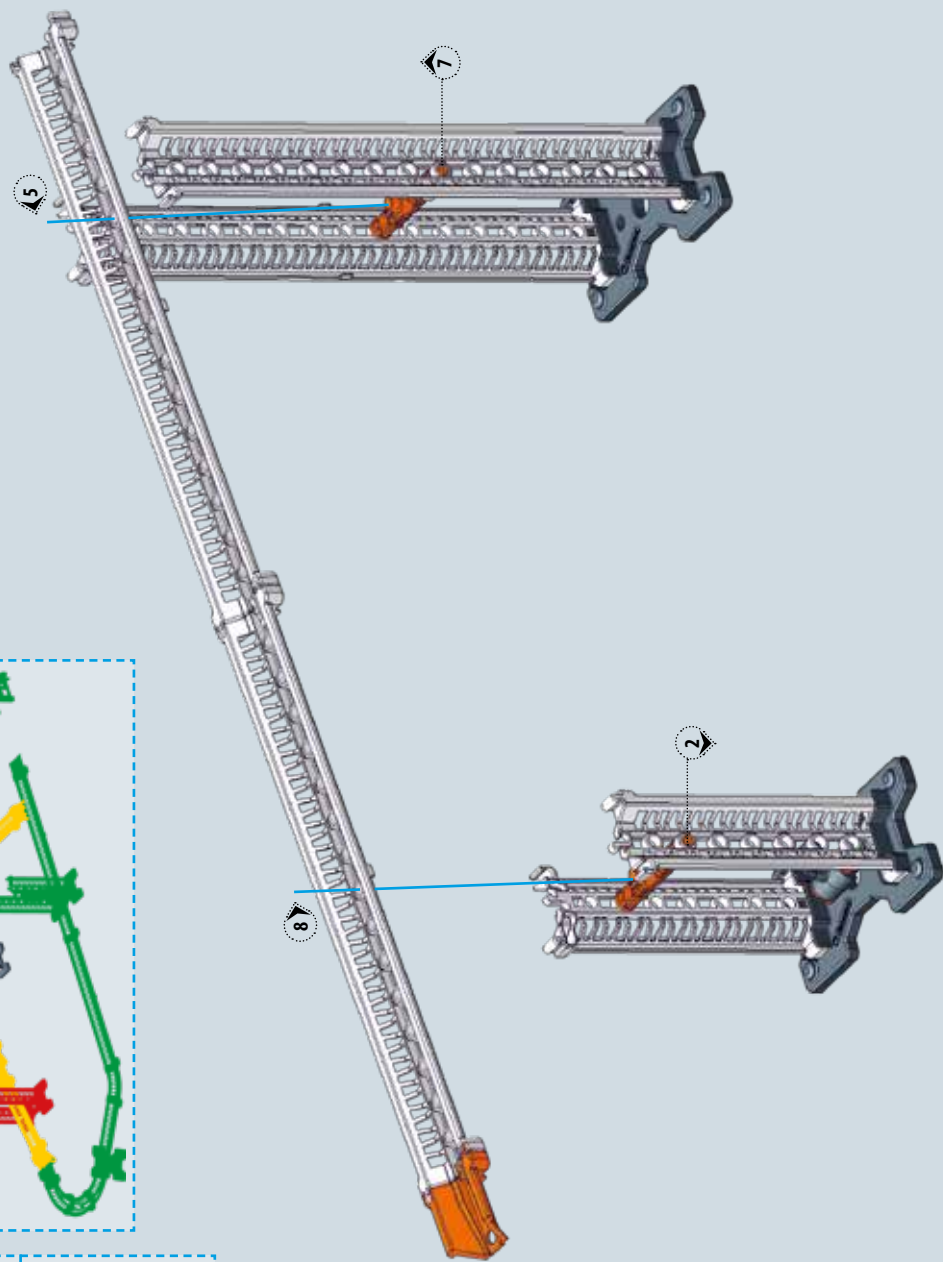
MEDIUM -  
DIFFICULTY  
ROUTES

## CIRCUIT NO. 7

### BLOCK A

#### LIST OF PIECES

	x4
	x2
	x2
	x1
	x2
	x1
	x1



**BLOCK B**

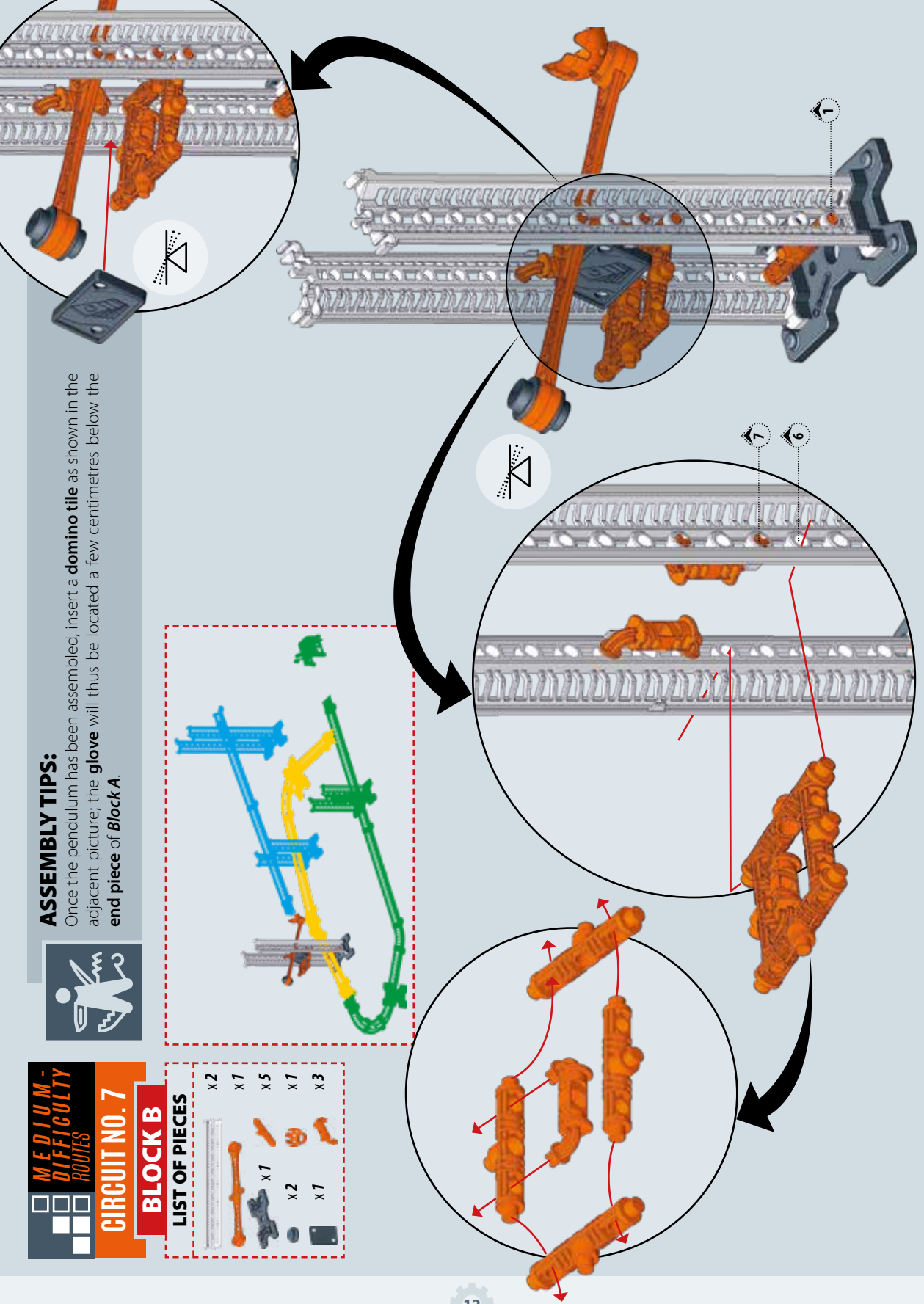
LIST OF PIECES

	x2
	x1
	x5
	x1
	x2
	x1
	x3



**ASSEMBLY TIPS:**

Once the pendulum has been assembled, insert a **domino tile** as shown in the adjacent picture; the **glove** will thus be located a few centimetres below the end piece of **Block A**.





CIRCUIT NO. 7

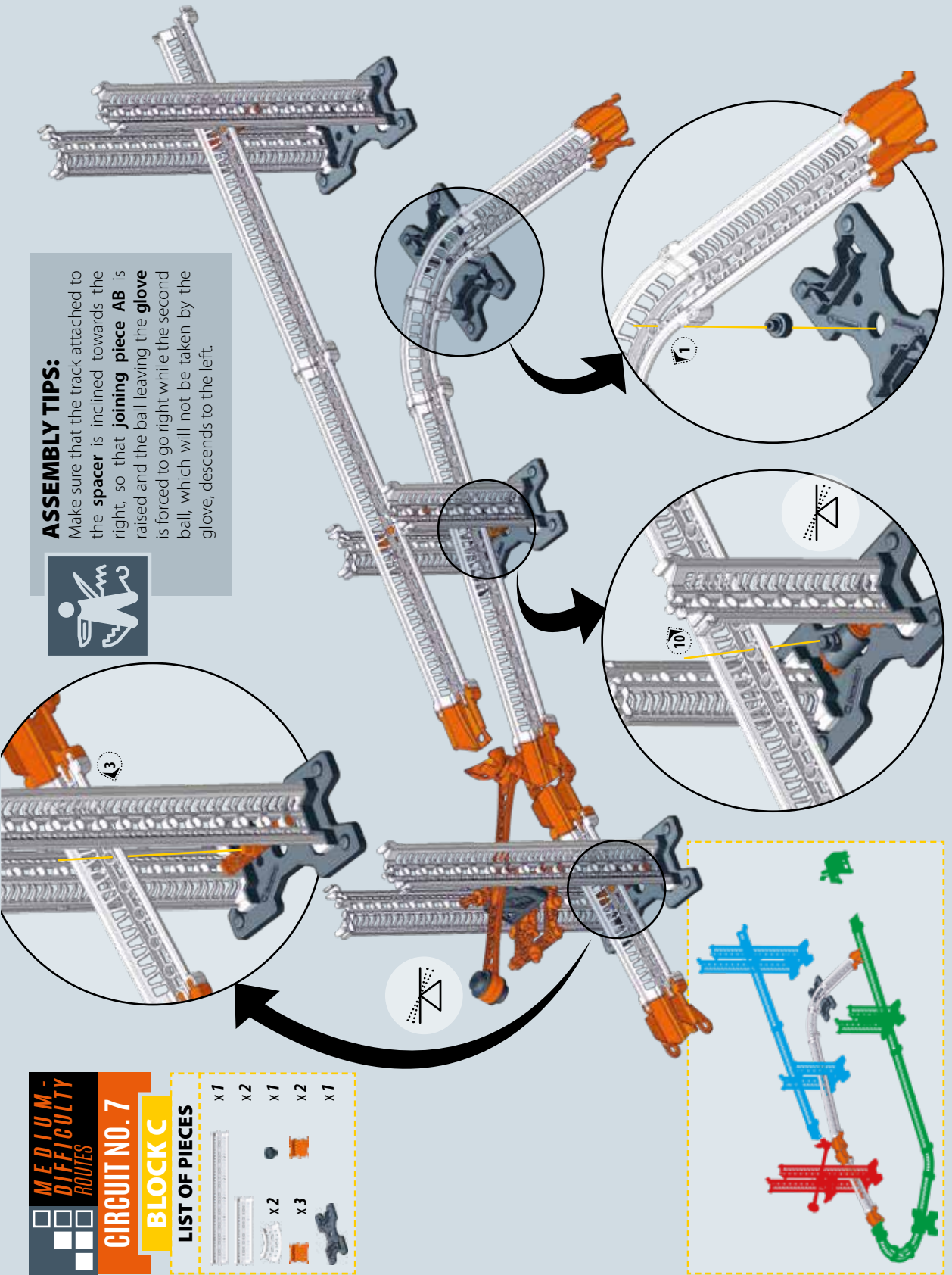
BLOCK C

LIST OF PIECES

-  x1
-  x2
-  x1
-  x2
-  x1
-  x2
-  x3
-  x2
-  x1

ASSEMBLY TIPS:

Make sure that the track attached to the spacer is inclined towards the right, so that joining piece AB is raised and the ball leaving the glove is forced to go right while the second ball, which will not be taken by the glove, descends to the left.



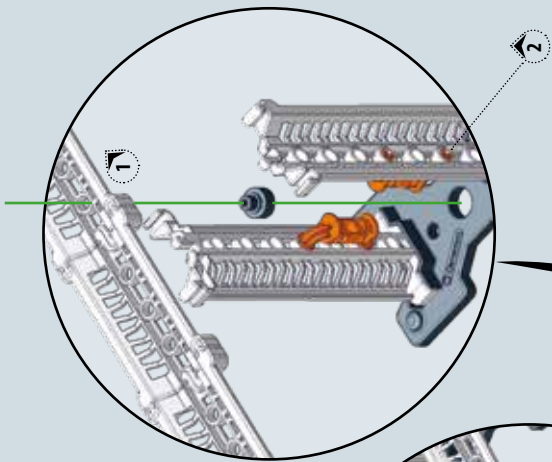
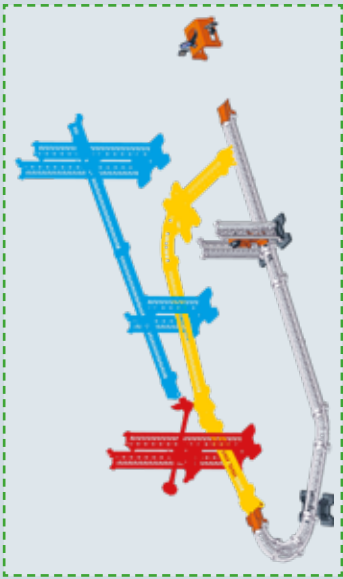
MEDIUM -  
DIFFICULTY  
ROUTES

# CIRCUIT NO. 7

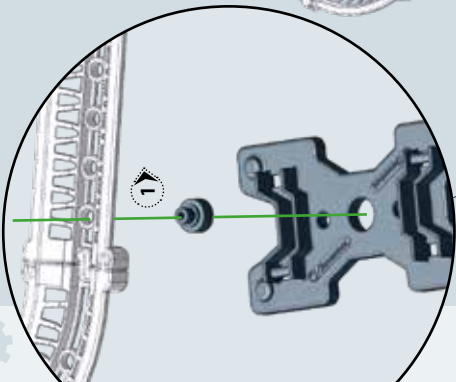
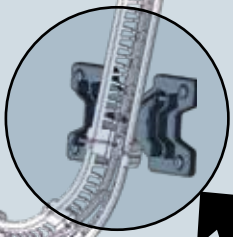
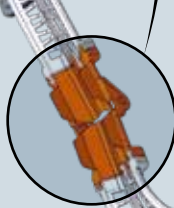
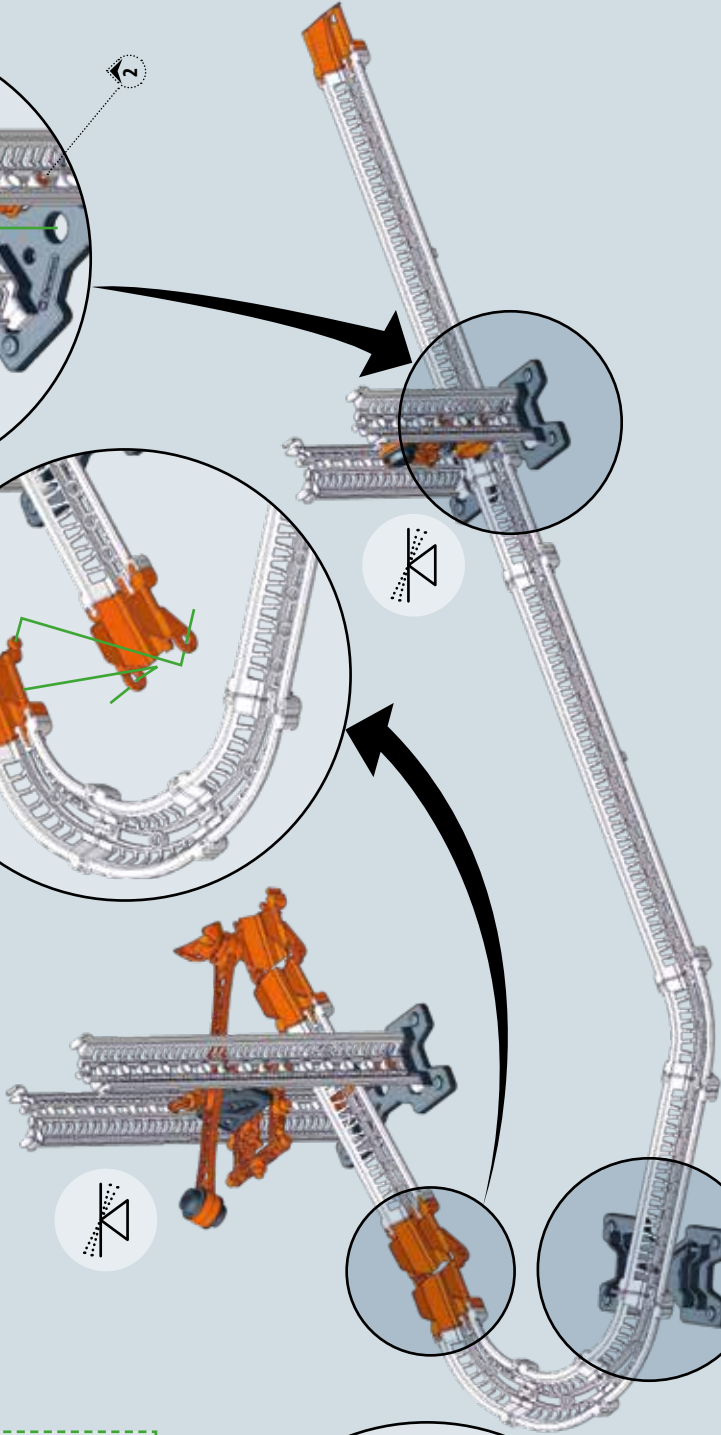
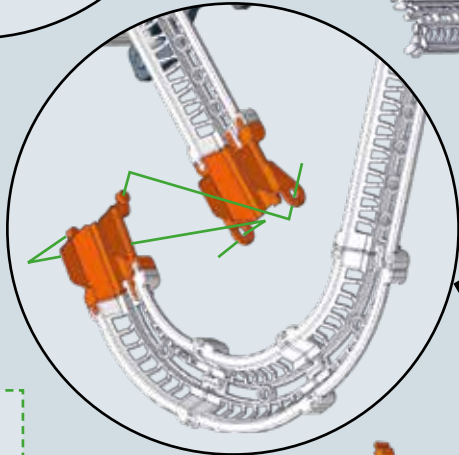
## BLOCK D

