# METADATA ANNOTATION IN THE SCIENTIFIC CONTEXT


You should start your project with **repeating** your collaborator's results

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## The Publication

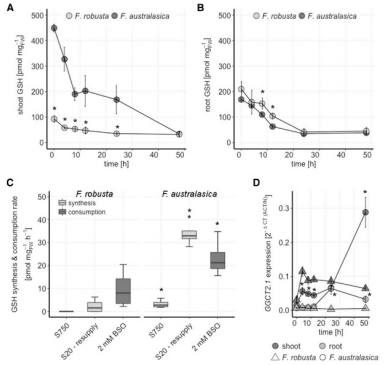


**Figure 4.** GSH turnover in *F. robusta* and *F. australasica*. GSH concentrations in shoots (A) and roots (B) of 20-d-old seedlings of *F. robusta* ($C_3$) and *F. australasica* ($C_3$) in a time course of 48 h after transfer to medium supplemented with 2 mM BSO. Data are presented as means and SE, $n = 4$. C, GSH synthesis was analyzed in 20-d-old seedlings exposed to low sulfate (20 µM sulfate; S20) or adequate sulfate (750 µM sulfate; S750) for 6 d by resupply with 0.2 mM [$^{35}$S]sulfate solution for 4 h. GSH consumption rate is calculated from A at 4 h after treatment with 2 mM BSO. Data are shown as box plot (25%–75%); the line represents median, and the whiskers represent 1.5 IQR, $n = 4$. D Transcript levels of *GGCT2.1* in shoots and roots of 20-d-old seedlings in a time course of 48 h after transfer to medium supplemented with 2 mM BSO. Data are presented as means and SEM, $n = 4$. Asterisks represent significant differences between *F. robusta* and *F. australasica* at $P < 0.05$ (Student's *t* test).

to higher GSH synthesis are therefore likely to be involved in the adjustment of S supply and GSH homeostasis of $C_4$ plants.

**Partitioning of S in Shoots and Roots of *Flaveria* Species**

To test the significance of the root for S metabolism in the context of the evolution of $C_4$ photosynthesis, the five species were grown under full nutrient and low S conditions. Total $S_i$ sulfate and low $M_r$ thiols were determined in shoots and roots (Supplemental Fig. S7). Whereas total S and sulfate did not show any clear patterns relative to photosynthetic type, Cys, and GSH at full nutrition. To better understand the partitioning of S in the different species, the relative portions of total S in sulfate, Cys, and GSH were calculated (Fig. 5). In the shoots of fully nourished *Flaveria* species, the fraction of total S occupied by inorganic sulfate was relatively stable at 50%–70%. However, in the roots, the fraction of inorganic sulfate was higher in the $C_4$ species. Exposure to S deficiency reduced the sulfate pool in the shoots and roots of *F. robusta*, *F. linearis*, *F. anomala*, and *F. palmeri* to 3.5%–16%. The $C_3$ species *F. australasica* suffered little loss of relative sulfate pool in shoots, but showed a strong decrease in roots. The increase in GSH fractions of total S in shoots and roots

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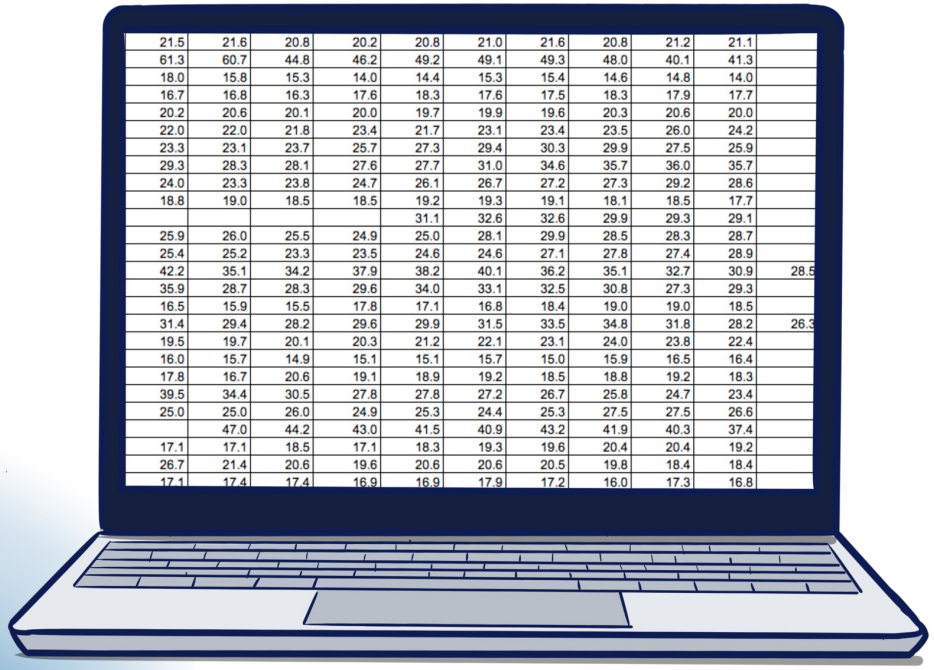
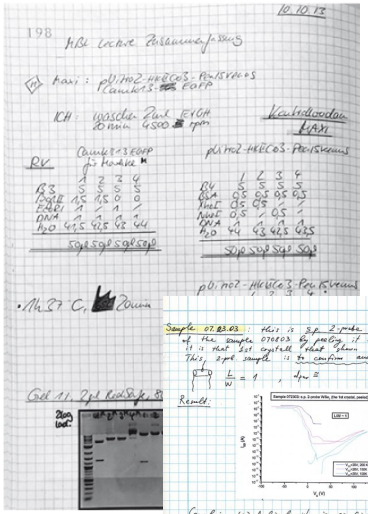
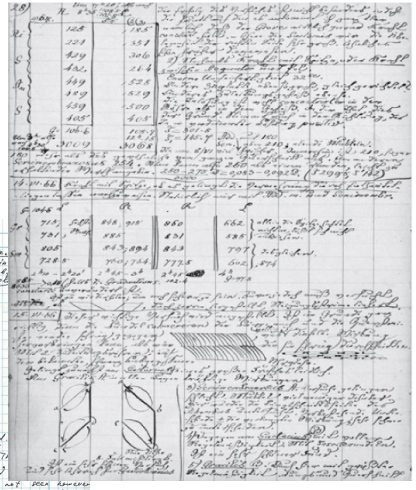
## The Data



| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 21.5 | 21.6 | 20.8 | 20.2 | 20.8 | 21.0 | 21.6 | 20.8 | 21.2 | 21.1 | |
| 61.3 | 60.7 | 44.8 | 46.2 | 49.2 | 49.1 | 49.3 | 48.0 | 40.1 | 41.3 | |
| 18.0 | 15.8 | 15.3 | 14.0 | 14.4 | 15.3 | 15.4 | 14.6 | 14.8 | 14.0 | |
| 16.7 | 16.8 | 16.3 | 17.6 | 18.3 | 17.6 | 17.5 | 18.3 | 17.9 | 17.7 | |
| 20.2 | 20.6 | 20.1 | 20.0 | 19.7 | 19.9 | 19.6 | 20.3 | 20.6 | 20.0 | |
| 22.0 | 22.0 | 21.8 | 23.4 | 21.7 | 23.1 | 23.4 | 23.5 | 26.0 | 24.2 | |
| 23.3 | 23.1 | 23.7 | 25.7 | 27.3 | 29.4 | 30.3 | 29.9 | 27.5 | 25.9 | |
| 29.3 | 28.3 | 28.1 | 27.6 | 27.7 | 31.0 | 34.6 | 35.7 | 36.0 | 35.7 | |
| 24.0 | 23.3 | 23.8 | 24.7 | 26.1 | 26.7 | 27.2 | 27.3 | 29.2 | 28.6 | |
| 18.8 | 19.0 | 18.5 | 18.5 | 19.2 | 19.3 | 19.1 | 18.1 | 18.5 | 17.7 | |
| | | | | 31.1 | 32.6 | 32.6 | 29.9 | 29.3 | 29.1 | |
| 25.9 | 26.0 | 25.5 | 24.9 | 25.0 | 28.1 | 29.9 | 28.5 | 28.3 | 28.7 | |
| 25.4 | 25.2 | 23.3 | 23.5 | 24.6 | 24.6 | 27.1 | 27.8 | 27.4 | 28.9 | |
| 42.2 | 35.1 | 34.2 | 37.9 | 38.2 | 40.1 | 36.2 | 35.1 | 32.7 | 30.9 | 28.5 |
| 35.9 | 28.7 | 28.3 | 29.6 | 34.0 | 33.1 | 32.5 | 30.8 | 27.3 | 29.3 | |
| 16.5 | 15.9 | 15.5 | 17.8 | 17.1 | 16.8 | 18.4 | 19.0 | 19.0 | 18.5 | |
| 31.4 | 29.4 | 28.2 | 29.6 | 29.9 | 31.5 | 33.5 | 34.8 | 31.8 | 28.2 | 26.3 |
| 19.5 | 19.7 | 20.1 | 20.3 | 21.2 | 22.1 | 23.1 | 24.0 | 23.8 | 22.4 | |
| 16.0 | 15.7 | 14.9 | 15.1 | 15.1 | 15.7 | 15.0 | 15.9 | 16.5 | 16.4 | |
| 17.8 | 16.7 | 20.6 | 19.1 | 18.9 | 19.2 | 18.5 | 18.8 | 19.2 | 18.3 | |
| 39.5 | 34.4 | 30.5 | 27.8 | 27.8 | 27.2 | 26.7 | 25.8 | 24.7 | 23.4 | |
| 25.0 | 25.0 | 26.0 | 24.9 | 25.3 | 24.4 | 25.3 | 27.5 | 27.5 | 26.6 | |
| | 47.0 | 44.2 | 43.0 | 41.5 | 40.9 | 43.2 | 41.9 | 40.3 | 37.4 | |
| 17.1 | 17.1 | 18.5 | 17.1 | 18.3 | 19.3 | 19.6 | 20.4 | 20.4 | 19.2 | |
| 26.7 | 21.4 | 20.6 | 19.6 | 20.6 | 20.6 | 20.5 | 19.8 | 18.4 | 18.4 | |
| 17.1 | 17.4 | 17.4 | 16.9 | 16.9 | 17.9 | 17.2 | 16.0 | 17.3 | 16.8 | |

