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UNIVERSITY OF BUCHAREST
VIRTUTE ET SAPIENTIA

INNOVATIVE EDUCATIONAL RESOURCES IN RENEWABLE ENERGIES

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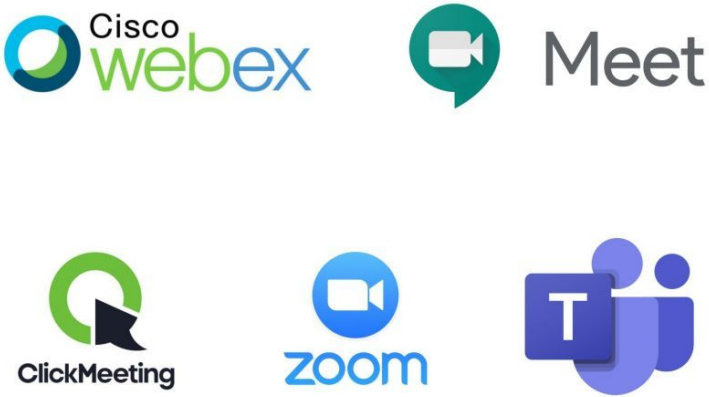
Context

- Distance learning has become the new norm
- For students in science, technology and engineering, practical work is a vital part of the learning process
- Online laboratory work lacks the engagement of in-person experimenting



Solutions

Virtual laboratories

- based on computer simulations
- the original physical process is replaced by a software program that reproduces it

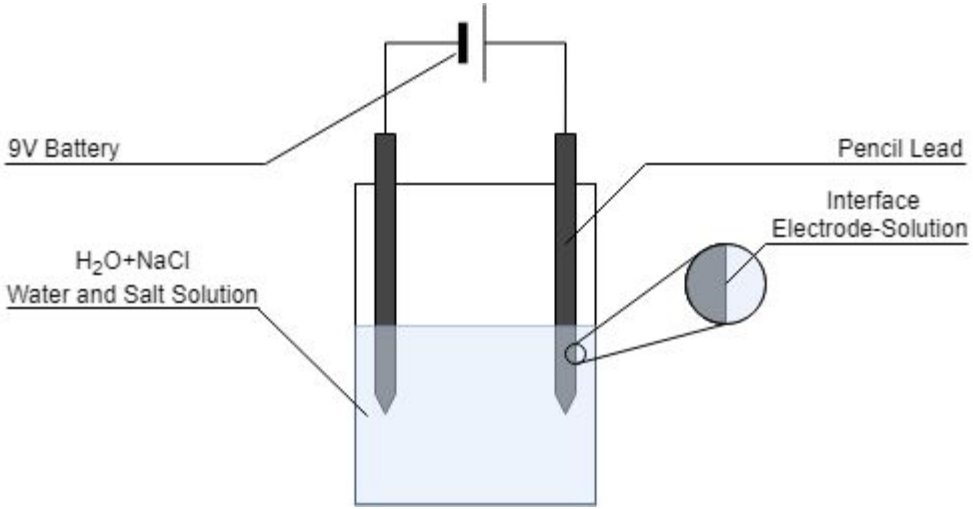
Remote laboratories

- use a virtual interface between students and the real experiment
- the setup can be controlled remotely

Our approach

1. "Do it yourself" Video Tutorial

- Offer a **very basic introduction** whose purpose is to engage the interest of an **audience who isn't familiar with the subject**
- The **electrolysis of water** was chosen for its overall simplicity

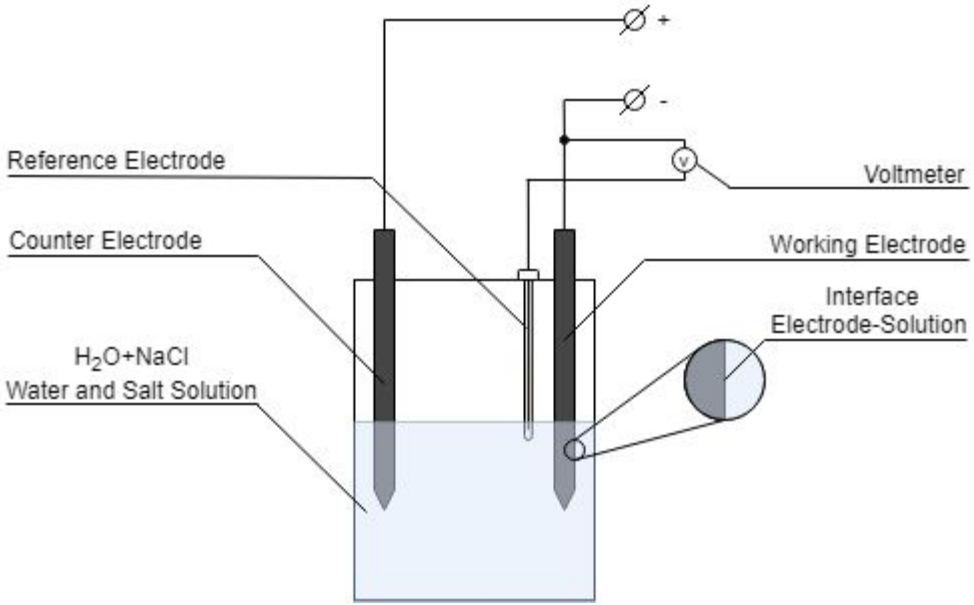


Functional model of the equipment (diagram)