### LIST OF PIECES

	x2		x1		x2		x1		x3		x4
	x3		x1		x2		x1		x3		x4
	x4		x1		x2		x1		x3		x4
	x1		x1		x2		x1		x3		x4
	x1		x1		x2		x1		x3		x4
	x2		x2		x2		x1		x3		x4
	x2		x2		x2		x1		x3		x4
	x1		x1		x2		x1		x3		x4
	x1		x1		x2		x1		x3		x4
	x1		x1		x2		x1		x3		x4
	x1		x1		x2		x1		x3		x4



2



1

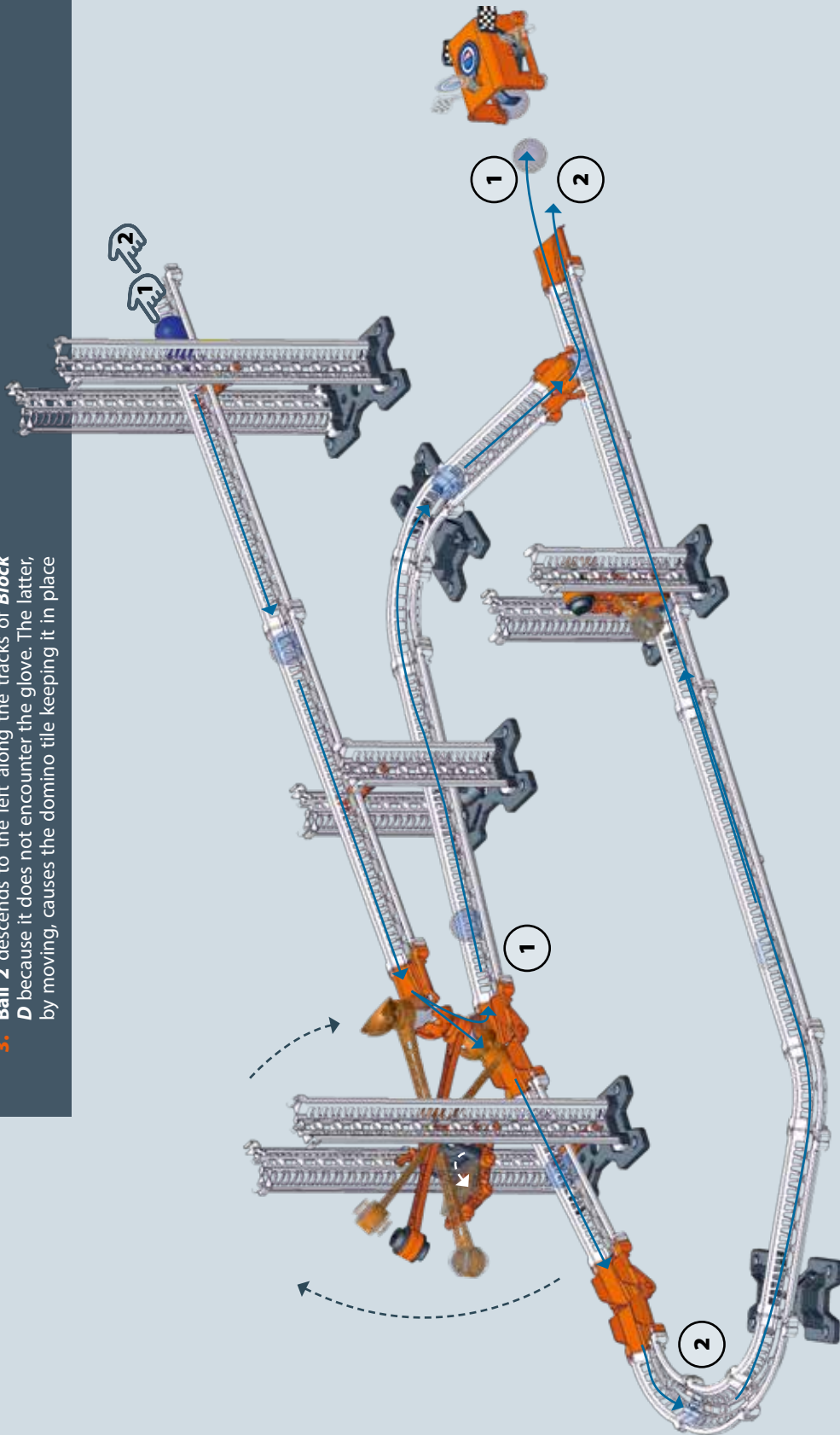


**WHAT HAPPENS:**

1. The first blue ball (**ball 1**) rolls down the track. It will be immediately followed by the second ball (**ball 2**).
2. **Ball 1** drops into the glove, descends to the right along the underlying track, ends up in the last section of **Block D** and enters the finish.
3. **Ball 2** descends to the left along the tracks of **Block D** because it does not encounter the glove. The latter, by moving, causes the domino tile keeping it in place

to fall and – due to the weight of the stamps – will lift completely.

4. **Ball 2** slows down gradually until it touches and activates the hammer pendulum, which pushes it towards the finish.

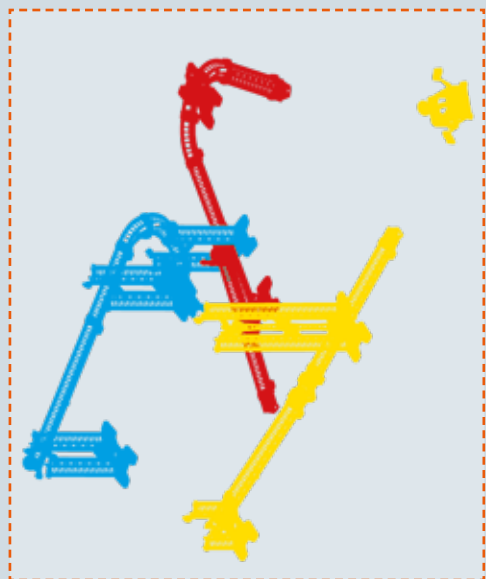
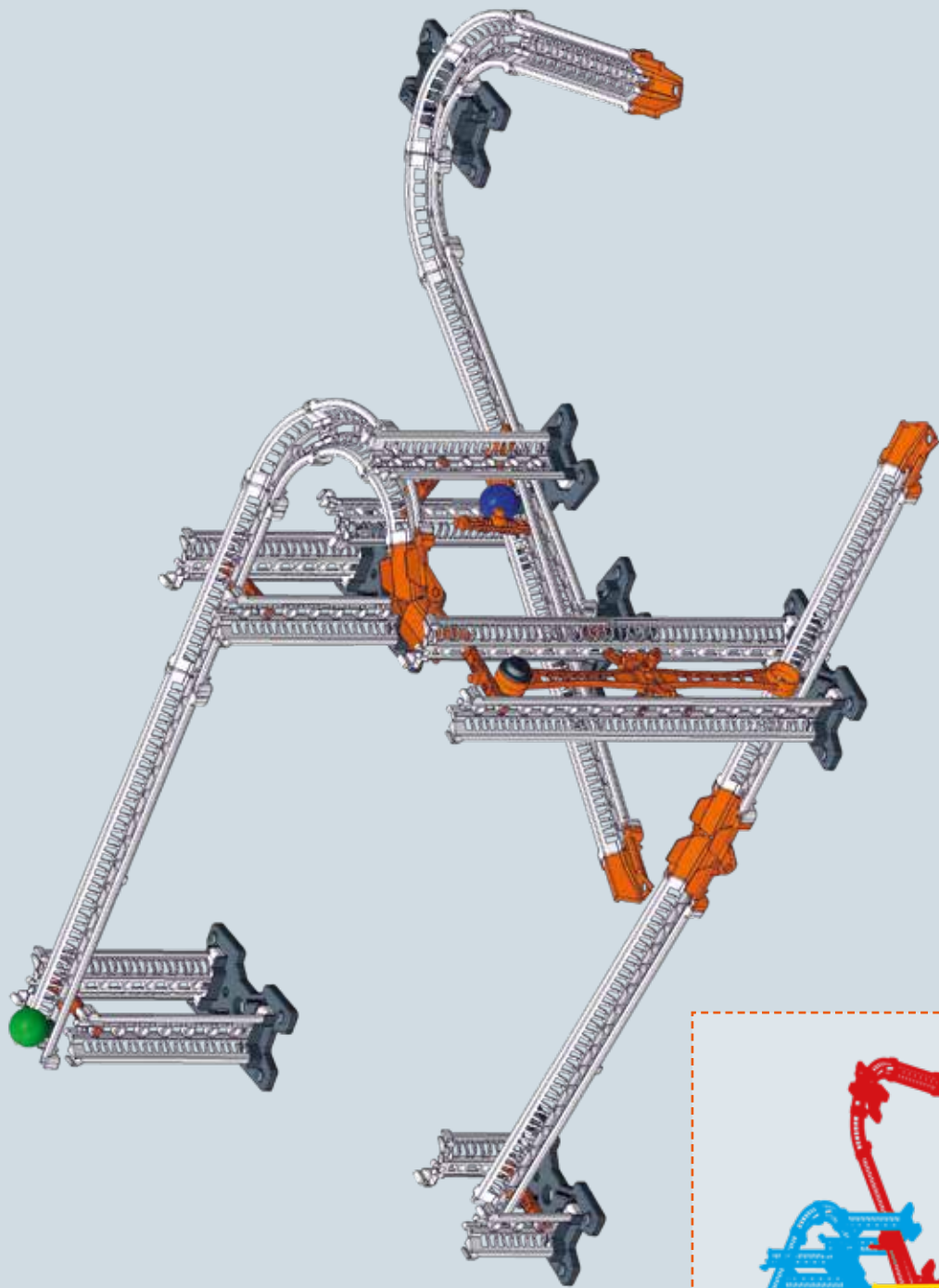


**MEDIUM -  
DIFFICULTY  
ROUTES**

**CIRCUIT NO. 8**

**LIST OF PIECES**

	x7
	x8
	x6
	x2
	x2
	x4
	x1
	x1
	x6
	x7
	x1
	x1
	x1
	x4





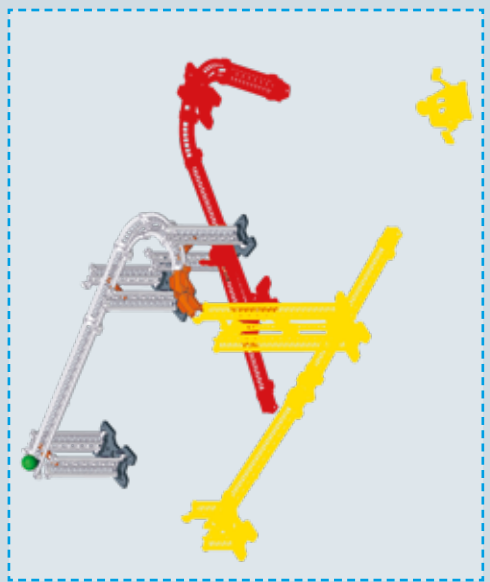
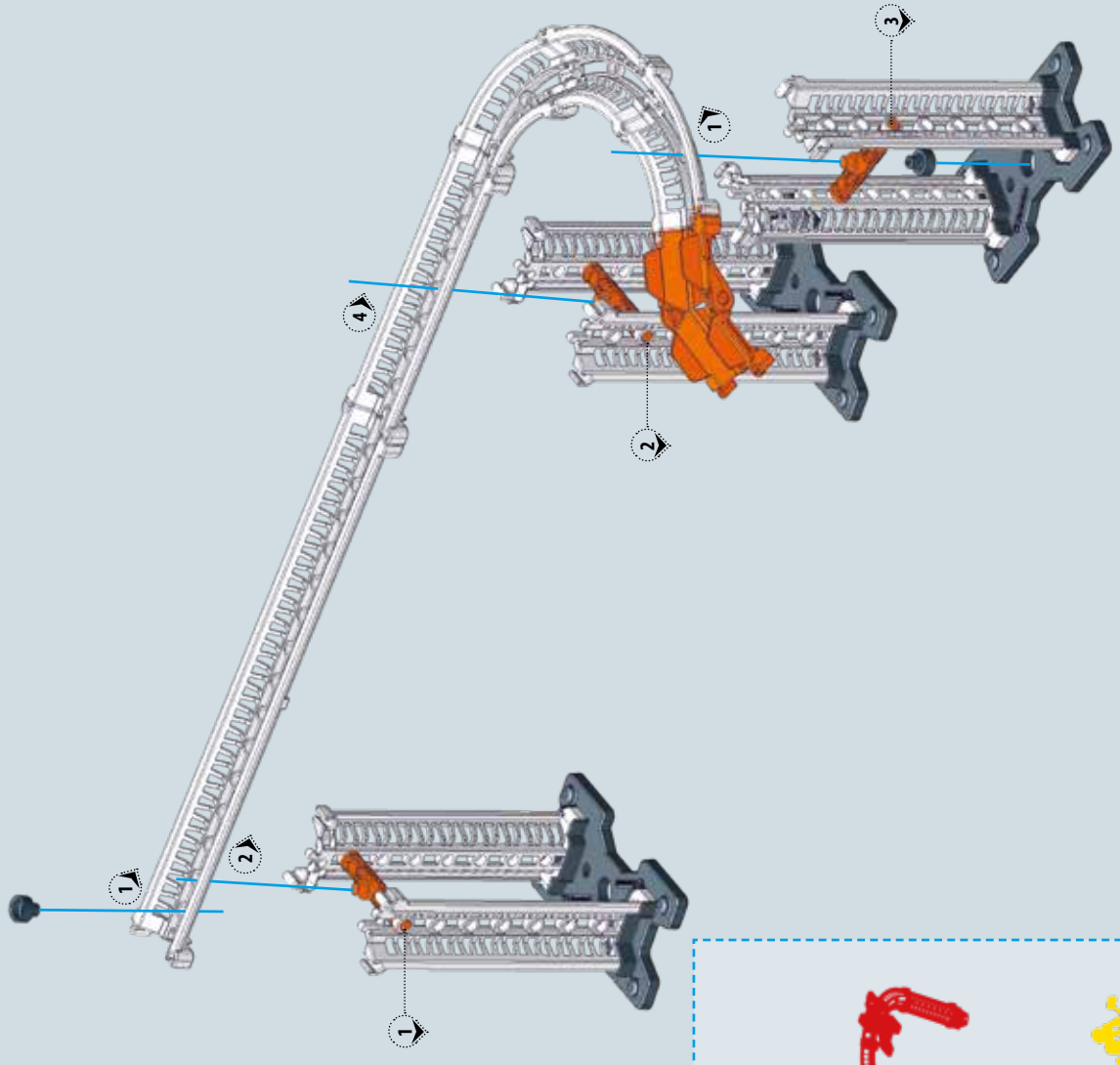
**MEDIUM -  
DIFFICULTY  
ROUTES**