# The Documentation





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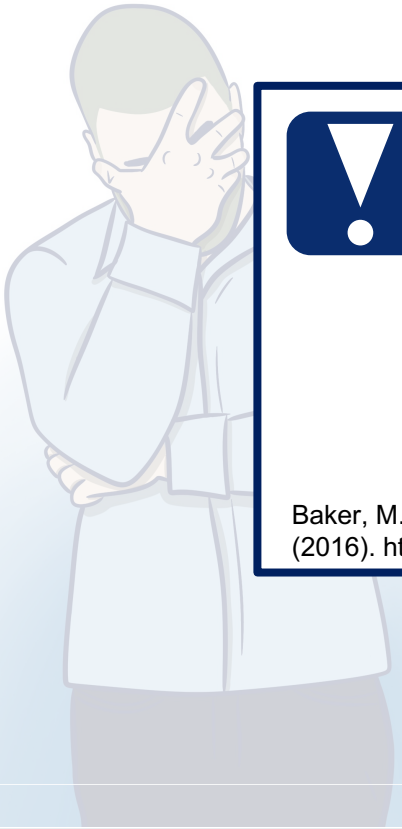

*»More than 70 % of researchers have tried and failed to reproduce another scientist's experiments.*

*More than half have failed to reproduce their own experiments.«*

Baker, M. 1,500 scientists lift the lid on reproducibility. *Nature* **533,** 452 – 454 (2016). https://doi.org/10.1038/533452a

# Worst practice – no documentation

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | t | ax | ay | az | scr |
| 2 | 0 | 0.3931848 | -0.1593144 | -0.4178079 | 0 |
| 3 | 0.01 | 0.3957354 | -0.15696 | -0.4242825 | 0 |
| 4 | 0.04 | 0.4138839 | -0.1547037 | -0.429678 | 0 |
| 5 | 0.05 | 0.4415481 | -0.1512702 | -0.4325229 | 0 |
| 6 | 0.06 | 0.4741173 | -0.1488177 | -0.434583 | 0 |
| 7 | 0.08 | 0.5021739 | -0.1521531 | -0.4285008 | 0 |
| 8 | 0.1 | 0.5247369 | -0.1669662 | -0.420849 | 0 |
| 9 | 0.11 | 0.5421987 | -0.1813869 | -0.4160421 | 0 |
| 10 | 0.14 | 0.5506353 | -0.1947285 | -0.4094694 | 0 |
| 11 | 0.15 | 0.5538726 | -0.203067 | -0.4057416 | 0 |
| 12 | 0.16 | 0.5534802 | -0.2035575 | -0.4056435 | 0 |
| 13 | 0.17 | 0.5527935 | -0.1961019 | -0.4098618 | 0 |
| 14 | 0.2 | 0.558189 | -0.1908045 | -0.4121181 | 0 |
| 15 | 0.21 | 0.5764356 | -0.1865862 | -0.4162383 | 0 |
| 16 | 0.22 | 0.589581 | -0.18639 | -0.4258521 | 0 |
| 17 | 0.25 | 0.6049827 | -0.1941399 | -0.4243806 | 0 |
| 18 | 0.26 | 0.619992 | -0.206991 | -0.4192794 | 0 |
| 19 | 0.27 | 0.6320583 | -0.2191554 | -0.4092732 | 0 |
| 20 | 0.3 | 0.6392196 | -0.2279844 | -0.3975993 | 0 |
| 21 | 0.31 | 0.6465771 | -0.2317122 | -0.3908304 | 0 |
| 22 | 0.32 | 0.6583491 | -0.2291616 | -0.3950487 | 0 |
| 23 | 0.34 | 0.6725736 | -0.2220984 | -0.4050549 | 0 |


