A4 Combining batteries

Oh no! You want to watch some television, but the remote control isn't working. You suspect that the batteries are dead, and the remote control therefore cannot send a signal anymore. You open the battery compartment and see that two batteries that each have a voltage of 1.5 volts are inserted here. You replace the batteries with new ones.

Figure 1: Remote control with the battery compartment opened.

?

Why does this remote control need two batteries?
Why isn't one 1.5-volt battery enough by itself?

Write down your ideas and guesses:

____

____

You need the following for the experiment:

- ☐ Aluminum foil
- ☐ 1 battery holder
- ☐ 7 batteries
- ☐ 2 cables with alligator clips
- ☐ Electrical tape
- ☐ 2 incandescent lamps (3.5 volts)
- ☐ 2 incandescent lamps (6 volts)
- ☐ 2 incandescent lamp sockets

Figure 2: Required materials.

How to set up the experiment:

Lay out all the materials as shown in the photo.
Prepare two electrical circuits.

1. **Comparison electrical circuit:** Build a simple electrical circuit with the 3.5-volt lamp and the battery holder. This electrical circuit will not change during the experiment.
2. **Experimentation electrical circuit:** Build a simple electrical circuit with the 3.5-volt lamp up to the point where you need to connect it to the batteries.

Tips for the experimentation electrical circuit:

- Press the alligator clips firmly on the battery terminals to establish a connection between the lamp socket and the battery.
- How to connect the batteries to each other:
  - Always connect the positive pole of one battery to the negative pole of the next one.
    This is a **series connection**.
  - Put crumpled aluminum foil between the terminals of each pair of batteries. This prevents loose connections!
  - Firmly connect the batteries together using electrical tape. Have your partner help you with this.

How to conduct the experiment:

1. In the experimentation electrical circuit, connect the 3.5-volt lamp with one battery, then successively with two, three, and four batteries.
2. Compare the lamp's brightness with the comparison electrical circuit after each step.
3. Enter your observations in the **"3.5-volt lamp"** column of the table.
   Tip: You will find a selection of terms above the table that you can choose from.
4. Install the 6-volt lamp in the comparison electrical circuit.
5. Repeat the entire experiment with the 6-volt lamp and enter your observations in the **"6-volt lamp"** column.

Write your observations in the table:

How does the lamp shine compared to the lamp in the comparison electrical circuit?
more brightly – equally brightly – less brightly – much less brightly

Number of batteries	3.5-volt lamp	6-volt lamp
1		
2		
3		
4		

Evaluate your observations:

1. With two, three, and four batteries, the lamp shines more brightly than with one battery because more ______________________ is available.

2. In your opinion, what will happen if you operate the lamp with five or even ten batteries connected in series?

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3. Sketch a circuit diagram of four batteries connected in series.

Sketched circuit diagram:

Doing further research:

1. Build a parallel circuit with two batteries.
   Tip: Use an interconnecting wire and adhesive tape.

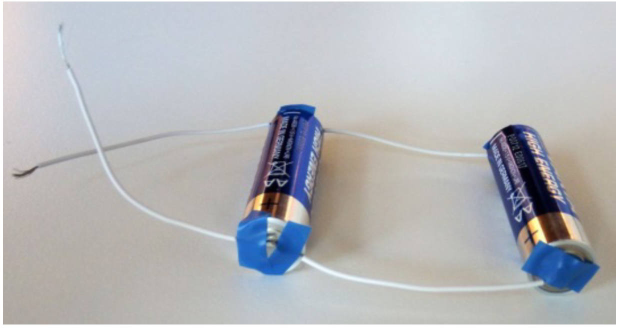

Figure 3: Parallel circuit with two batteries.

2. Connect an electric motor to the two batteries connected in parallel.
3. Connect the second electric motor to two batteries connected in series.
4. Which motor runs faster? Which runs longer?