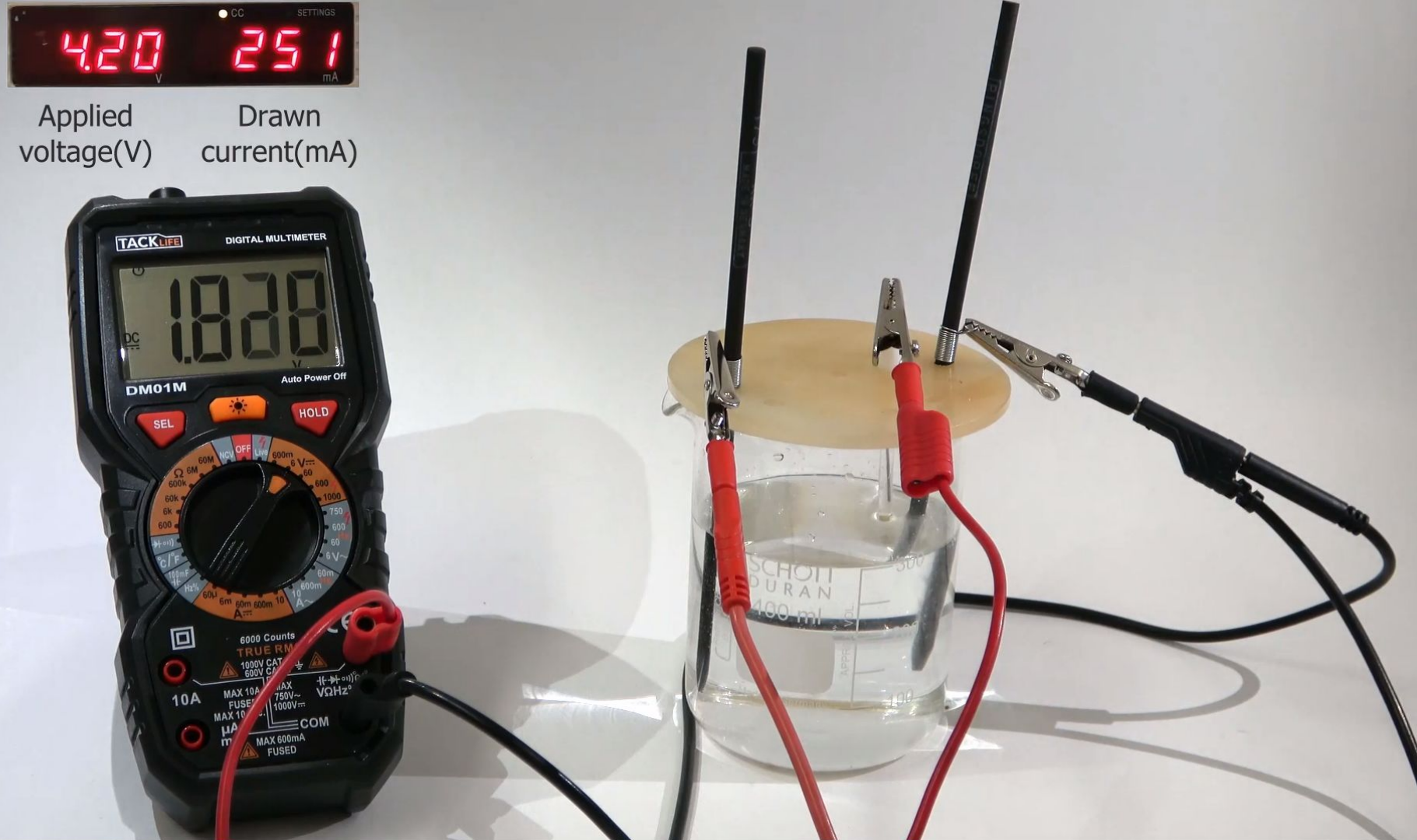
KODAK
Super Heavy Duty
6F22 9V

2. Video Lecture

- The aim is to provide the audience with a classic laboratory experience
- Higher degree of complexity
- Leads the audience towards a **more formal understanding** of the presented phenomena