someRandomFileName.csv

# Slightly better – lab notes

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | t | ax | ay | az | scr |
| 2 | 0 | 0.3931848 | -0.1593144 | -0.4178079 | 0 |
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| 4 | 0.04 | 0.4138839 | -0.1547037 | -0.429678 | 0 |
| 5 | 0.05 | 0.4415481 | -0.1512702 | -0.4325229 | 0 |
| 6 | 0.06 | 0.4741173 | -0.1488177 | -0.434583 | 0 |
| 7 | 0.08 | 0.5021739 | -0.1521531 | -0.4285008 | 0 |
| 8 | 0.1 | 0.5247369 | -0.1669662 | -0.420849 | 0 |
| 9 | 0.11 | 0.5421987 | -0.1813869 | -0.4160421 | 0 |
| 10 | 0.14 | 0.5506353 | -0.1947285 | -0.4094694 | 0 |
| 11 | 0.15 | 0.5538726 | -0.203067 | -0.4057416 | |
| 12 | 0.16 | 0.5534802 | -0.2035575 | -0.4056435 | |
| 13 | 0.17 | 0.5527935 | -0.1961019 | -0.4098618 | |
| 14 | 0.2 | 0.558189 | -0.1908045 | -0.4121181 | |
| 15 | 0.21 | 0.5764356 | -0.1865862 | -0.4162383 | |
| 16 | 0.22 | 0.589581 | -0.18639 | -0.4258521 | |
| 17 | 0.25 | 0.6049827 | -0.1941399 | -0.4243806 | |
| 18 | 0.26 | 0.619992 | -0.206991 | -0.4192794 | |
| 19 | 0.27 | 0.6320583 | -0.2191554 | -0.4092732 | |
| 20 | 0.3 | 0.6392196 | -0.2279844 | -0.3975993 | |
| 21 | 0.31 | 0.6465771 | -0.2317122 | -0.3908304 | |
| 22 | 0.32 | 0.6583491 | -0.2291616 | -0.3950487 | |
| 23 | 0.34 | 0.6725736 | -0.2220984 | -0.4050549 | 0 |

csv 20220228_recordingData.csv

2022-02-28

Gotham City, New Jersey, USA

Flight of the bat

weather: more clouds than sun, 11°C, 74% humidity, 1023 mbar, SSW, 17 km/h

recording device strapped to upper arm

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| 5 | 0.05 | 0.4415481 | -0.1512702 | -0.4325229 | 0 |
| 6 | 0.06 | 0.4741173 | -0.1488177 | -0.434583 | 0 |
| 7 | 0.08 | 0.5021739 | -0.1521531 | -0.4285008 | 0 |
| 8 | 0.1 | 0.5247369 | -0.1669662 | -0.420849 | 0 |
| 9 | 0.11 | 0.5421987 | -0.1813869 | -0.4160421 | 0 |
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| 19 | 0.27 | 0.6320583 | -0.2191554 | -0.4092732 | |
| 20 | 0.3 | 0.6392196 | -0.2279844 | -0.3975993 | |
| 21 | 0.31 | 0.6465771 | -0.2317122 | -0.3908304 | |
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| 4 | 0.04 | 0.4138839 | -0.1547037 | -0.429678 | 0 |
| 5 | 0.05 | 0.4415481 | -0.1512702 | -0.4325229 | 0 |
| 6 | 0.06 | 0.4741173 | -0.1488177 | -0.434583 | 0 |
| 7 | 0.08 | 0.5021739 | -0.1521531 | -0.4285008 | 0 |
| 8 | 0.1 | 0.5247369 | -0.1669662 | -0.420849 | 0 |
| 9 | 0.11 | 0.5421987 | -0.1813869 | -0.4160421 | 0 |
| 10 | 0.14 | 0.5506353 | -0.1947285 | -0.4094694 | 0 |
| 11 | 0.15 | 0.5538726 | -0.203067 | -0.4057416 | |
| 12 | 0.16 | 0.5534802 | -0.2035575 | -0.4056435 | |
| 13 | 0.17 | 0.5527935 | -0.1961019 | -0.4098618 | |
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| 23 | 0.34 | 0.6725736 | -0.2220984 | -0.4050549 | 0 |