**CIRCUIT NO. 8**

**BLOCK A**

**LIST OF PIECES**

-  x1
-  x7
-  x3
-  x1
-  x3
-  x2
-  x3
-  x1
-  x3
-  x2



CIRCUIT NO. 8

BLOCK B

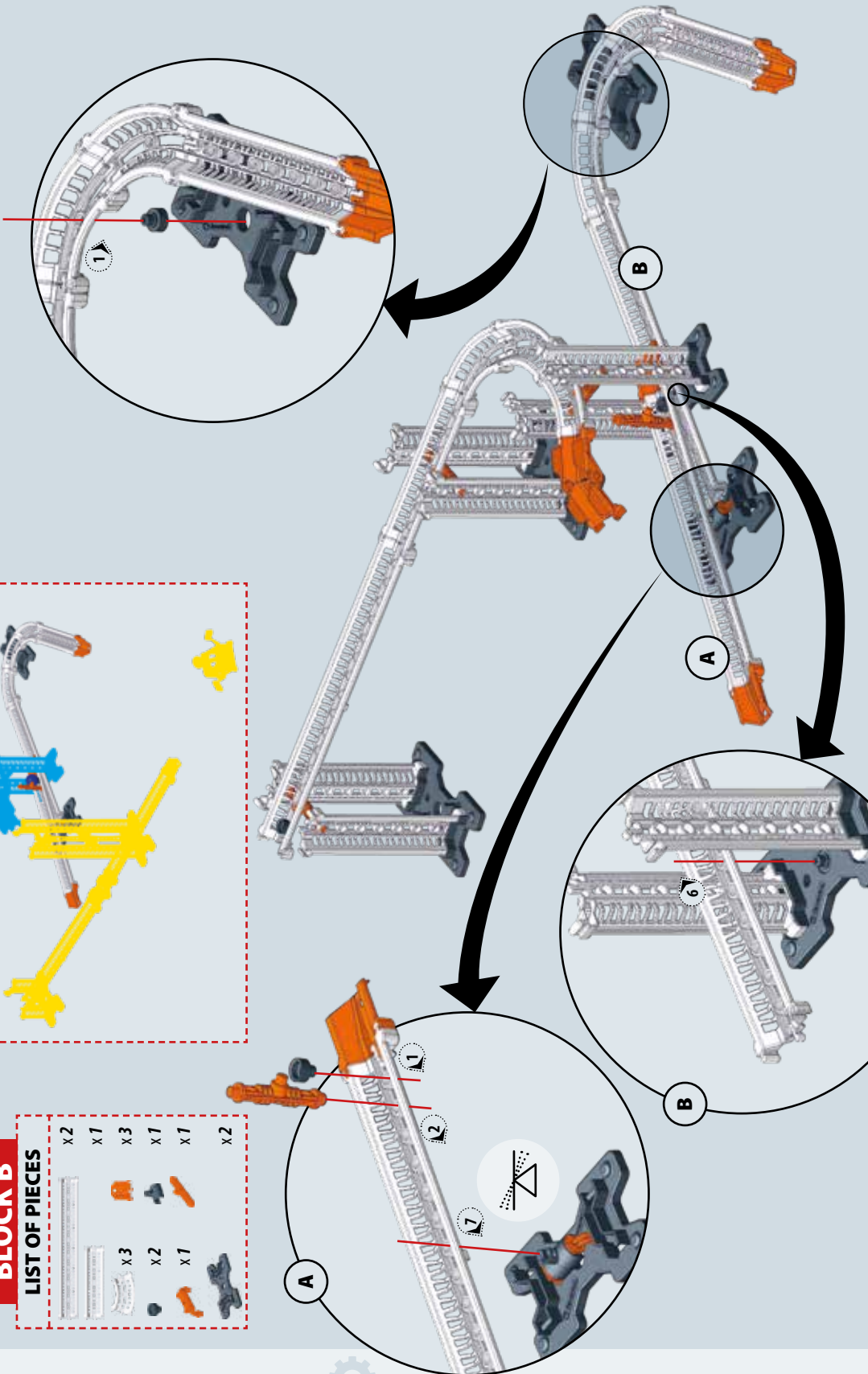
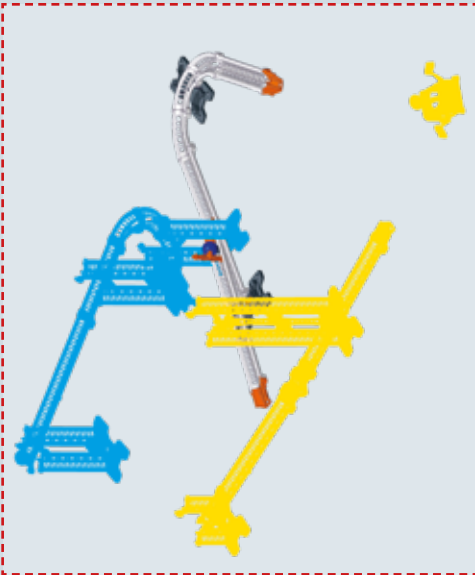
LIST OF PIECES

	x2		x1		x3		x1		x1		x2
	x3		x2		x1		x1		x1		x2



ASSEMBLY TIPS:

The track marked with the letter A must be inclined towards the right and placed on top of the one marked with the letter B.



CIRCUIT NO. 8

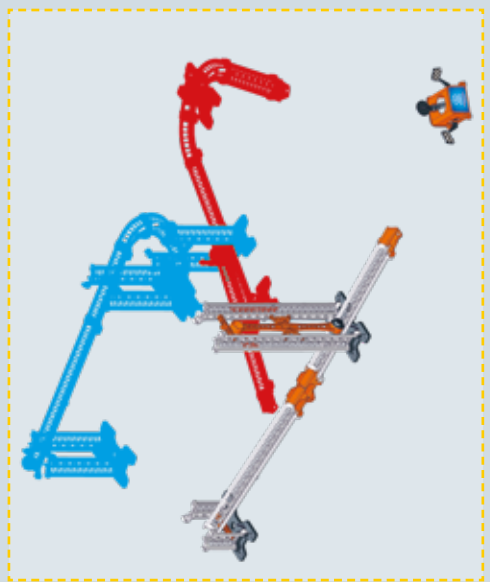
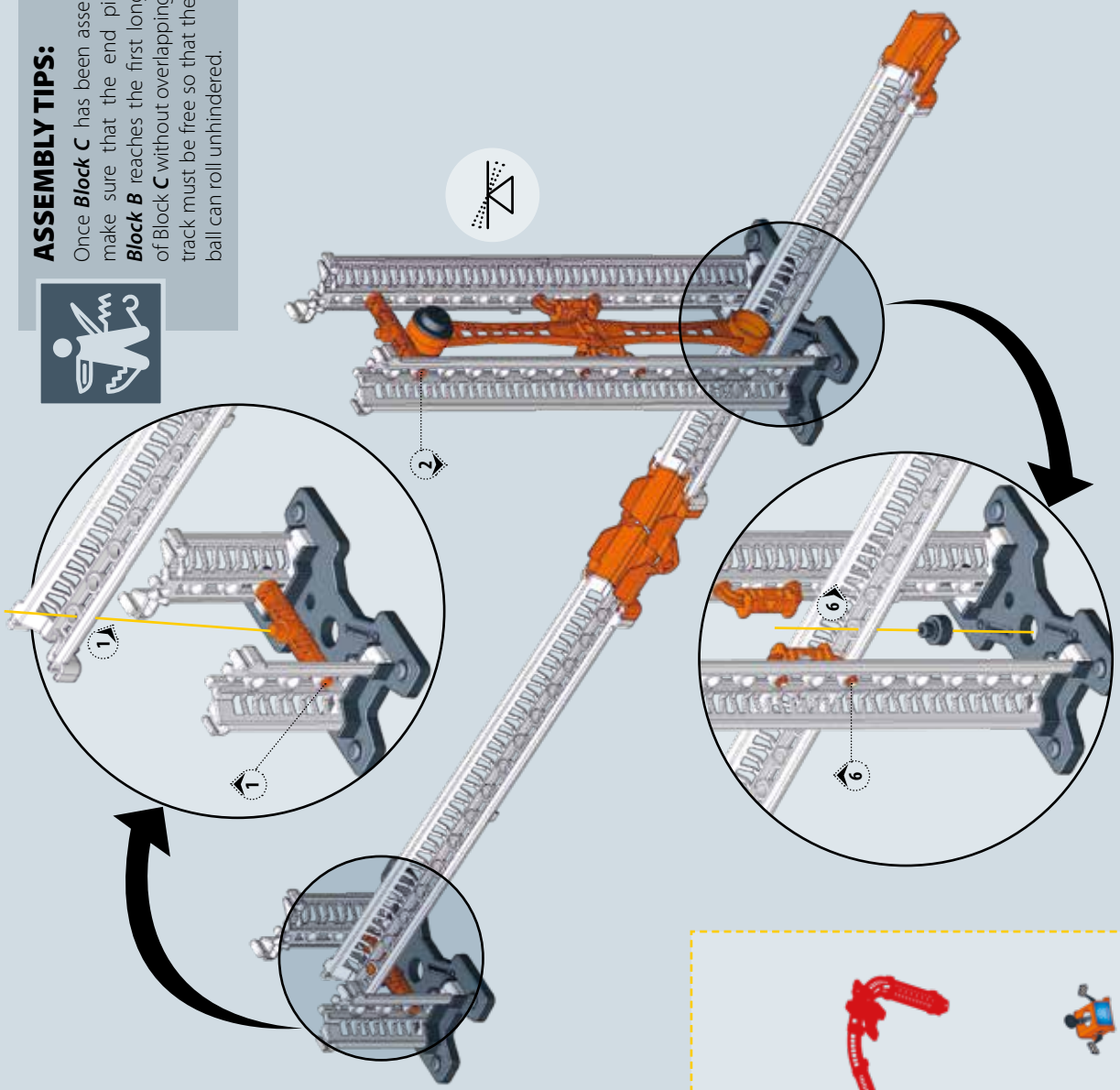
BLOCK C

LIST OF PIECES

	x4		x4
	x2		x1
	x1		x1
	x1		x2
	x1		x1
	x2		x2
	x2		x1
	x3		x4

ASSEMBLY TIPS:

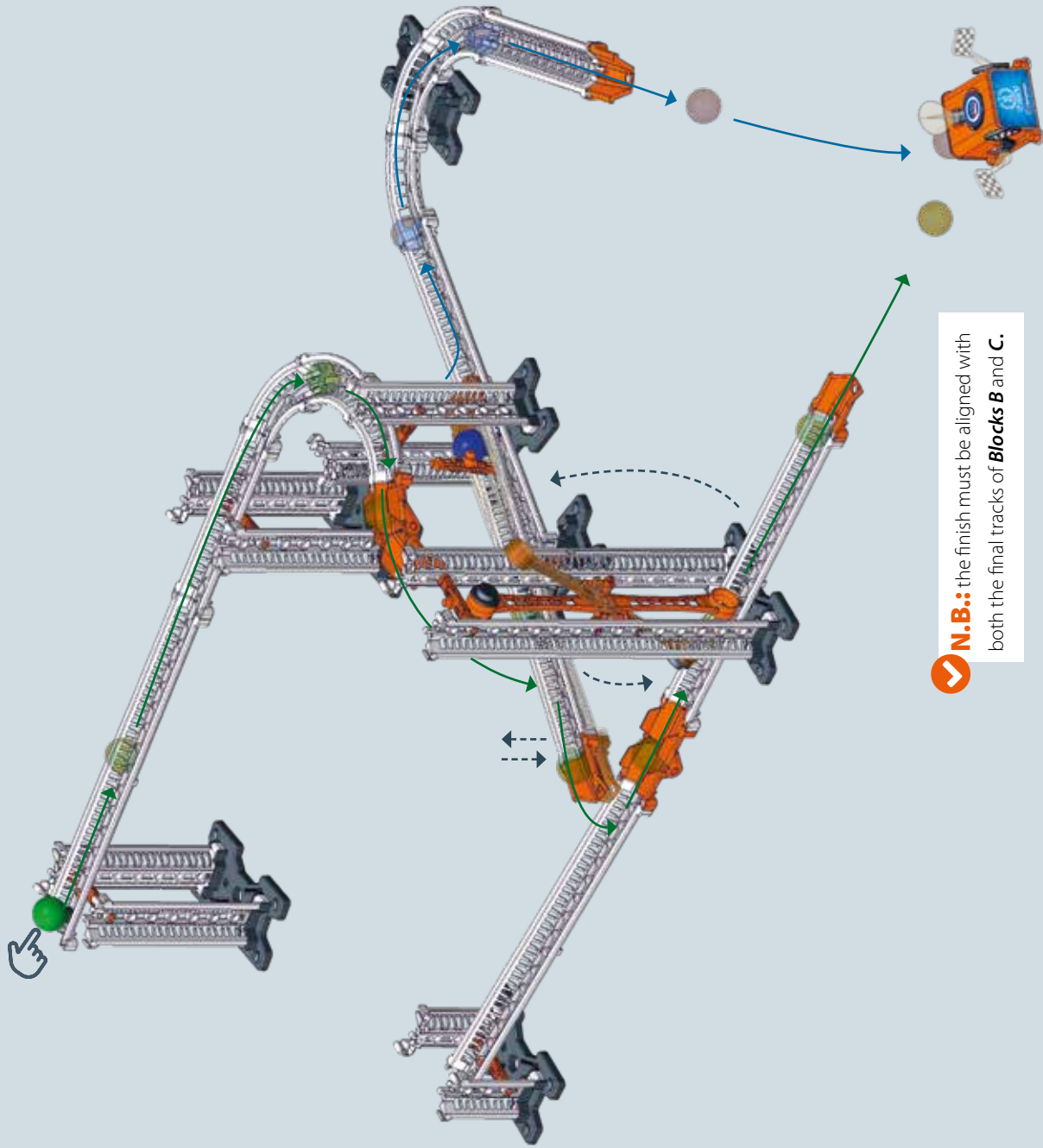
Once **Block C** has been assembled, make sure that the end piece of **Block B** reaches the first long track of **Block C** without overlapping it: the track must be free so that the green ball can roll unhindered.





**WHAT HAPPENS:**

1. The green ball rolls along the track and falls onto the tilting track.
2. This track is inclined towards the right, therefore the arrival of the green ball – which is heavier than the blue ball – causes its inclination to change.
3. The green ball rolls towards the left and falls onto the track of **Block C**.
4. The green ball rolls a short way up the track towards the left but then inverts its direction and strikes the hammer pendulum.
5. The hammer pendulum strikes the green ball which enters the finish.
6. Meanwhile, the blue ball – due to the movement of the tilting track – loses its balance and starts rolling towards the right on the underlying track.
7. The blue ball enters the finish.



✓ **N.B.:** the finish must be aligned with both the final tracks of **Blocks B** and **C**.



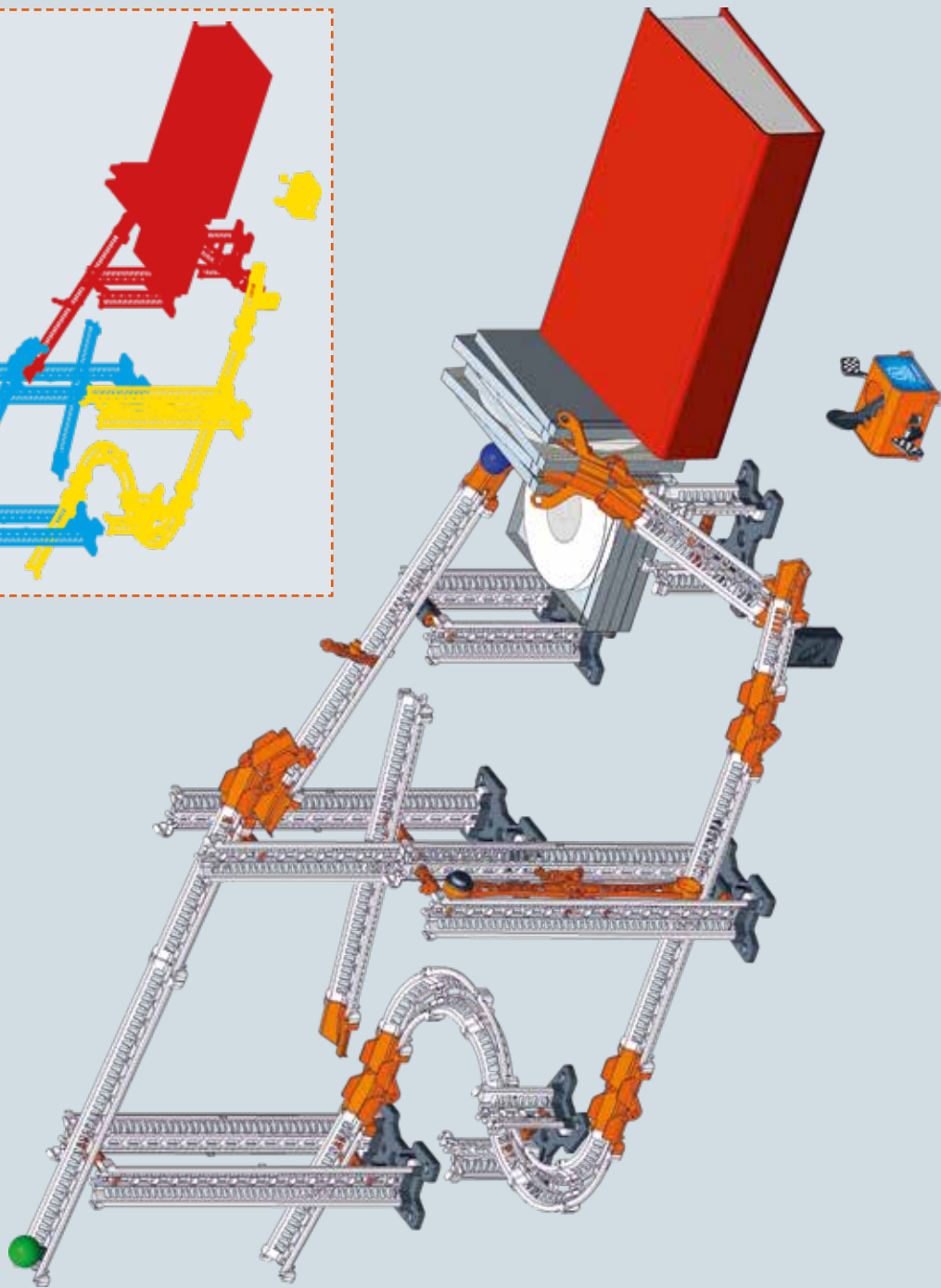
**CIRCUIT NO. 9**

**LIST OF PIECES**

	x 10
	x 5
	x 6
	x 5
	x 1
	x 1
	x 4
	x 9
	x 1
	x 2
	x 1
	x 2
	x 1
	x 3
	x 4
	x 5
	x 6
	x 7
	x 8
	x 9
	x 10
	x 11
	x 12
	x 13
	x 14
	x 15
	x 16
	x 17
	x 18
	x 19
	x 20
	x 21
	x 22
	x 23
	x 24
	x 25
	x 26
	x 27
	x 28
	x 29
	x 30
	x 31
	x 32
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	x 34
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	x 68
	x 69
	x 70
	x 71
	x 72
	x 73
	x 74
	x 75
	x 76
	x 77
	x 78
	x 79
	x 80
	x 81
	x 82
	x 83
	x 84
	x 85
	x 86
	x 87
	x 88
	x 89
	x 90
	x 91
	x 92
	x 93
	x 94
	x 95
	x 96
	x 97
	x 98
	x 99
	x 100