Functional model of the equipment (diagram)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COM
MAX 600mA FUSED
SCHOTT
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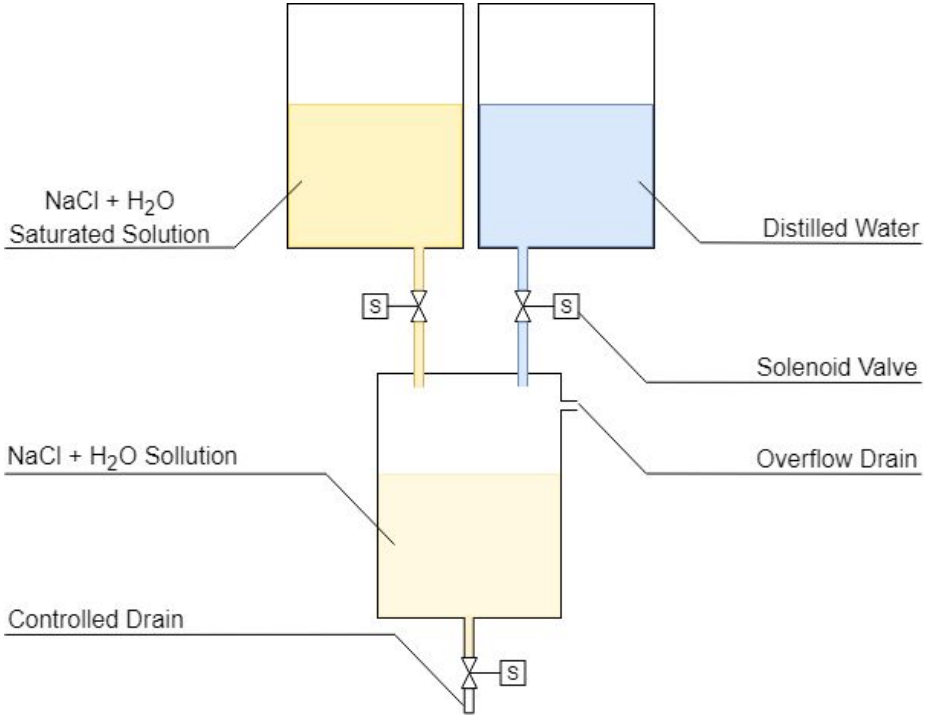
3. Remote Laboratory

- Emulate the laboratory experience by converting the traditional experiment into a **remote laboratory set-up**
- Will feature an **online remote interface** that can be used to fully control the experiment

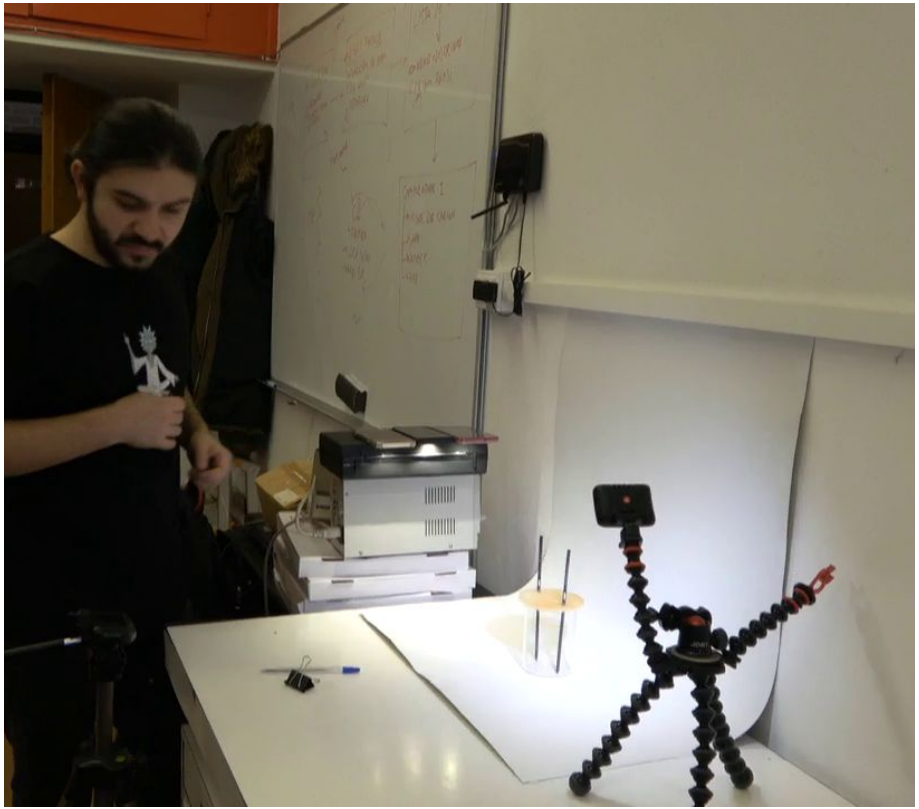


Variable concentration control system model (diagram)

Production of Video Material

Scenography

- Keeping the camera still, preferably on a tripod
- Unobstructed field of view unobstructed
- Good lighting
- Proper framing



Videography

- Keeping the subject in focus
- Having over or under exposed areas in the scene results in loss of information
- Proper choice of white balance
- Exclusively static shots are preferred

Audio

- It is recommended to record the explanation and relevant commentary separately
- This should follow a **pre-written script**

INT. LAB
Slideshow of relevant imagery(stock footage and B-roll) that describe the practical uses of the experiment.

Let's dive a bit deeper into the science behind electrolysis. By passing a direct electric current through a substance, it will suffer certain chemical changes. (electron - dissolution ~ On the screen ~) These changes are driven by chemical reactions that wouldn't otherwise be spontaneous. In these reactions, the substance either loses an electron - this is called oxidation -, or gains one - reduction.