csv 20220228_recordingData.csv

LAB NOTES IV
LAB NOTES III
LAB NOTES II
LAB NOTES I

2022-02-28

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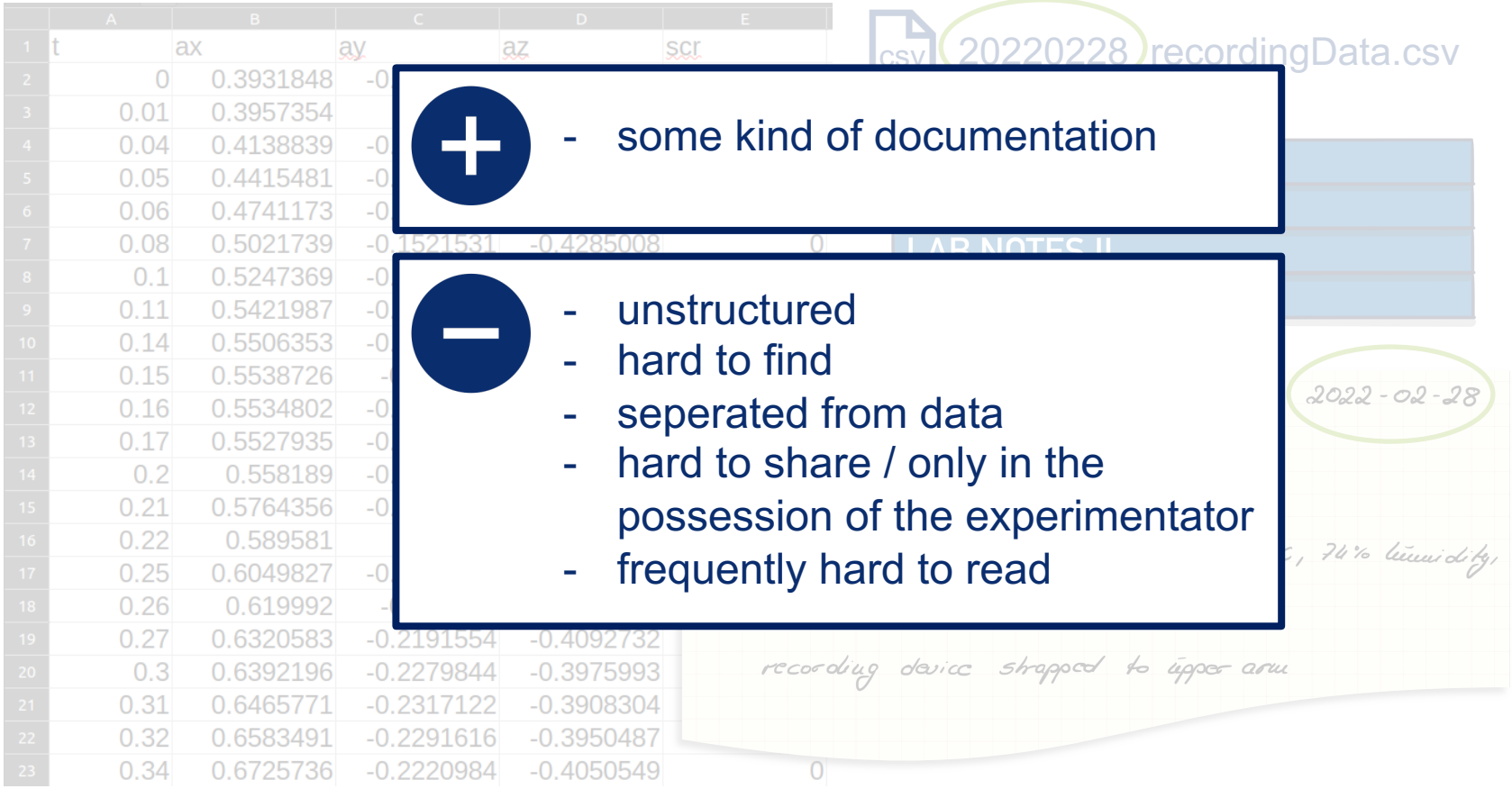


- some kind of documentation

- unstructured
- hard to find
- seperated from data
- hard to share / only in the possession of the experimentator
- frequently hard to read

# Even better – Readme style metadata

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | t | ax | ay | az | scr |
| 2 | 0 | 0.3931848 | -0.1593144 | -0.4178079 | 0 |
| 3 | 0.01 | 0.3957354 | -0.15696 | -0.4242825 | 0 |
| 4 | 0.04 | 0.4138839 | -0.1547037 | -0.429678 | 0 |
| 5 | 0.05 | 0.4415481 | -0.1512702 | -0.4325229 | 0 |
| 6 | 0.06 | 0.4741173 | -0.1488177 | -0.434583 | 0 |
| 7 | 0.08 | 0.5021739 | -0.1521531 | -0.4285008 | 0 |
| 8 | 0.1 | 0.5247369 | -0.1669662 | -0.420849 | 0 |
| 9 | 0.11 | 0.5421987 | -0.1813869 | -0.4160421 | 0 |
| 10 | 0.14 | 0.5506353 | -0.1947285 | -0.4094694 | 0 |
| 11 | 0.15 | 0.5538726 | -0.203067 | -0.4057416 | 0 |
| 12 | 0.16 | 0.5534802 | -0.2035575 | -0.4056435 | 0 |
| 13 | 0.17 | 0.5527935 | -0.1961019 | -0.4098618 | 0 |
| 14 | 0.2 | 0.558189 | -0.1908045 | -0.4121181 | 0 |
| 15 | 0.21 | 0.5764356 | -0.1865862 | -0.4162383 | 0 |
| 16 | 0.22 | 0.589581 | -0.18639 | -0.4258521 | 0 |
| 17 | 0.25 | 0.6049827 | -0.1941399 | -0.4243806 | 0 |
| 18 | 0.26 | 0.619992 | -0.206991 | -0.4192794 | 0 |
| 19 | 0.27 | 0.6320583 | -0.2191554 | -0.4092732 | 0 |
| 20 | 0.3 | 0.6392196 | -0.2279844 | -0.3975993 | 0 |
| 21 | 0.31 | 0.6465771 | -0.2317122 | -0.3908304 | 0 |
| 22 | 0.32 | 0.6583491 | -0.2291616 | -0.3950487 | 0 |
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20220228_recordingData.csv