**NOT INCLUDED IN THE KIT**

BOOK	x 1
CD CASES	x 10
PENCIL	x 1



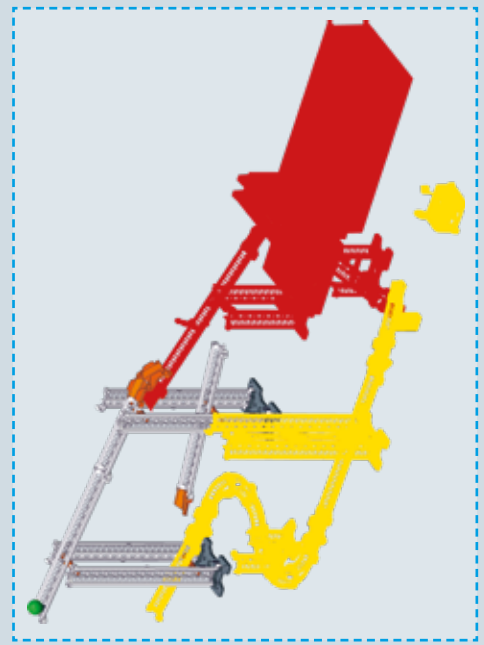
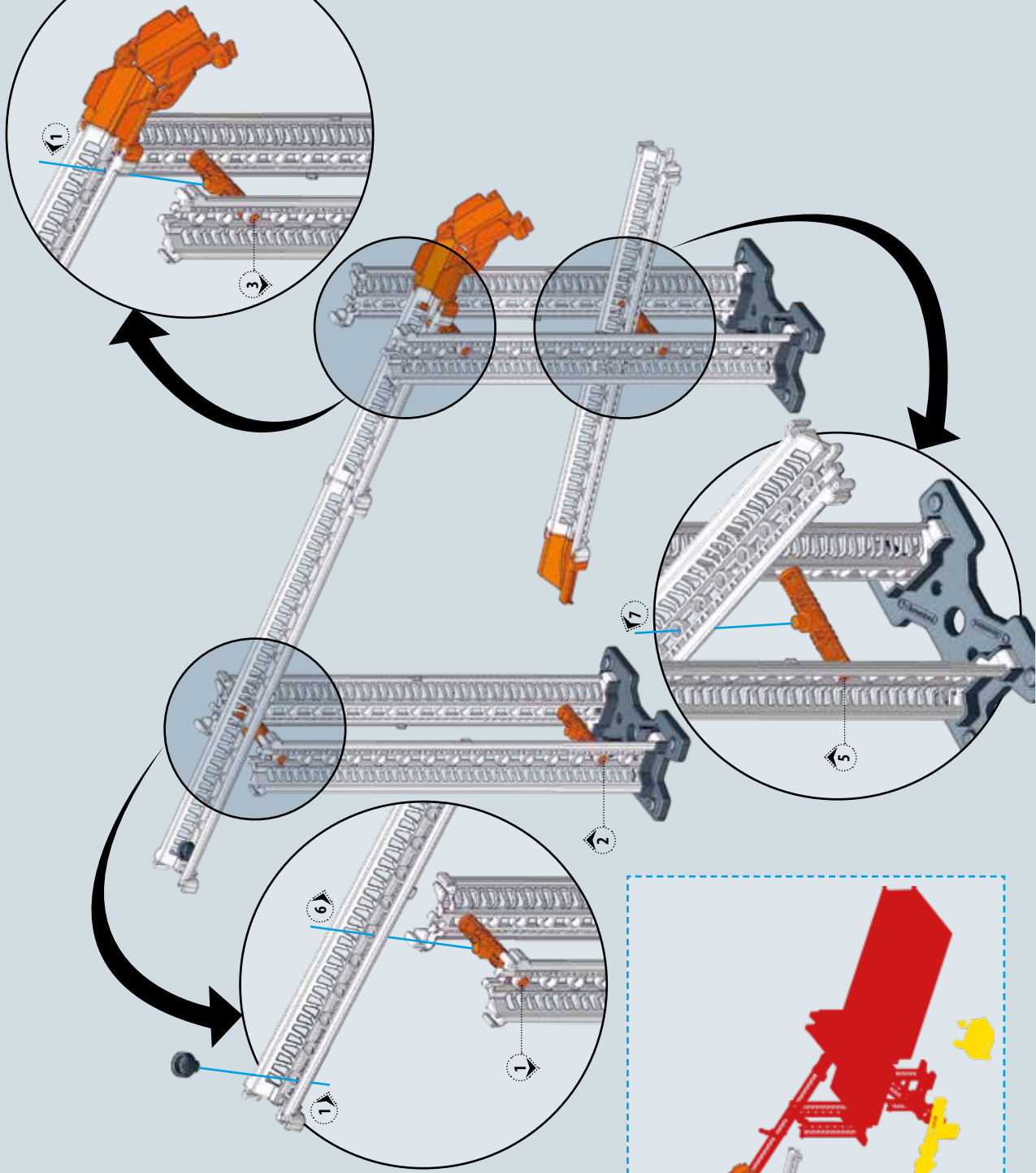
**DIFFICULT  
ROUTES**

**CIRCUIT NO. 9**

**BLOCK A**

**LIST OF PIECES**

	x6		x1		x1		x1
	x1		x1		x4		x1
	x1		x1		x2		x1



**LIST OF PIECES**

	x1
	x3
	x3
	x1
	x1
	x1
	x2

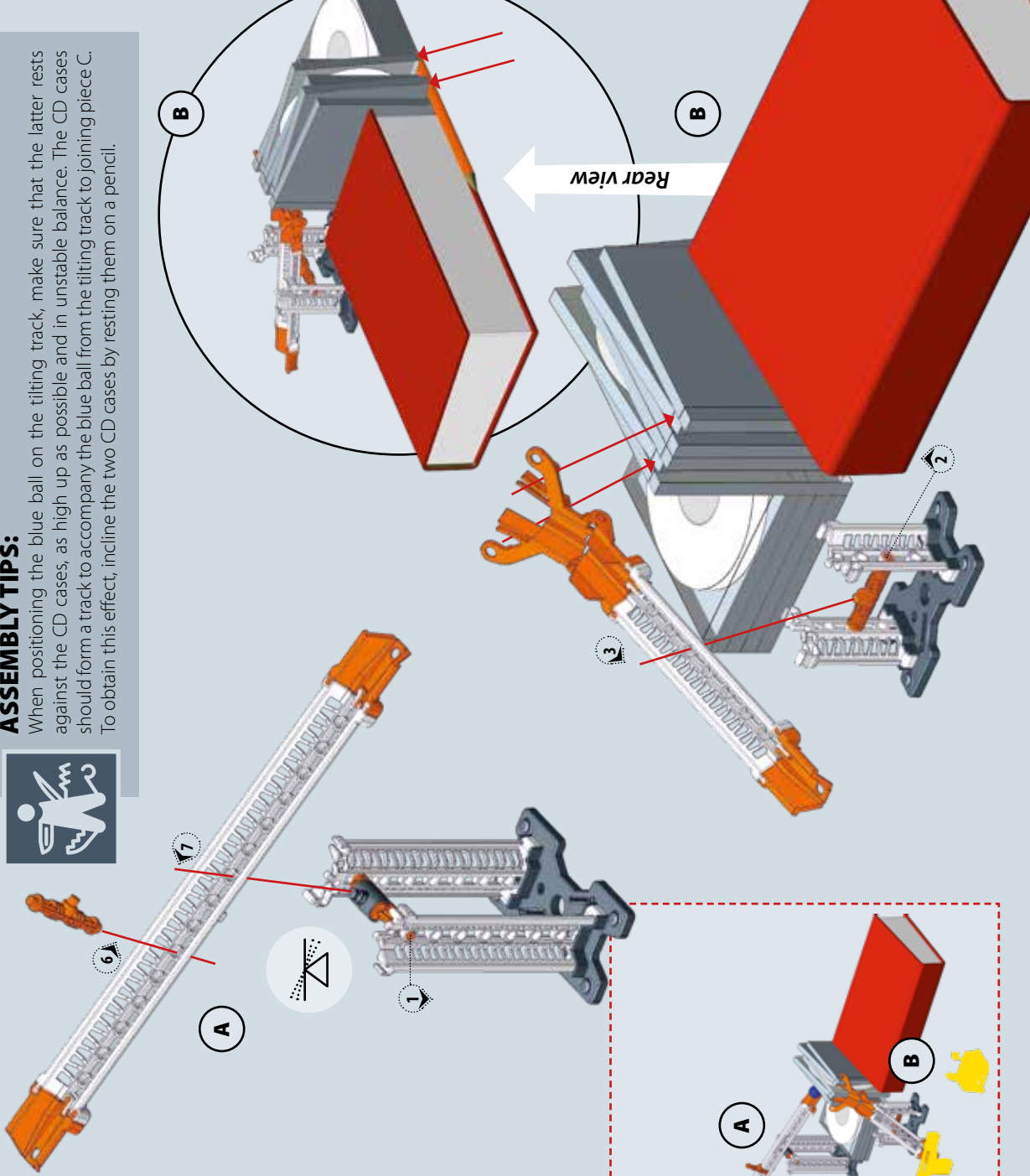
**NOT INCLUDED IN THE KIT**

BOOK	x1
CD CASES	x10
PENCIL	x1



**ASSEMBLY TIPS:**

When positioning the blue ball on the tilting track, make sure that the latter rests against the CD cases, as high up as possible and in unstable balance. The CD cases should form a track to accompany the blue ball from the tilting track to joining piece C. To obtain this effect, incline the two CD cases by resting them on a pencil.





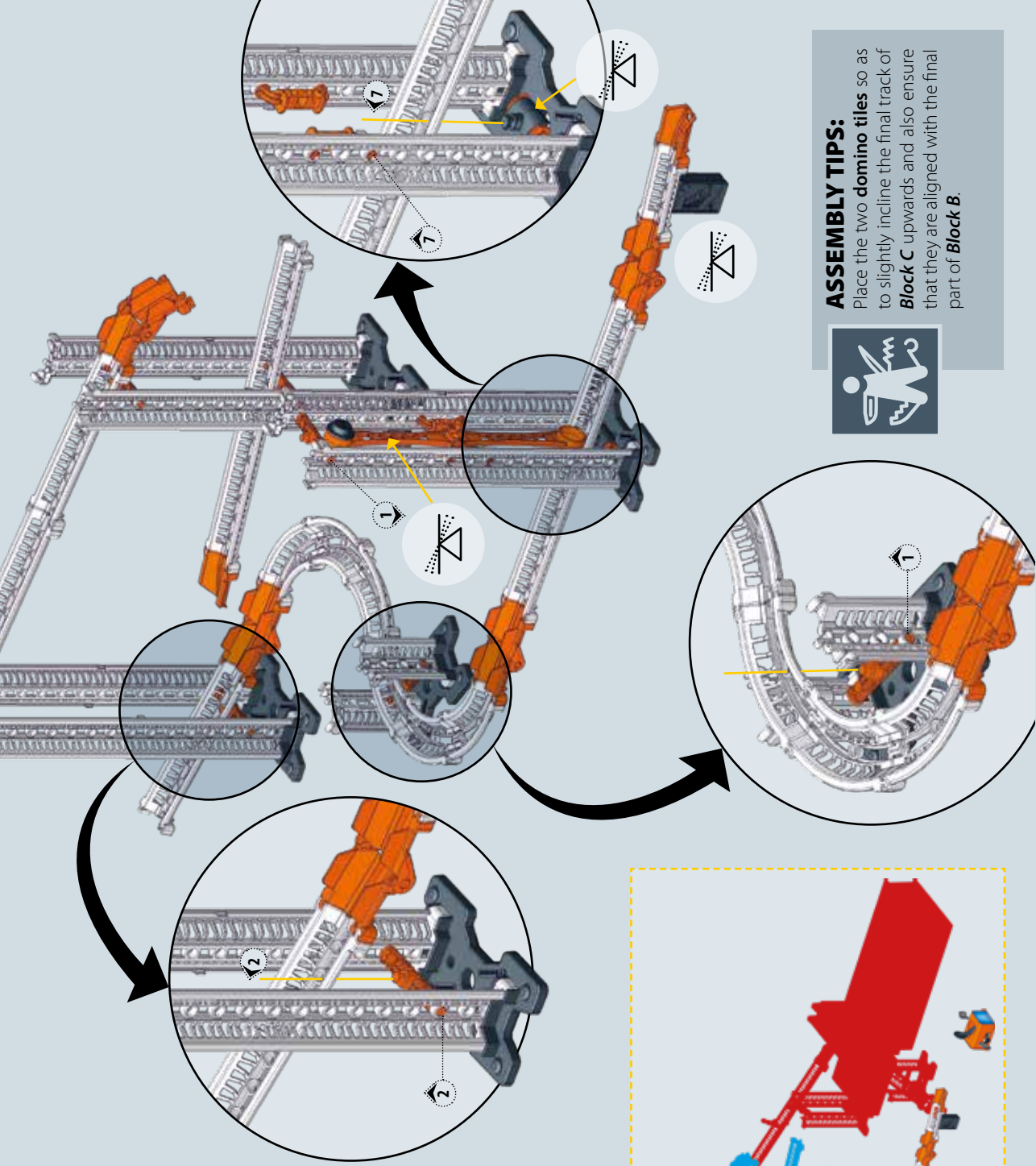
**DIFFICULT ROUTES**

**CIRCUIT NO. 9**

**BLOCK C**

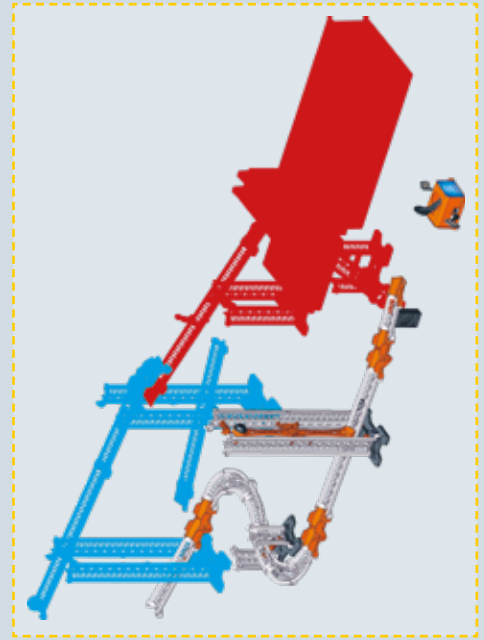
**LIST OF PIECES**

	x3		x1		x6		x3		x2		x1		x3		x1		x2		x3		x4
	x3		x3		x1		x2		x1		x2		x3		x1		x2		x3		x4



**ASSEMBLY TIPS:**

Place the two domino tiles so as to slightly incline the final track of Block C upwards and also ensure that they are aligned with the final part of Block B.