Image showing ($2H_2O$ -> $2H_2$ + O_2)

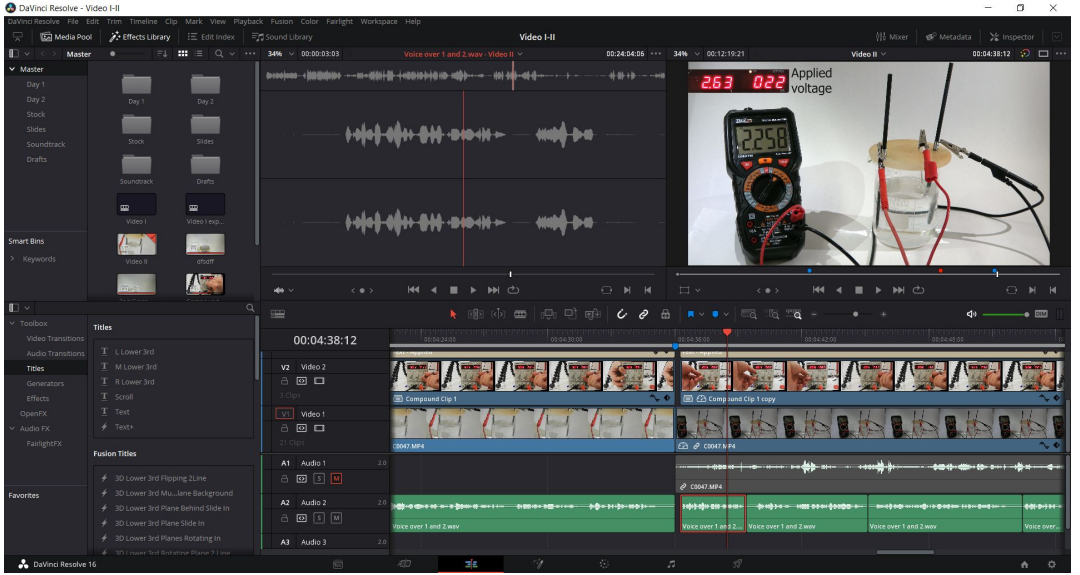
Take water, for instance. By applying a direct current, water is decomposed into oxygen and hydrogen gas. Hydrogen will appear at the cathode (where electrons enter the water), and oxygen will appear at the anode. The amount of hydrogen generated is twice the amount of oxygen, and both are proportional to the total electrical charge conducted by the solution.

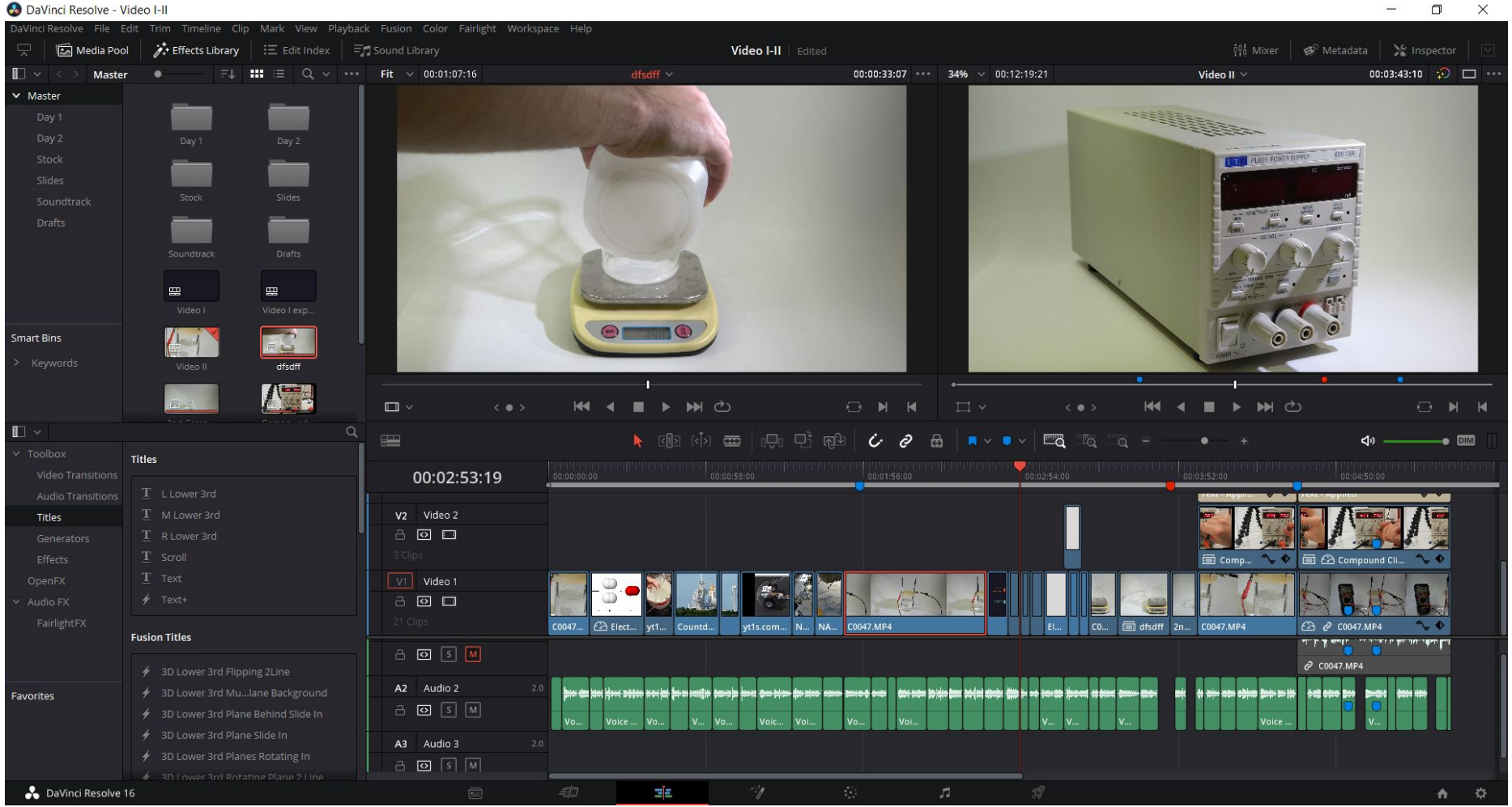
Slideshow of relevant imagery(stock footage and B-roll) that describe the practical uses of the experiment.