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| 6 | 0.06 | 0.4741173 | -0.1488177 | -0.434583 | 0 |
| 7 | 0.08 | 0.5021739 | -0.1521531 | -0.4285008 | 0 |
| 8 | 0.1 | 0.5247369 | -0.1669662 | -0.420849 | 0 |
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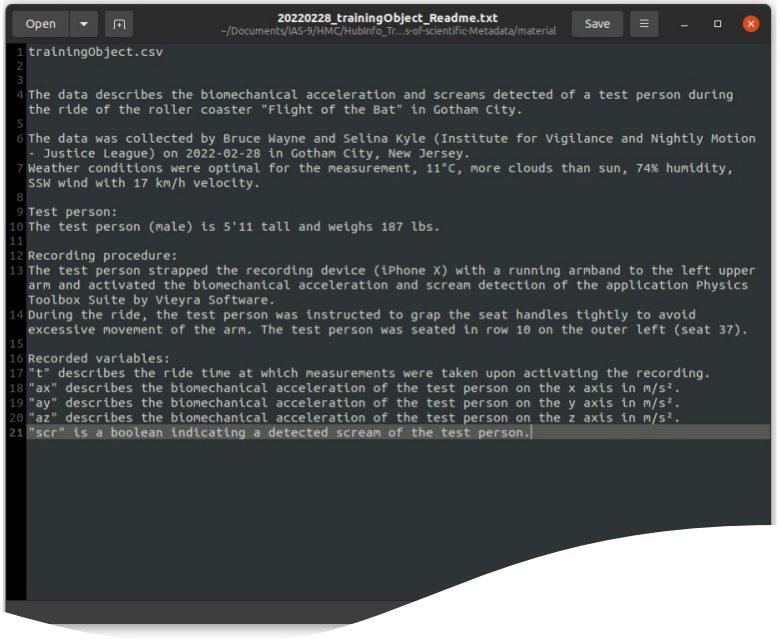
| 20 | 0.3 | 0.6392196 | -0.2279844 | -0.3975993 | 0 |
| 21 | 0.31 | 0.6465771 | -0.2317122 | -0.3908304 | 0 |
| 22 | 0.32 | 0.6583491 | -0.2291616 | -0.3950487 | 0 |
| 23 | 0.34 | 0.6725736 | -0.2220984 | -0.4050549 | 0 |