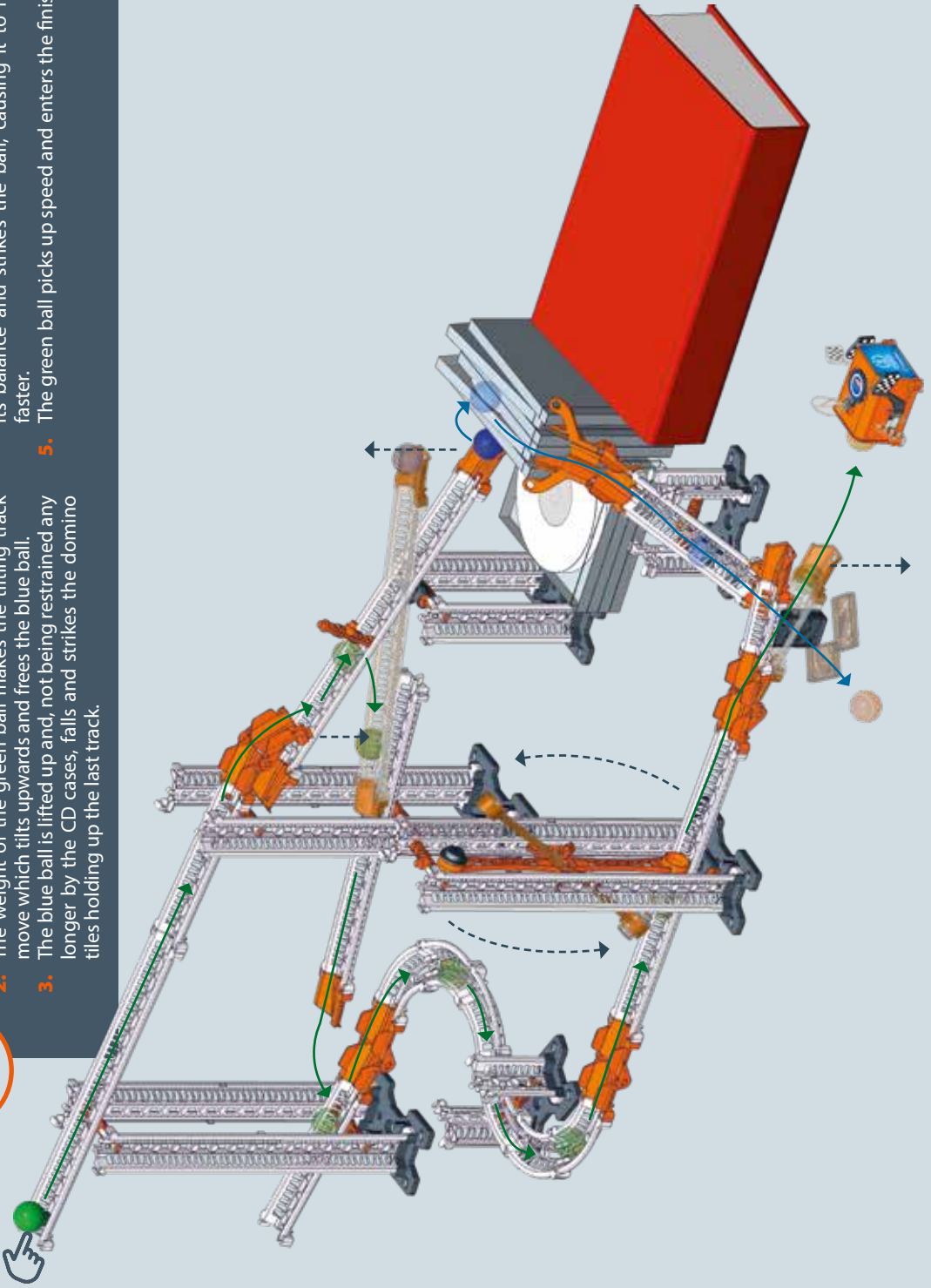
**DIFFICULT  
ROUTES**  
**CIRCUIT NO. 9**



**WHAT HAPPENS:**

1. The green ball rolls down the inclined track and falls on the underlying track where it is stopped by the vertical beam.
2. The weight of the green ball makes the tilting track move which tilts upwards and frees the blue ball.
3. The blue ball is lifted up and, not being restrained any longer by the CD cases, falls and strikes the domino tiles holding up the last track.

4. Meanwhile, the green ball falls on the underlying tracks and, after rolling along the curved tracks, gradually strikes the hammer pendulum which loses its balance and strikes the ball, causing it to move faster.
5. The green ball picks up speed and enters the finish.



**DIFFICULT ROUTES**

**CIRCUIT NO. 10**

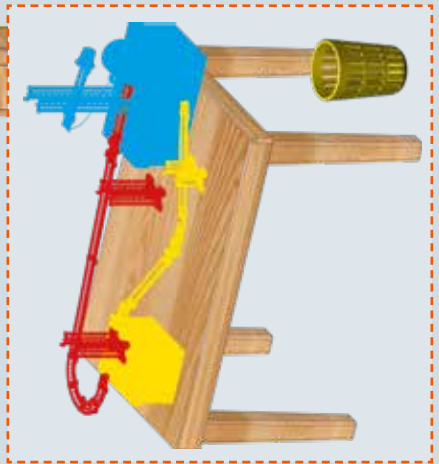
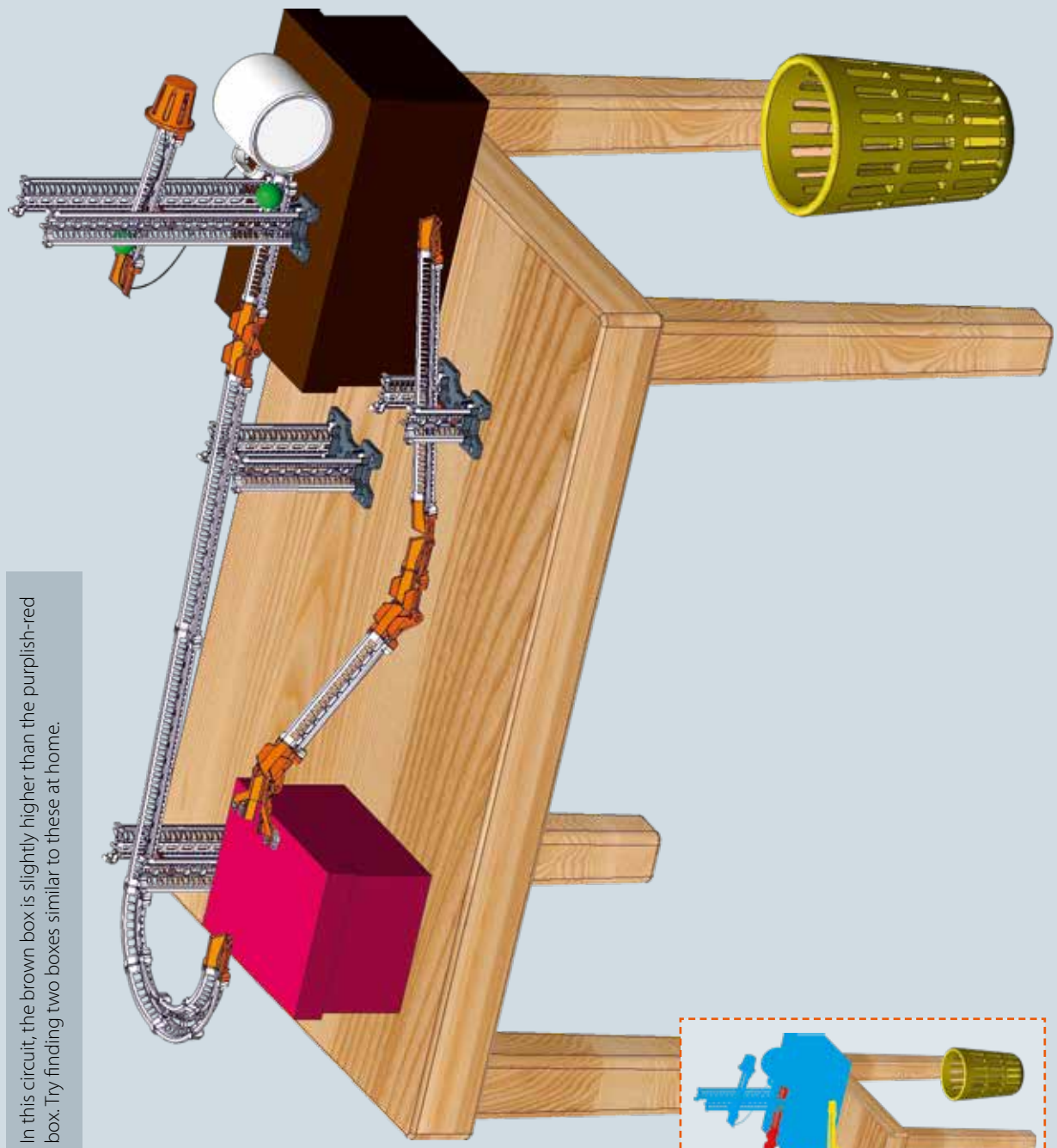
**LIST OF PIECES**

	x5
	x7
	x4
	x3
	x1
	x4
	x2
	x1
	x1
	x1
	x2
	x1
	x2
	x2

**NOT INCLUDED IN THE KIT**

BOX	x2
CUP	x1
BASKET	x1

In this circuit, the brown box is slightly higher than the purplish-red box. Try finding two boxes similar to these at home.



# DIFFICULT ROUTES

## CIRCUIT NO. 10

### BLOCK A

#### LIST OF PIECES

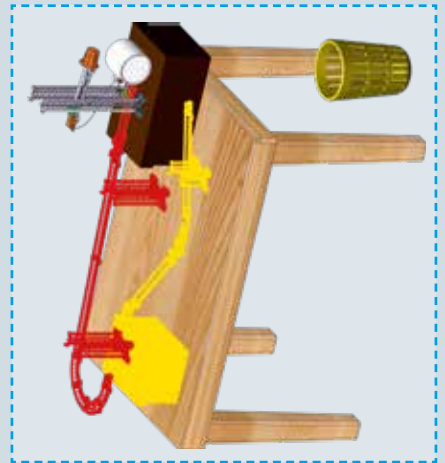
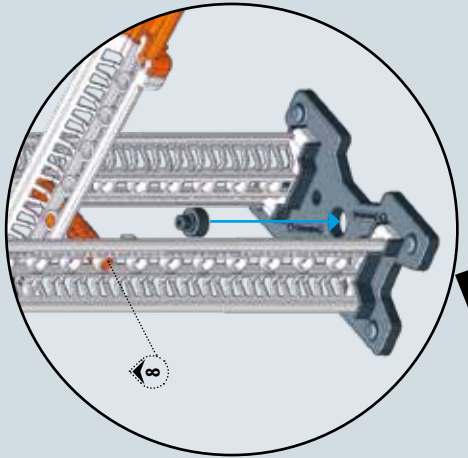
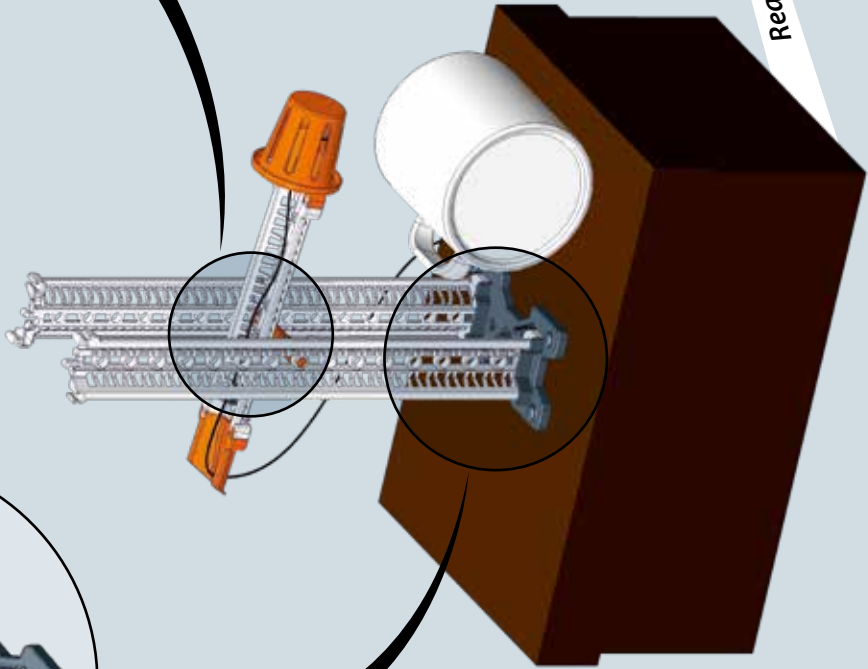
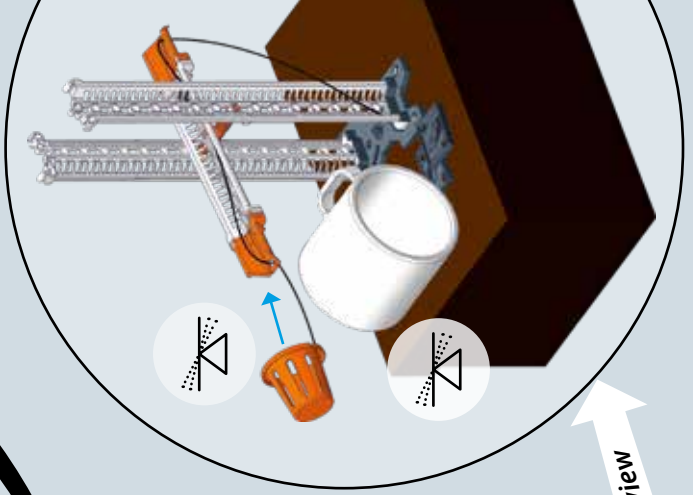
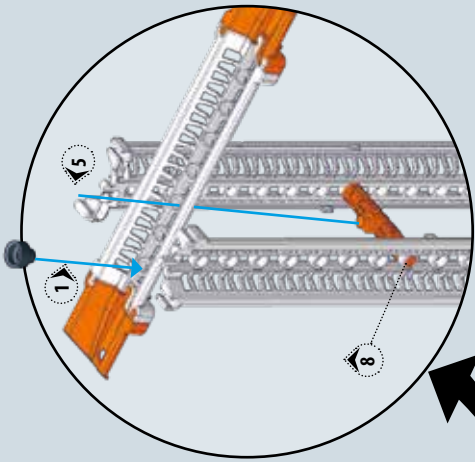
	x2
	x1
	x1
	x1
	x1
	x1
	x2
	x2

#### NOT INCLUDED IN THE KIT

BOX	x1
CUP	x1

#### ASSEMBLY TIPS:

Tie one end of the **string** to the **basket** and pass the other end through the respective holes of the **end pieces**. Next, pass the string alongside the vertical tracks and insert it through the holes of the two **domino tiles** (tie it with a knot), which will keep the cup still.

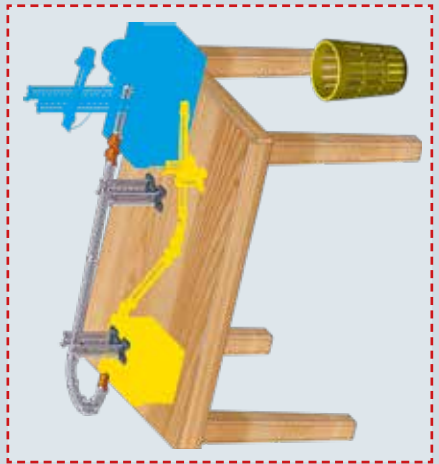
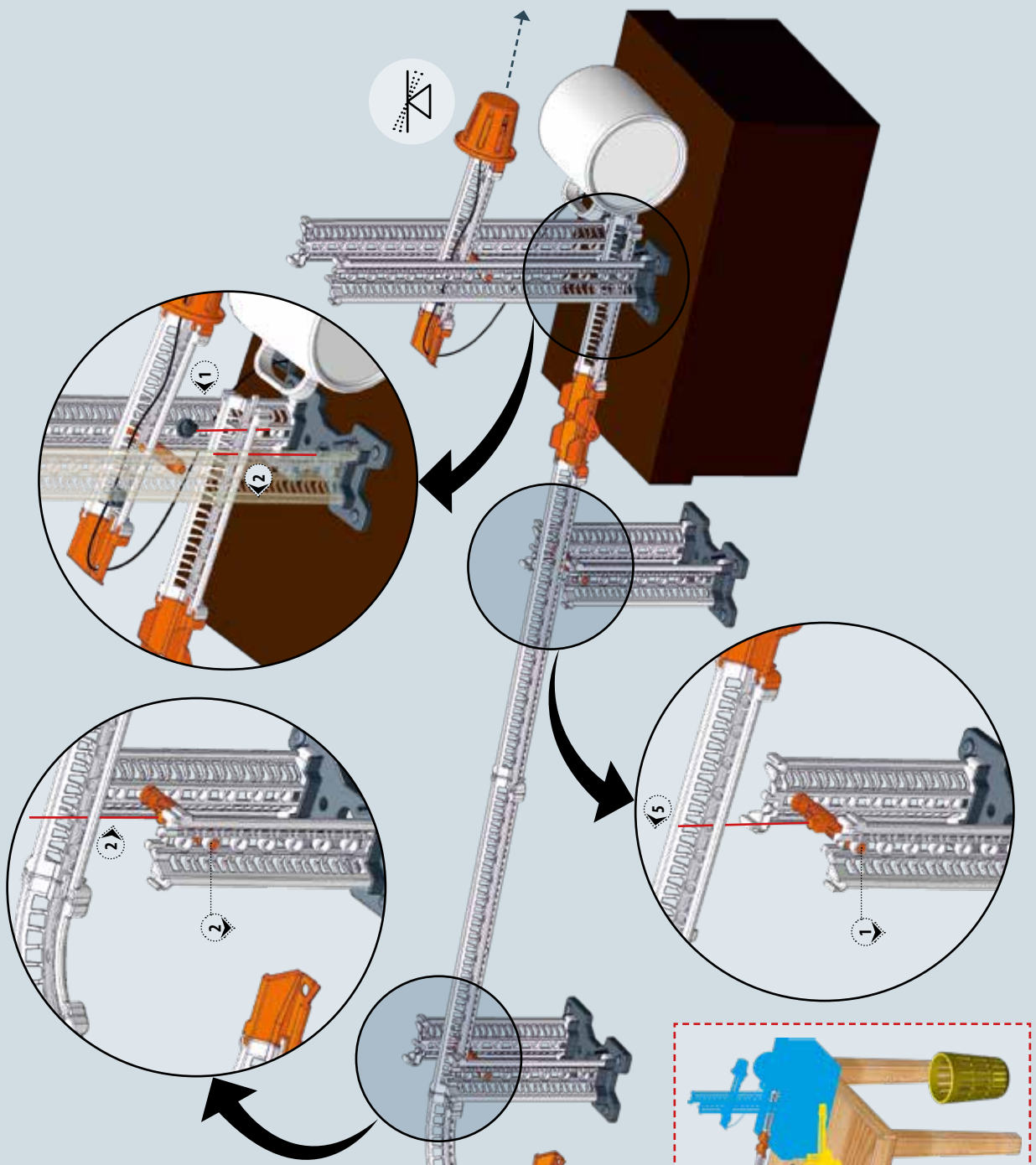