This is sometimes called water splitting and is one of the methods of extracting

Post-production

- Video editing
- Audio editing
- Fine touching - Corrections
- Rendering




DaVinci Resolve - Video I-II
DaVinci Resolve File Edit Trim Timeline Clip Mark View Playback Fusion Color Fairlight Workspace Help
Media Pool
Effects Library
Edit Index
Sound Library
Video I-II
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Slides
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Drafts
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Smart Bins
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Toolbox
Video Transitions
Audio Transitions
Titles
Generators
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OpenFX
Audio FX
FairlightFX
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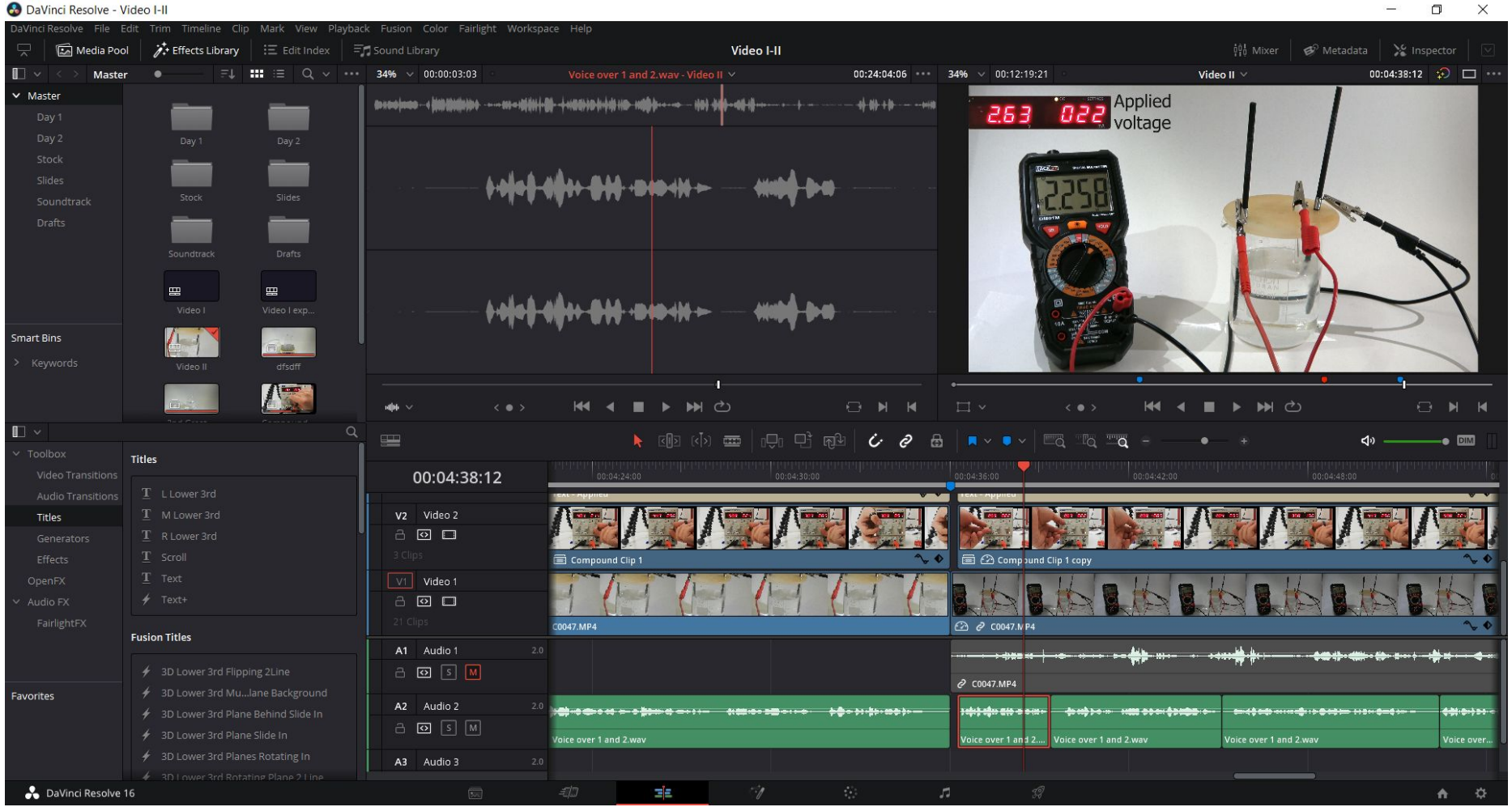
DaVinci Resolve - Video I-II
DaVinci Resolve File Edit Trim Timeline Clip Mark View Playback Fusion Color Fairlight Workspace Help
Media Pool