csv 20220228_recordingData.csv

txt 20220228_recordingData_Readme.txt



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| 7 | 0.08 | 0.5021739 | -0.1521531 | -0.4285008 | 0 |
| 8 | 0.1 | 0.5247369 | -0.1669662 | -0.420849 | 0 |
| 9 | 0.11 | 0.5421987 | -0.1813869 | -0.4160421 | 0 |
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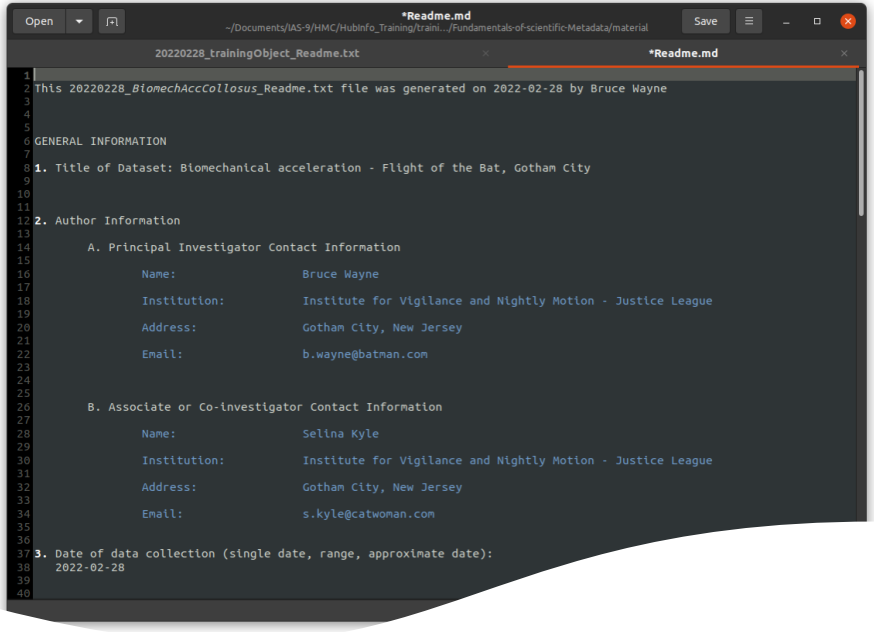
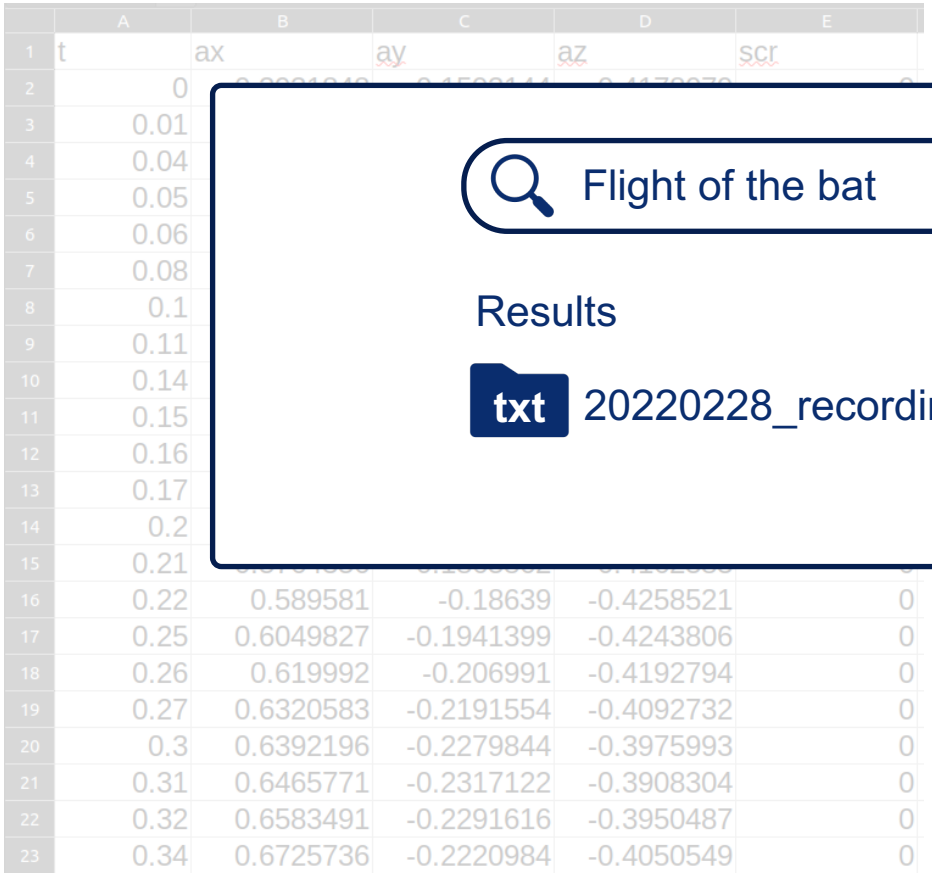
| 18 | 0.26 | 0.619992 | -0.206991 | -0.4192794 | 0 |
| 19 | 0.27 | 0.6320583 | -0.2191554 | -0.4092732 | 0 |
| 20 | 0.3 | 0.6392196 | -0.2279844 | -0.3975993 | 0 |
| 21 | 0.31 | 0.6465771 | -0.2317122 | -0.3908304 | 0 |
| 22 | 0.32 | 0.6583491 | -0.2291616 | -0.3950487 | 0 |
| 23 | 0.34 | 0.6725736 | -0.2220984 | -0.4050549 | 0 |