**BLOCK B**

**LIST OF PIECES**

	x2		x5		x2		x1		x1		x2
	x4		x1		x1		x1		x1		x2





**BLOCK C**

**LIST OF PIECES**

-  x1
-  x1
-  x1
-  x2
-  x1
-  x3
-  x2
-  x1
-  x1
-  x1

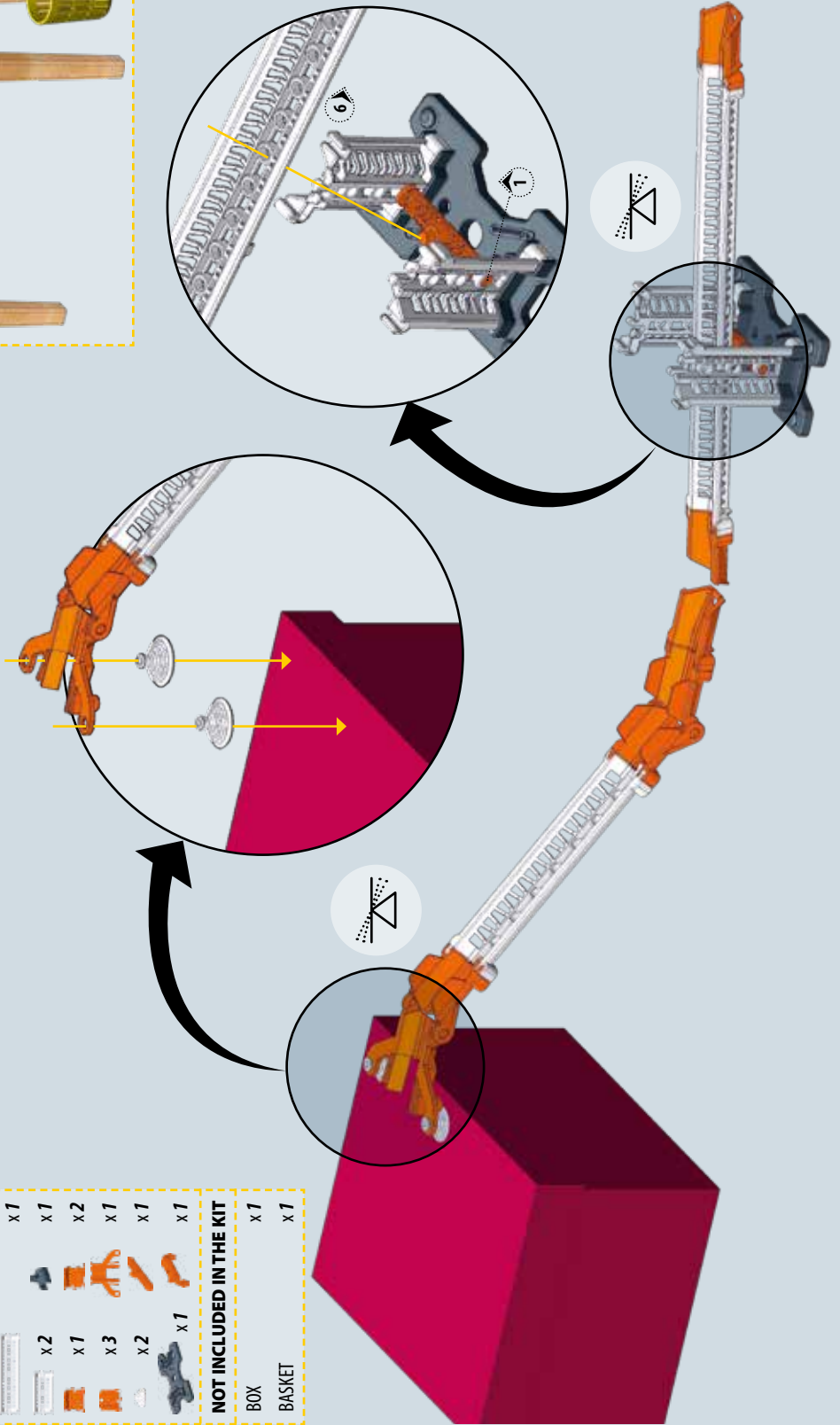
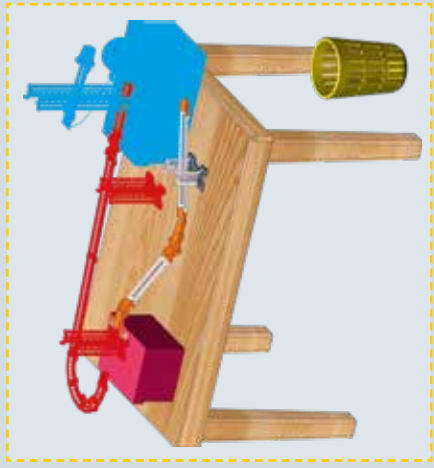
**NOT INCLUDED IN THE KIT**

- BOX** x1
- BASKET** x1



**ASSEMBLY TIPS:**

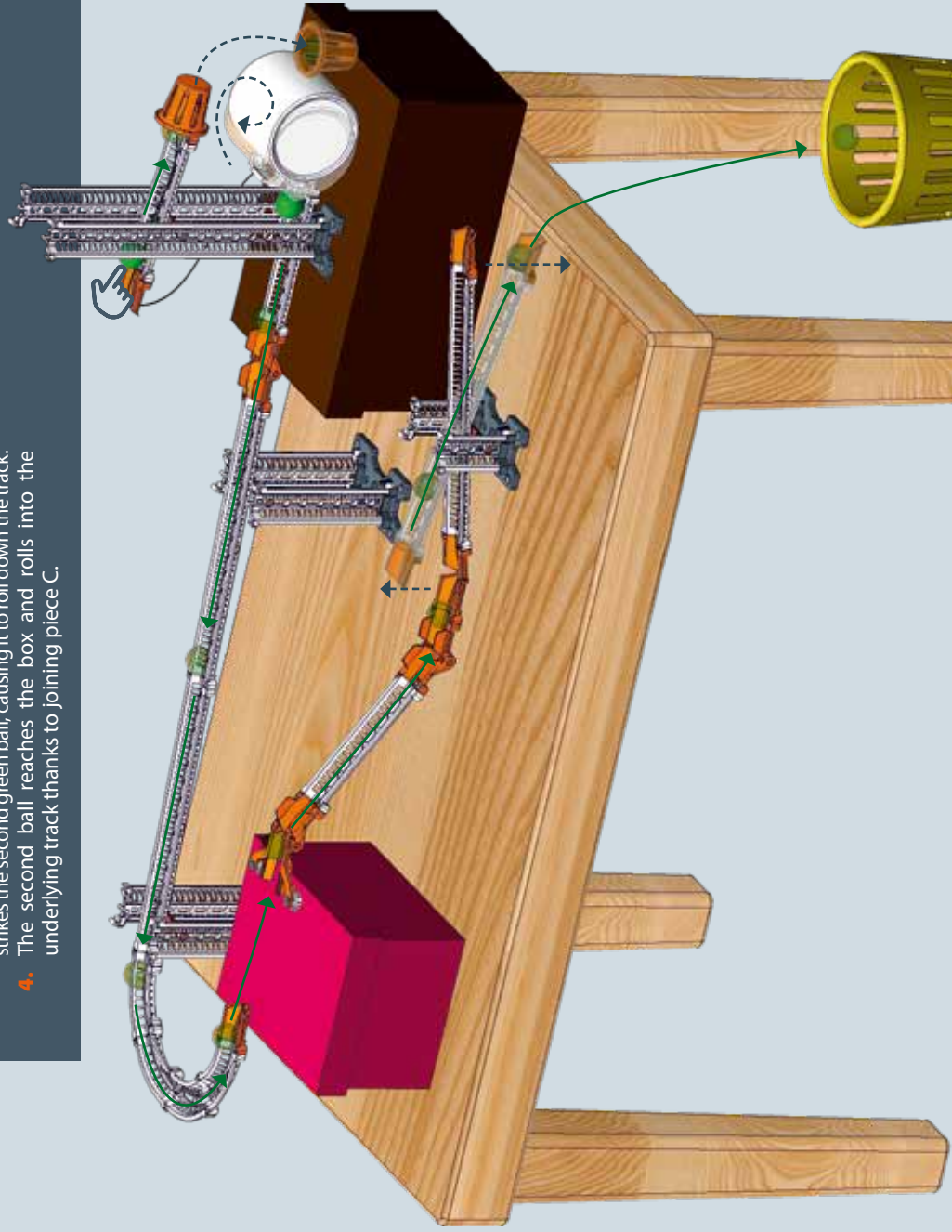
The surface of the box must be smooth enough to enable the **suction cups of joining piece C** to take hold. If you have difficulties with this step, try placing a large-size magazine with a plasticised cover above the lid of the box. Once you have prepared this block, draw the **end pieces** of the two route segments together so that the final track remains inclined towards the left. As you will see further on, the ball's arrival will cause it change position.





**WHAT HAPPENS:**

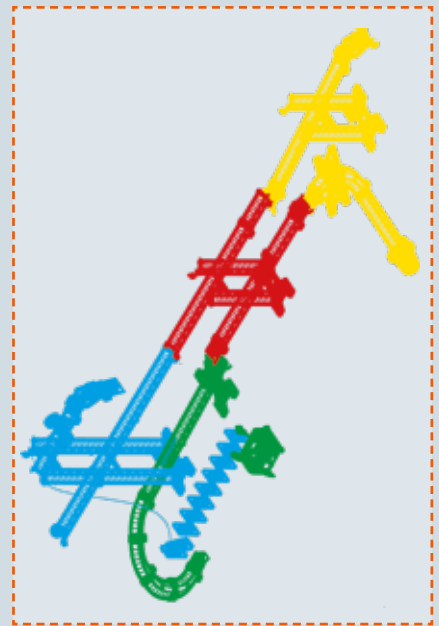
1. The first green ball rolls along the short track until it enters the basket, causing it to fall.
  2. The weight of the basket tenses the string which, in turn, shifts the domino pieces from their current position, thus freeing the cup.
  3. Due to the weight of the handle, the cup loses its balance and strikes the second green ball, causing it to roll down the track.
  4. The second ball reaches the box and rolls into the underlying track thanks to joining piece C.
5. The ball picks up speed on the downhill and starts to ascend the tilting track.
  6. Under the weight of the ball, the tilting track changes its inclination, causing the ball to descend and roll off the table into the basket.



**DIFFICULT  
ROUTES**  
**CIRCUIT NO. 11**

**LIST OF PIECES**

	x7
	x7
	x6
	x2
	x6
	x5
	x1
	x1
	x3
	x1
	x1
	x10
	x2
	x5
	x1
	x1
	x3
	x1
	x1
	x4
	x7
	x7
	x6
	x2
	x6
	x5
	x1
	x1
	x3
	x1
	x1
	x10
	x2





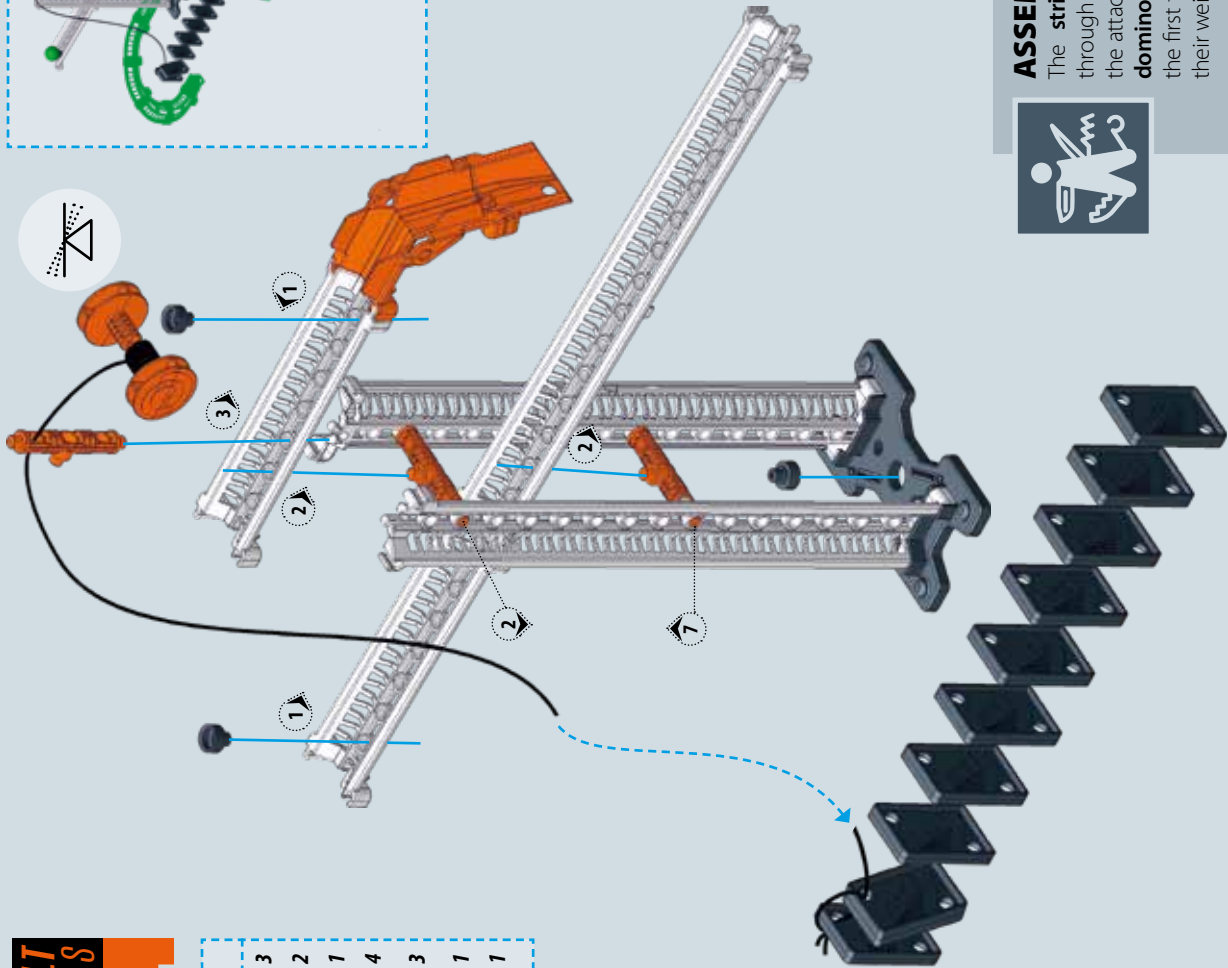
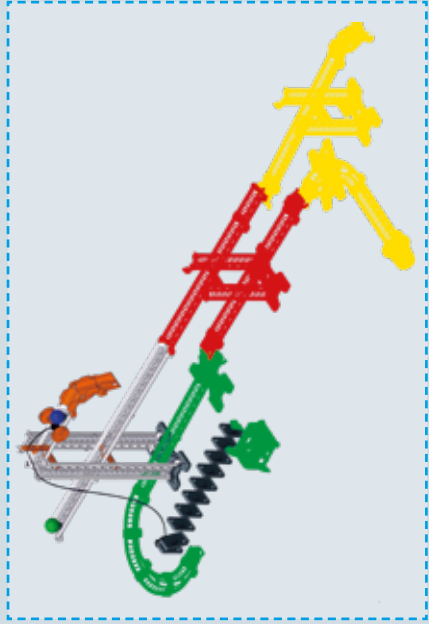
**DIFFICULT ROUTES**

**CIRCUIT NO. 11**

**BLOCK A**

**LIST OF PIECES**

	x3		x2		x1		x4		x3		x1		x1
	x1		x1		x1		x1		x10		x1		x1
	x1		x1		x1		x1		x1		x1		x1



**ASSEMBLY TIPS:**

The **string** is wound around the **barbell**, it passes through the hole on the top of the beam and lies above the attachment point of the vertical beams. Once all the **domino tiles** have been aligned, pass the string through the first two holes of the tiles and tie a knot. In this way, their weight will cause the **barbell** to move more easily.