Effects Library
Edit Index
Sound Library
Video I-II
Mixer
Metadata
Inspector
Master
Day 1
Day 2
Stock
Slides
Soundtrack
Drafts
Video I
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Smart Bins
Keywords
Voice over 1 and 2.wav - Video II
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Video II
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Toolbox
Video Transitions
Audio Transitions
Titles
Generators
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OpenFX
Audio FX
FairlightFX
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3D Lower 3rd Plane Slide In
3D Lower 3rd Planes Rotating In
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V2 Video 2
3 Clips
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Compound Clip 1 copy
V1 Video 1
21 Clips
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A1 Audio 1
A2 Audio 2
A3 Audio 3
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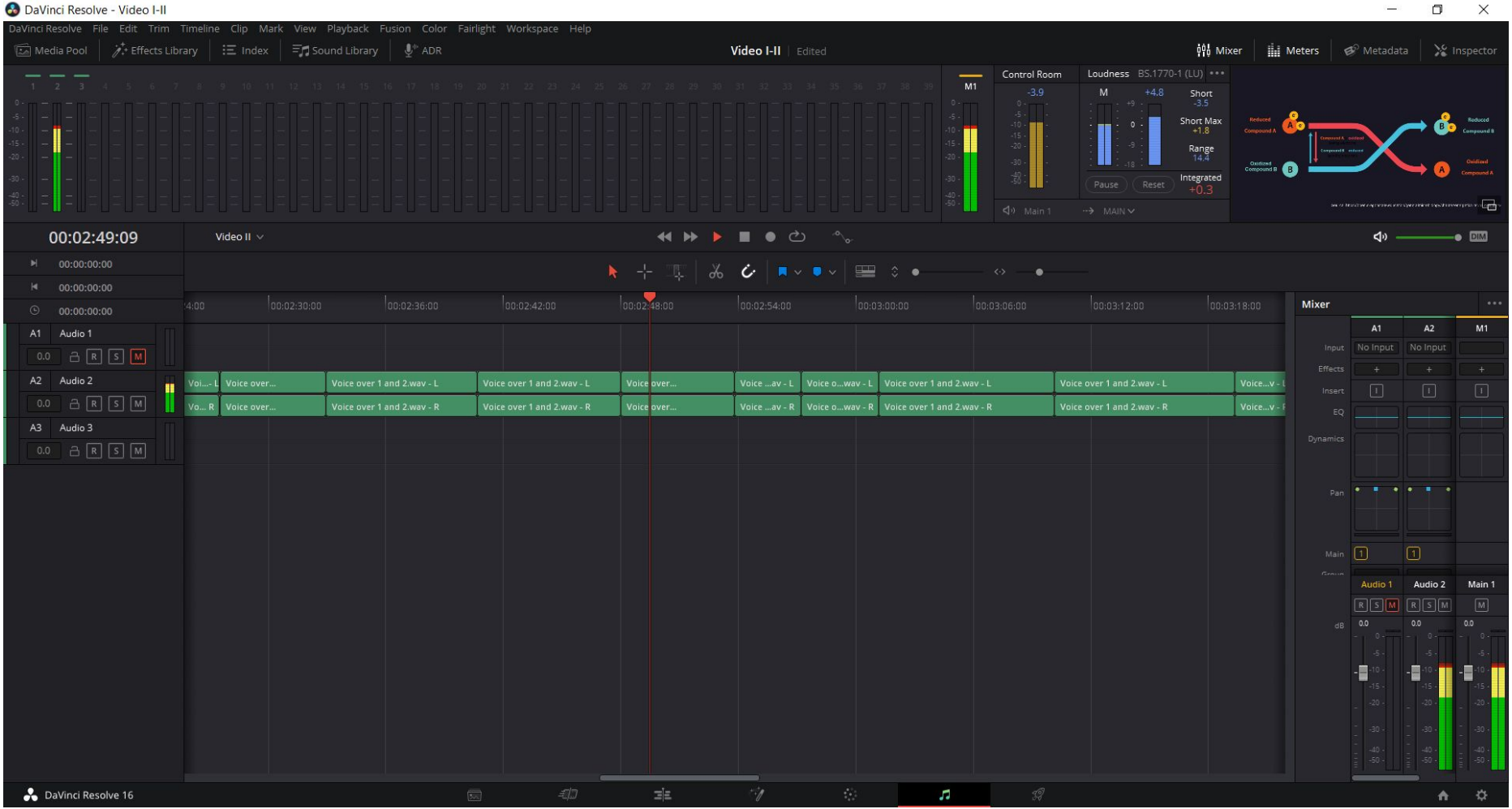
DaVinci Resolve 16