csv 20220228_recordingData.csv

txt 20220228_recordingData_Readme.txt



# Even better – Readme style metadata



| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | t | ax | ay | az | scr |
| 2 | 0 | | | | |
| 3 | 0.01 | | | | |
| 4 | 0.04 | | | | |
| 5 | 0.05 | | | | |
| 6 | 0.06 | | | | |
| 7 | 0.08 | | | | |
| 8 | 0.1 | | | | |
| 9 | 0.11 | | | | |
| 10 | 0.14 | | | | |
| 11 | 0.15 | | | | |
| 12 | 0.16 | | | | |
| 13 | 0.17 | | | | |
| 14 | 0.2 | | | | |
| 15 | 0.21 | | | | |
| 16 | 0.22 | 0.589581 | -0.18639 | -0.4258521 | 0 |
| 17 | 0.25 | 0.6049827 | -0.1941399 | -0.4243806 | 0 |
| 18 | 0.26 | 0.619992 | -0.206991 | -0.4192794 | 0 |
| 19 | 0.27 | 0.6320583 | -0.2191554 | -0.4092732 | 0 |
| 20 | 0.3 | 0.6392196 | -0.2279844 | -0.3975993 | 0 |
| 21 | 0.31 | 0.6465771 | -0.2317122 | -0.3908304 | 0 |
| 22 | 0.32 | 0.6583491 | -0.2291616 | -0.3950487 | 0 |
| 23 | 0.34 | 0.6725736 | -0.2220984 | -0.4050549 | 0 |

csv 20220228_recordingData.csv

me.txt

Flight of the bat

Results

txt 20220228_recordingData_Readme.txt

# Even better – Readme style metadata

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | t | ax | ay | az | scr |
| 2 | 0 | 0.3931848 | -0 | | |
| 3 | 0.01 | 0.3957354 | | | |
| 4 | 0.04 | 0.4138839 | -0 | | |
| 5 | 0.05 | 0.4415481 | -0 | | |
| 6 | 0.06 | 0.4741173 | -0 | | |
| 7 | 0.08 | 0.5021739 | -0 | | |
| 8 | 0.1 | 0.5247369 | -0 | | |
| 9 | 0.11 | 0.5421987 | -0 | | |
| 10 | 0.14 | 0.5506353 | -0 | | |
| 11 | 0.15 | 0.5538726 | - | | |
| 12 | 0.16 | 0.5534802 | -0 | | |
| 13 | 0.17 | 0.5527935 | -0.1961019 | -0.4098618 | 0 |
| 14 | 0.2 | 0.558189 | -0 | | |
| 15 | 0.21 | 0.5764356 | -0 | | |
| 16 | 0.22 | 0.589581 | | | |
| 17 | 0.25 | 0.6049827 | -0 | | |
| 18 | 0.26 | 0.619992 | - | | |
| 19 | 0.27 | 0.6320583 | -0 | | |
| 20 | 0.3 | 0.6392196 | -0.2279844 | -0.3975993 | 0 |
| 21 | 0.31 | 0.6465771 | -0.2317122 | -0.3908304 | 0 |
| 22 | 0.32 | 0.6583491 | -0.2291616 | -0.3950487 | 0 |
| 23 | 0.34 | 0.6725736 | -0.2220984 | -0.4050549 | 0 |

20220228_recordingData.csv

gData_Readme.txt

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- documentation linked to the data
- locally searchable
- Readme file can be shared with the data
- increased readability

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- unstructured
- subjective information
- only keyword search possible

# Even better – Readme style metadata

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | t | ax | ay | az | scr |
| 2 | 0 | 0.3931848 | -0.1593144 | -0.4178079 | 0 |
| 3 | 0.01 | 0.3957354 | -0.15696 | -0.4242825 | 0 |
| 4 | 0.04 | 0.4138839 | -0.1547037 | -0.429678 | 0 |
| 5 | 0.05 | 0.4415481 | -0.1512702 | -0.4325229 | 0 |
| 6 | 0.06 | 0.4741173 | -0.1488177 | -0.434583 | 0 |
| 7 | 0.08 | 0.5021739 | -0.1521531 | -0.4285008 | 0 |
| 8 | 0.1 | | | | |
| 9 | 0.11 | | | | |
| 10 | 0.14 | | | | |
| 11 | 0.15 | | | | |
| 12 | 0.16 | | | | |
| 13 | 0.17 | | | | |
| 14 | 0.2 | | | | |
| 15 | 0.21 | 0.5764356 | -0.1865862 | -0.4162383 | 0 |
| 16 | 0.22 | 0.589581 | -0.18639 | -0.4258521 | 0 |
| 17 | 0.25 | 0.6049827 | -0.1941399 | -0.4243806 | 0 |
| 18 | 0.26 | 0.619992 | -0.206991 | -0.4192794 | 0 |
| 19 | 0.27 | 0.6320583 | -0.2191554 | -0.4092732 | 0 |
| 20 | 0.3 | 0.6392196 | -0.2279844 | -0.3975993 | 0 |
| 21 | 0.31 | 0.6465771 | -0.2317122 | -0.3908304 | 0 |
| 22 | 0.32 | 0.6583491 | -0.2291616 | -0.3950487 | 0 |
| 23 | 0.34 | 0.6725736 | -0.2220984 | -0.4050549 | 0 |

csv 20220228_recordingData.csv

txt 20220228_recordingData_Readme.txt

https://ordo.open.ac.uk/articles/dataset/Template_for_a_README_file_for_data_uploads/13332743/1

**Link in Episode!**

# QUESTIONS?