**BLOCK B**

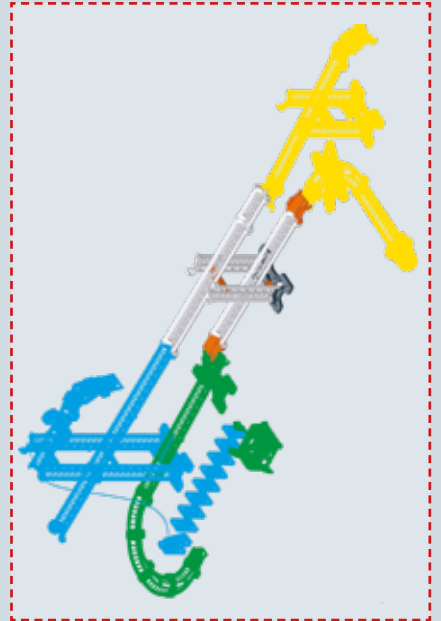
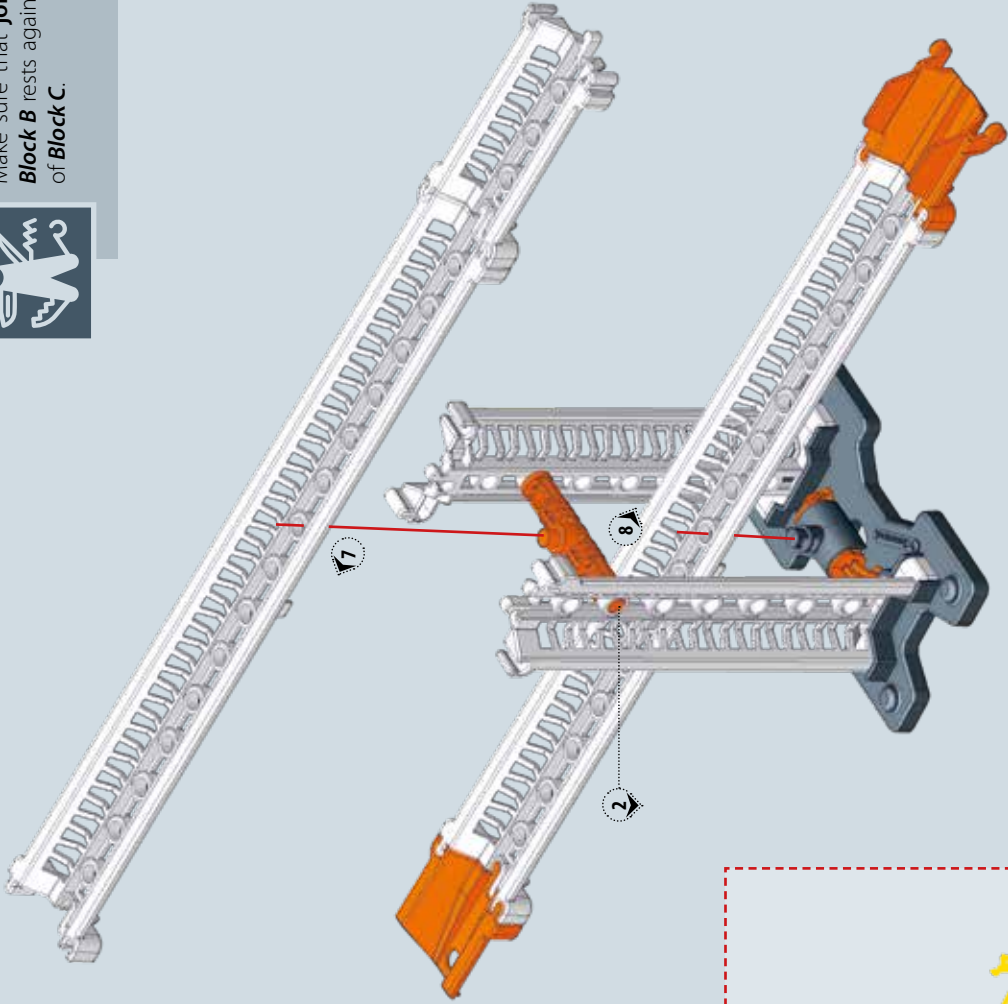
**LIST OF PIECES**

	x2
	x2
	x1
	x1
	x1
	x1
	x1



**ASSEMBLY TIPS:**

Make sure that **joining piece A** of **Block B** rests against the **end piece** of **Block C**.





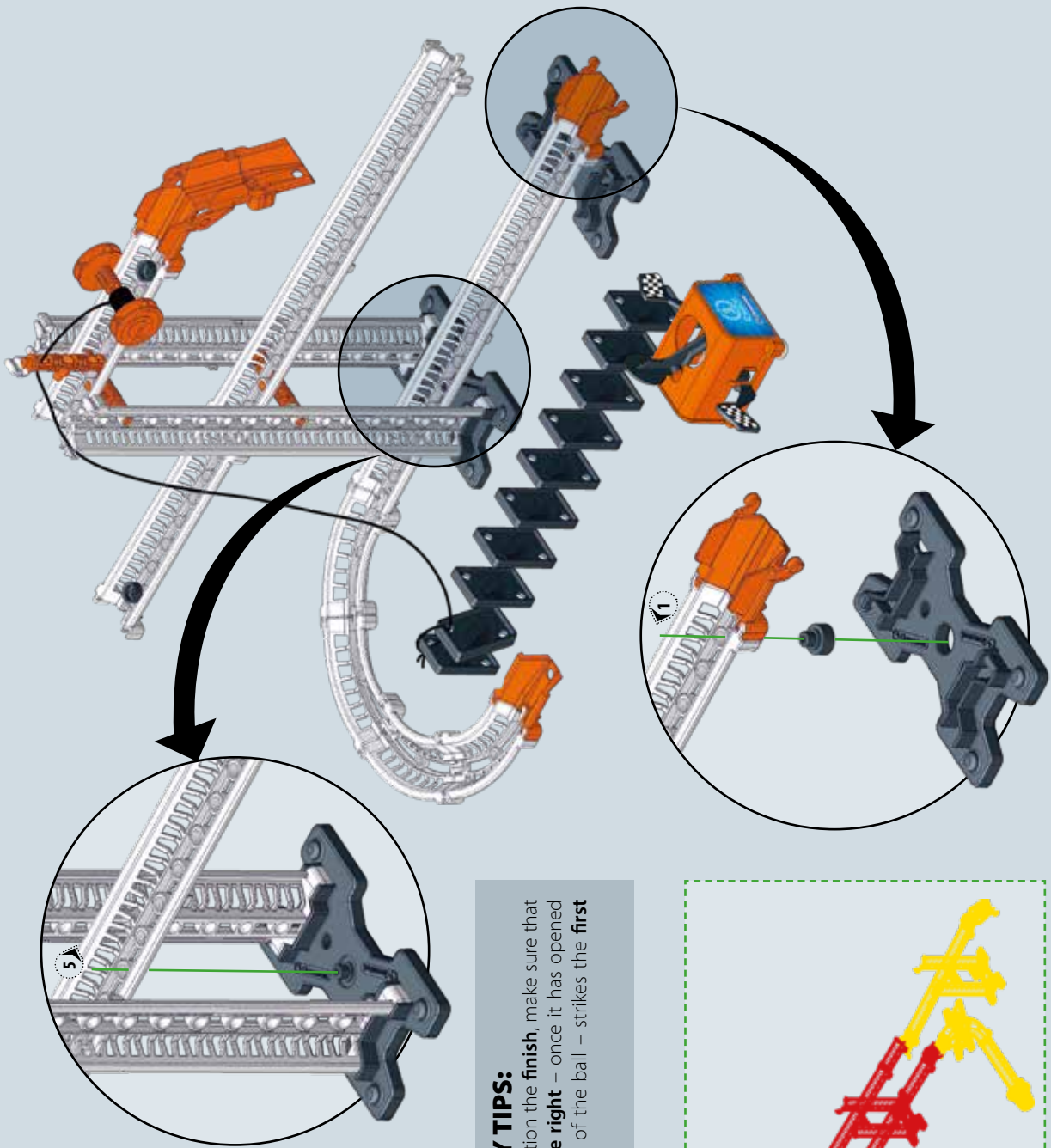
**DIFFICULT ROUTES**

**CIRCUIT NO. 11**

**BLOCK D**

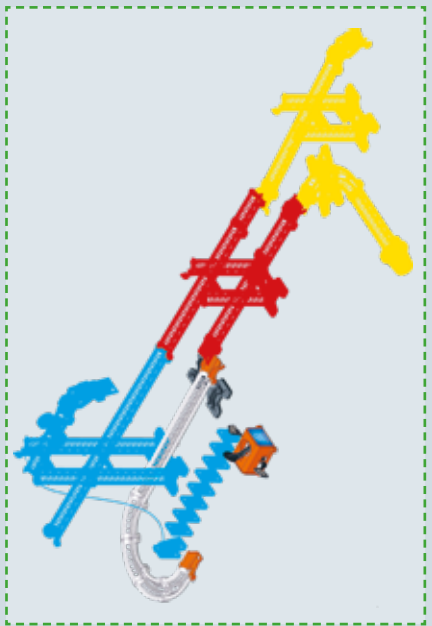
**LIST OF PIECES**

-  x1
-  x1
-  x1
-  x1
-  x4
-  x1
-  x1
-  x1
-  x3
-  x4



**ASSEMBLY TIPS:**

When you position the **finish**, make sure that the **flag on the right** – once it has opened with the arrival of the ball – strikes the **first domino tile**.

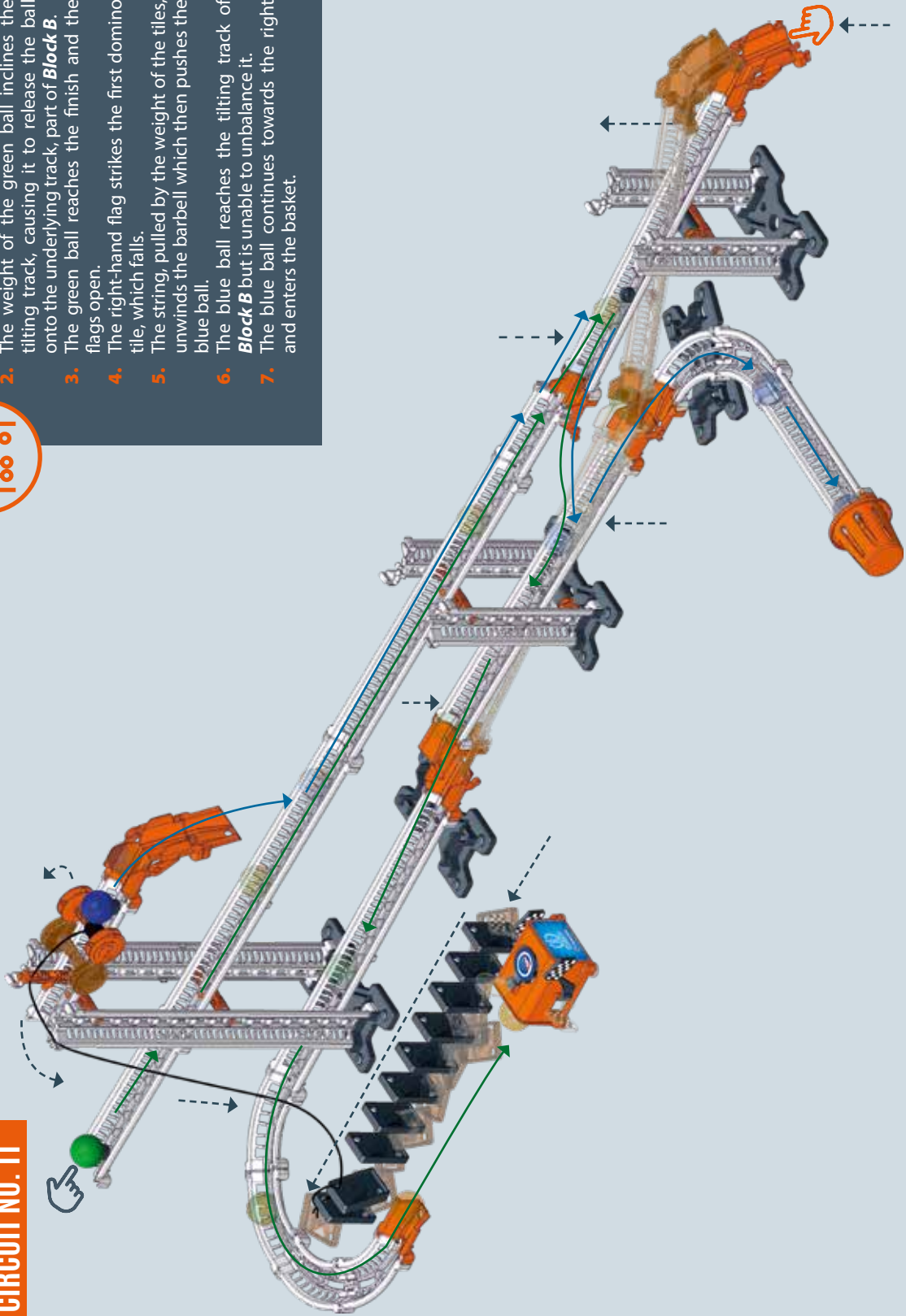


**DIFFICULT  
ROUTES**  
**CIRCUIT NO. 11**



**WHAT HAPPENS:**

1. The green ball rolls along the track and falls onto the tilting track, stopping against the cup.
2. The weight of the green ball inclines the tilting track, causing it to release the ball onto the underlying track, part of **Block B**.
3. The green ball reaches the finish and the flags open.
4. The right-hand flag strikes the first domino tile, which falls.
5. The string, pulled by the weight of the tiles, unwinds the barbell which then pushes the blue ball.
6. The blue ball reaches the tilting track of **Block B** but is unable to unbalance it.
7. The blue ball continues towards the right and enters the basket.





**DIFFICULT ROUTES**

**CIRCUIT NO. 12**

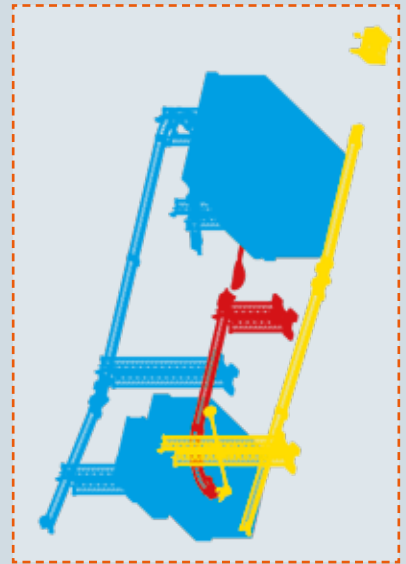
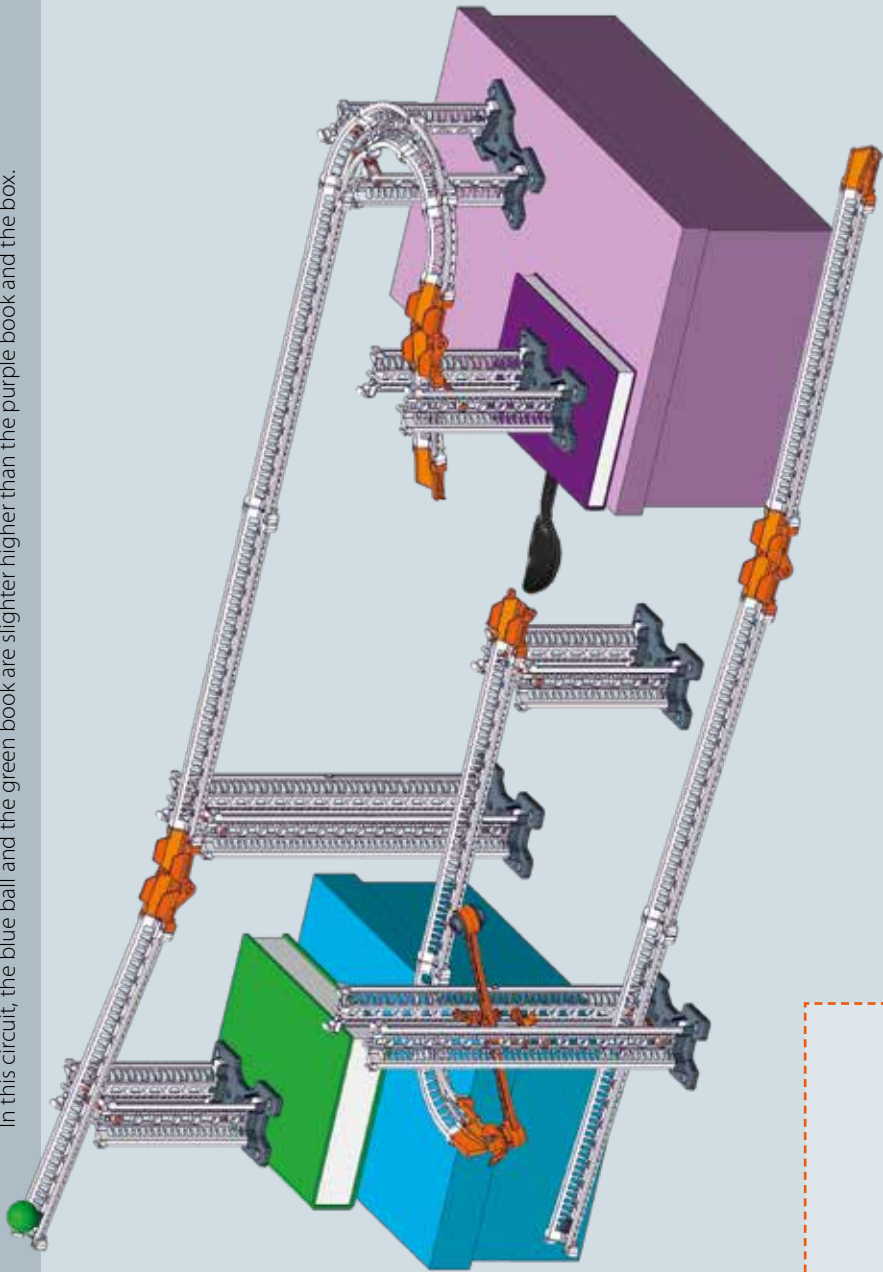
**LIST OF PIECES**

-  x 11
-  x 8
-  x 6
-  x 3
-  x 2
-  x 1
-  x 1
-  x 7
-  x 1
-  x 4
-  x 3
-  x 1
-  x 1
-  x 1
-  x 1
-  x 1
-  x 1
-  x 1
-  x 1
-  x 1
-  x 1
-  x 1
-  x 1
-  x 1
-  x 1
-  x 1
-  x 1
-  x 1
-  x 1
-  x 1
-  x 1
-  x 1
-  x 1

**NOT INCLUDED IN THE KIT**

- BOX x 2
- BOOK x 2
- PLASTIC SPOON x 1

In this circuit, the blue ball and the green book are slightly higher than the purple book and the box.