DaVinci Resolve - Video I-II
DaVinci Resolve File Edit Trim Timeline Clip Mark View Playback Fusion Color Fairlight Workspace Help
Media Pool
Effects Library
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Sound Library
ADR
Video I-II
Edited
Mixer
Meters
Metadata
Inspector
Control Room
Loudness
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Range
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Pause
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Video II
A1 Audio 1
A2 Audio 2
A3 Audio 3
Voice over...
Voice over 1 and 2.wav - L
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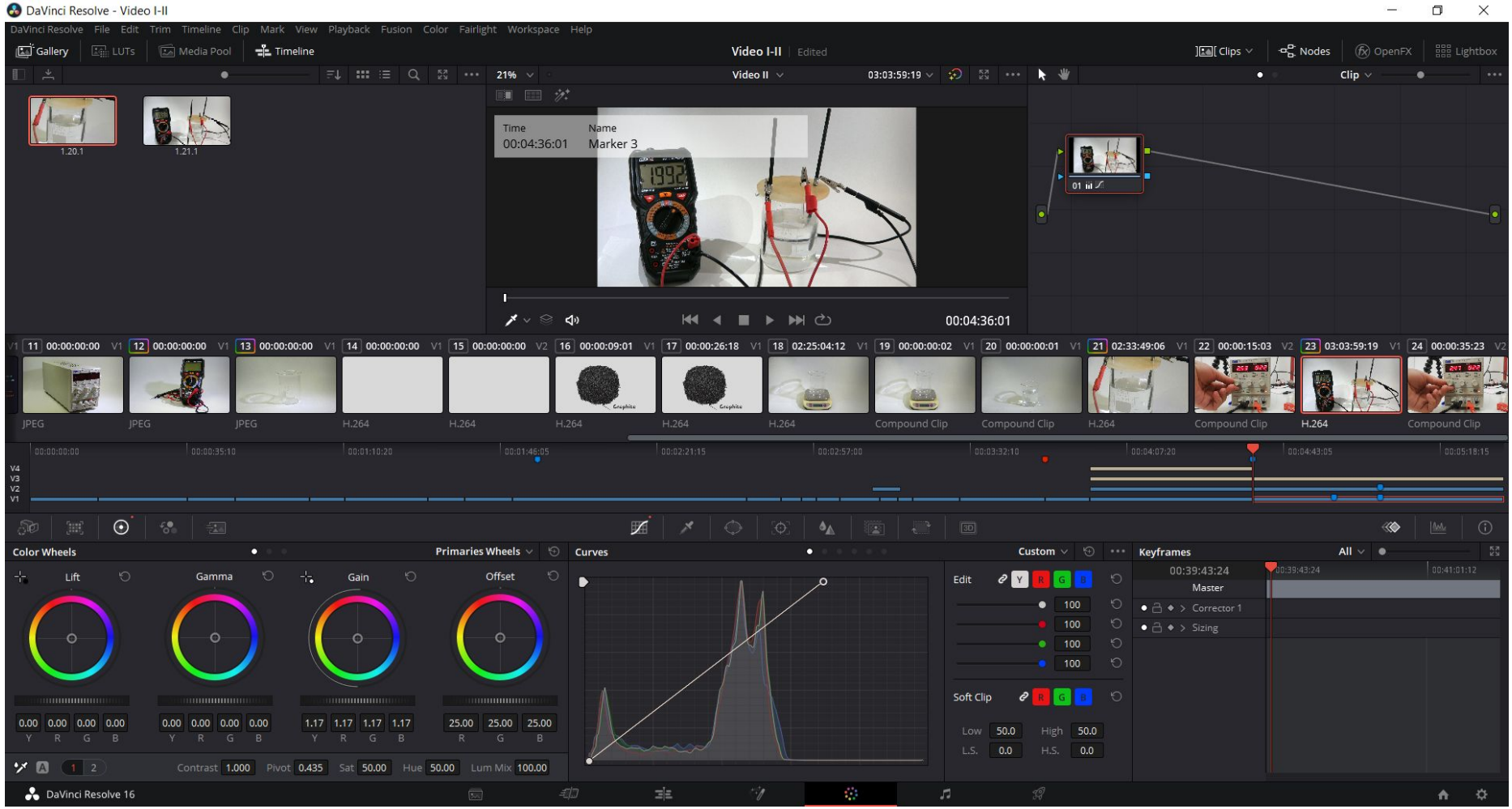
EQ
Dynamics
Pan
Main
No Input
Audio 1
Audio 2
Main 1
DaVinci Resolve 16


DaVinci Resolve - Video I-II
DaVinci Resolve File Edit Trim Timeline Clip Mark View Playback Fusion Color Fairlight Workspace Help
Gallery LUTs Media Pool Timeline
Video I-II Edited
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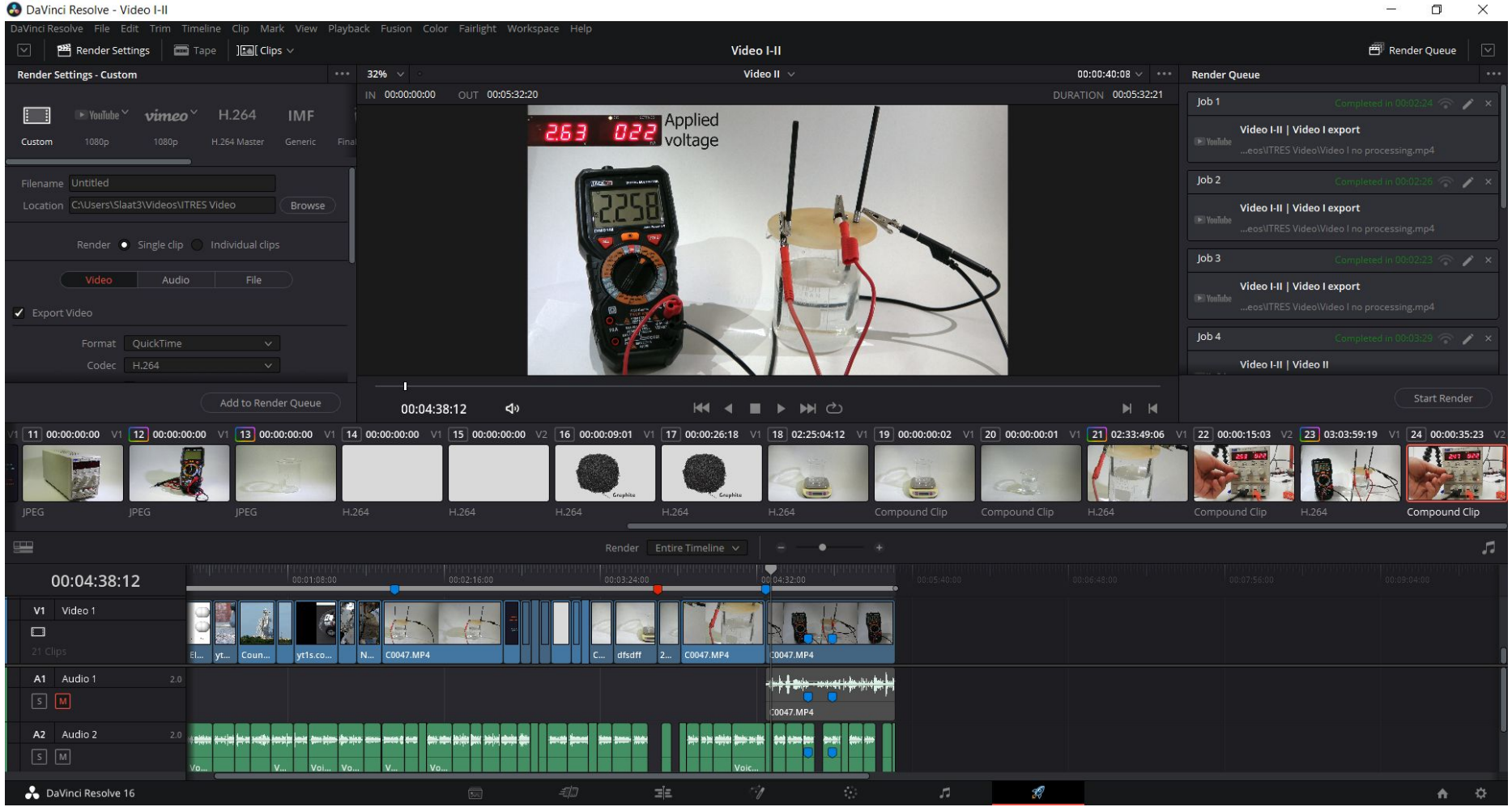
DaVinci Resolve 16


DaVinci Resolve - Video I-II
DaVinci Resolve File Edit Trim Timeline Clip Mark View Playback Fusion Color Fairlight Workspace Help
Render Settings
Tape
Clips
Video I-II
Render Queue
Render Settings - Custom
Custom
1080p
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H.264 Master
Generic
IMF
Filename Untitled
Location C:\Users\Slaat3\Videos\ITRES Video
Browse
Render Single clip Individual clips
Video Audio File
Export Video
Format QuickTime
Codec H.264
Add to Render Queue
32%
Video II
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IN 00:00:00:00
OUT 00:05:32:20
DURATION 00:05:32:21
Applied voltage
00:04:38:12
Render Queue
Job 1
Completed in 00:02:24
Video I-II | Video I export
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Job 2
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Video I-II | Video I export
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Job 3
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Job 4
Completed in 00:03:29
Video I-II | Video II
Start Render
JPEG
JPEG
JPEG
H.264
H.264
H.264
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H.264
Compound Clip
Compound Clip
H.264
Compound Clip
H.264
Compound Clip
Render Entire Timeline
00:04:38:12
V1 Video 1
21 Clips
A1 Audio 1 2.0
A2 Audio 2 2.0
C0047.MP4
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DaVinci Resolve 16

Conclusions

- Creating **different levels of understanding** for the same subject of knowledge allows **wide accessibility** for this type of educational resources.
- Having the academic concepts presented in a **friendly manner**, with the information divided into **easily manageable pieces** is the main part of this project's appeal.
- Especially in the era of online education, having the option to **acquire knowledge through one's own experience**, in a scientifically valid context, is very valuable for young people.
- This type of learning has been appreciated by our students and all those who have accessed the available educational open resources.

Learn more:

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