**DIFFICULT  
ROUTES**

**CIRCUIT NO. 12**

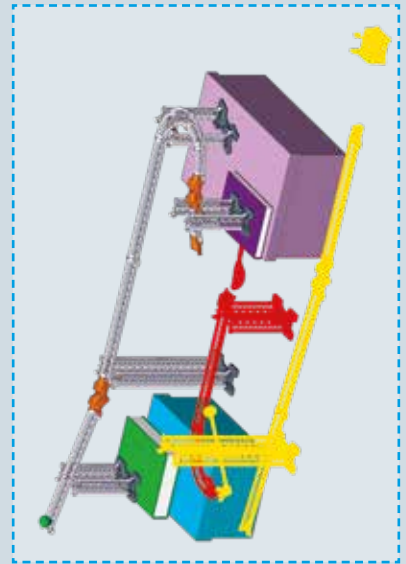
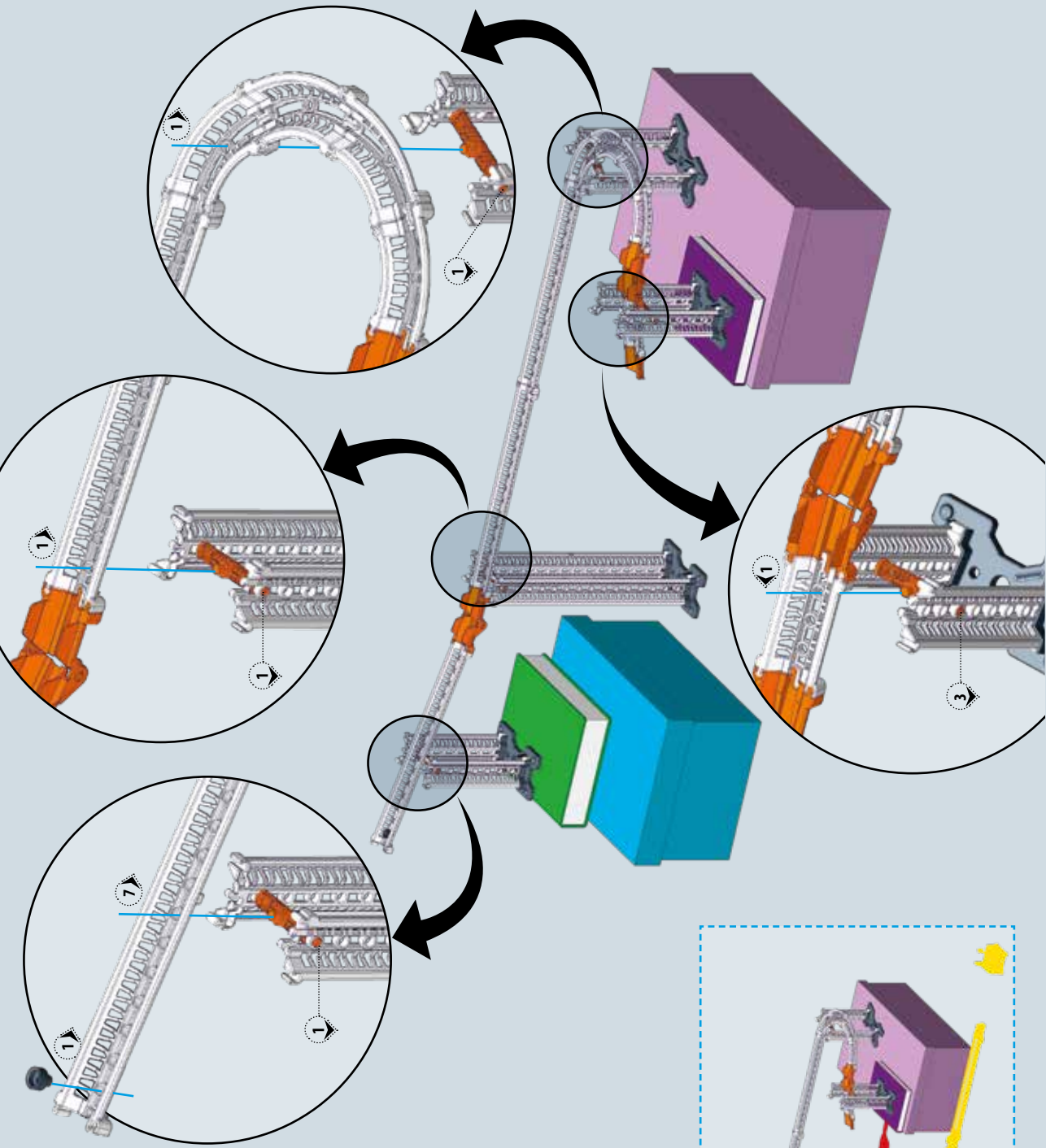
**BLOCK A**

**LIST OF PIECES**

	x5		x6		x4		x2		x1		x4
	x1		x2		x2		x1		x4		x4
	x4		x1		x1		x1		x4		x4

**NOT INCLUDED IN THE KIT**

<b>BOX</b>	x2
<b>BOOK</b>	x2





# DIFFICULT ROUTES

## CIRCUIT NO. 12

### BLOCK B

#### LIST OF PIECES

-  x1
-  x2
-  x1
-  x1
-  x1

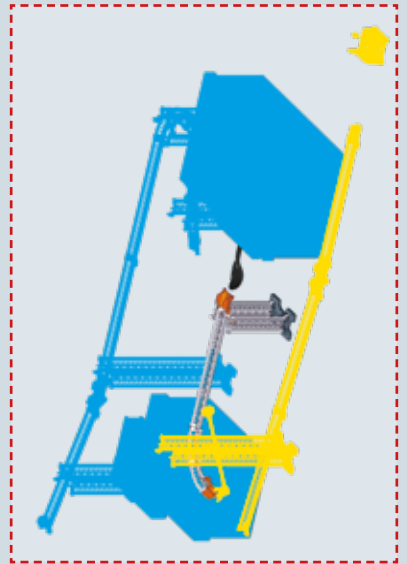
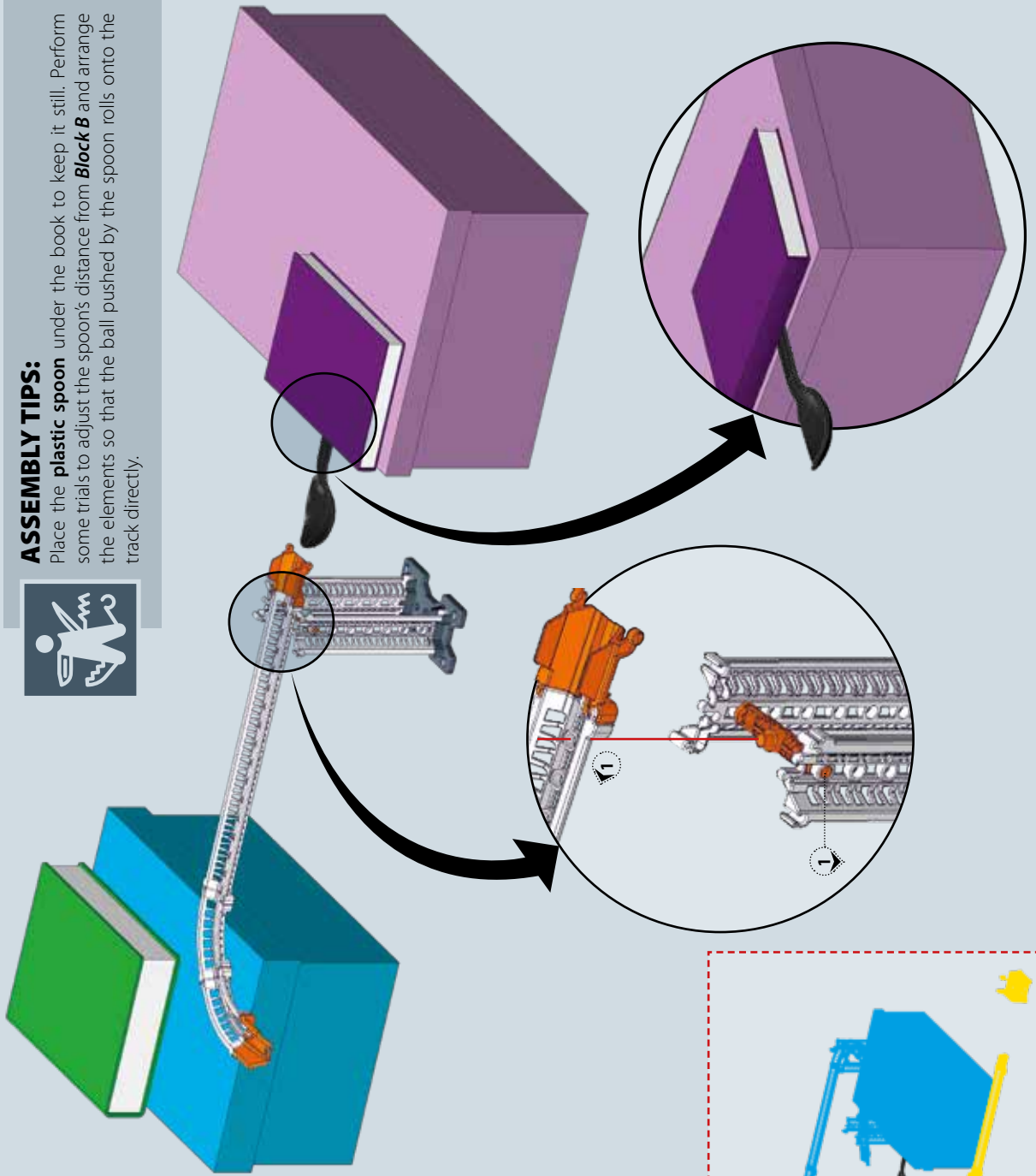
#### NOT INCLUDED IN THE KIT

- PLASTIC SPOON x1



#### ASSEMBLY TIPS:

Place the **plastic spoon** under the book to keep it still. Perform some trials to adjust the spoon's distance from **Block B** and arrange the elements so that the ball pushed by the spoon rolls onto the track directly.





# DIFFICULT ROUTES

## CIRCUIT NO. 12

### BLOCK C

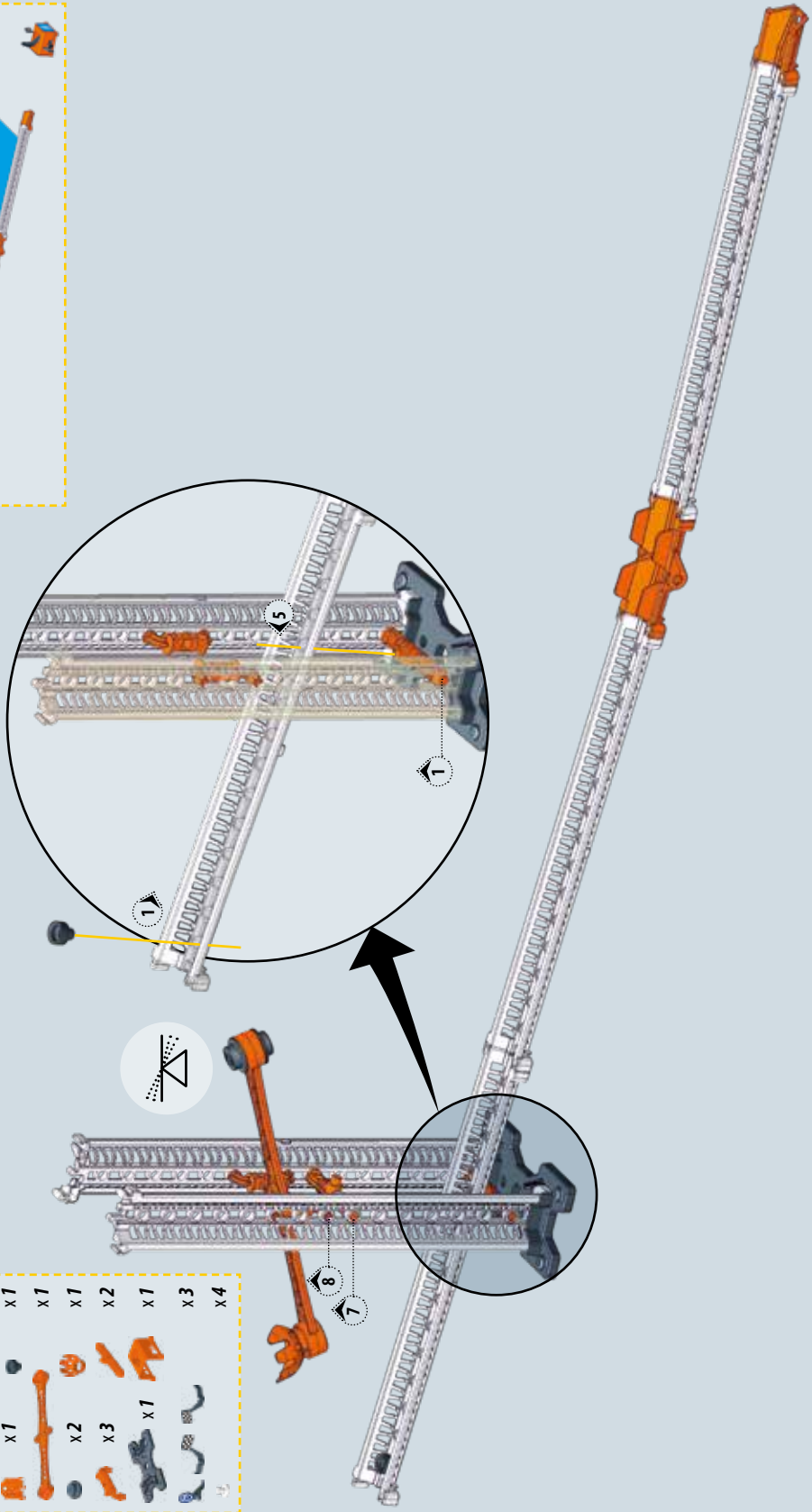
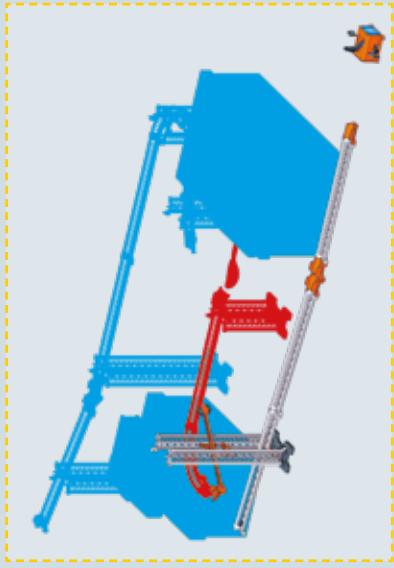
#### LIST OF PIECES

	x5
	x1
	x1
	x1
	x2
	x3
	x1
	x3
	x4



#### ASSEMBLY TIPS:

Once this block has been assembled, arrange it carefully so that the **glove** – the open part of which faces the **end piece** of **Block B** – rests under it. Leave enough space for the ball to enter easily.





**DIFFICULT  
ROUTES**  
**CIRCUIT NO. 12**



**WHAT HAPPENS:**

1. The ball rolls down the track until it drops off the **end piece** and into the spoon.
2. The spoon bends slightly and pushes on the track of **Block B**.
3. The ball rolls along the track and enters the **glove**, which swings and releases it onto the underlying track.
4. The ball rolls along the final track and enters the finish.

