



## Metadata Standards

Fundamentals of Scientific Metadata: Why Context Matters

# Schema or standard?

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A well established metadata schema can become a standard.

# The Dublin Core



Researchers, librarians and web technologists drafted the **Dublin Core** – a set of library-card-catalog-like metadata elements for the web – in 1995 at a meeting in Dublin, Ohio (USA). [1]

Creator  
Contributor  
Publisher  
Title  
Date  
Language  
Format  
Subject  
Description  
Identifier  
Relation  
Source  
Type  
Coverage  
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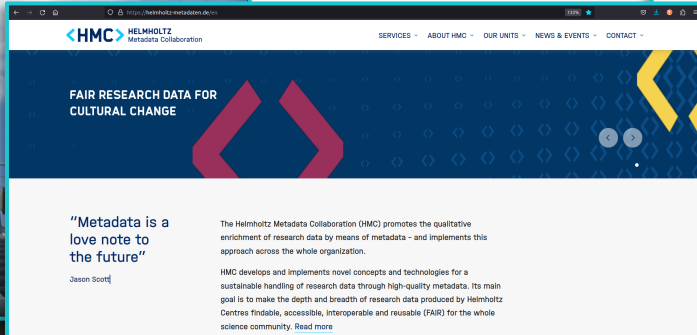
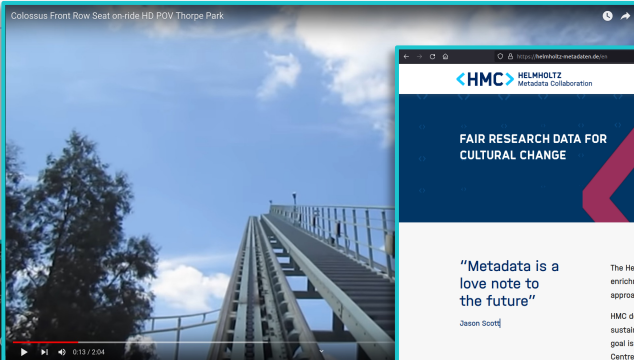
[1] <https://www.dublincore.org/resources/metadata-basics/>

[2] <https://www.dublincore.org/specifications/dublin-core/dcmi-terms/#section-3>

[3] <https://www.dublincore.org/about/>

[4] <https://www.iso.org/standard/71339.html>

# Web resources



## Sulfate Metabolism in *C. Flaveria* Species Is Controlled by the Root and Connected to Serine Biosynthesis<sup>11OPEN</sup>

Sebastian Gerlich,<sup>1,2</sup> Berkeley J. Walker,<sup>1</sup> Stephan Krueger,<sup>2</sup> and Stanislav Kopriva<sup>1,2,3,4</sup>  
<sup>1</sup>Max Planck Institute, University of Cologne, 50674 Cologne, Germany  
<sup>2</sup>Center of Excellence in Plant Sciences, University of Cologne, 50674 Cologne, Germany  
<sup>3</sup>Institute of Plant Biochemistry, Cluster of Excellence on Plant Sciences, Heinrich Heine University Düsseldorf, 25 Düsseldorf, Germany  
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Evolution of  $C_4$  photosynthesis led to an increase in carbon assimilation rates and plant growth compared to  $C_3$  photosynthetic plants. This enhanced plant growth, in turn, affects the requirement for soil-derived mineral nutrients. However, mineral nutrition has scarcely been considered in connection with  $C_4$  photosynthesis. Sulfur is crucial for plant growth and development, and preliminary studies in the genus *Flaveria* suggested metabolic differences in sulfate assimilation along the  $C_4$  pathway. Here, we show that in controlled conditions, solar accumulation of the reduced sulfur compounds Cys and glutathione (GSH) increased with progressing establishment of the  $C_4$  photosynthetic cycle in different *Flaveria* species. An increased demand for reduced sulfur in *C. Flaveria* species is reflected in high rates of [<sup>35</sup>S]sulfate incorporation into GSH upon sulfate deprivation and increased GSH turnover as a reaction to the inhibition of GSH synthesis. Expression analyses indicate that the  $\gamma$ -glutamyl cycle is crucial for the recycling of GSH in  $C_4$  species. Sulfate reduction and GSH synthesis seems to be spatially localized in the roots of  $C_4$  species, which might be linked to the colocalization with the phosphorylated pathway of biosynthesis. Interspecific grafting experiments of *F. robusta* ( $C_4$ ) and *F. hirsuta* ( $C_3$ ) revealed that the root system primarily transports sulfate acquisition, GSH synthesis, and sulfate and metabolite allocation in  $C_4$  and  $C_3$  plants. This study thus shows that future of  $C_4$  photosynthesis resulted in a wide range of adaptations of sulfate metabolism and points out the need for broader studies on importance of mineral nutrition for  $C_4$  plants.

Sulfur (S) possesses a wide variety of essential functions for cell structure and metabolism. Incorporated in the amino acids Cys and Met, S is an important component of proteins. Cys is further a constituent of the tripeptide glutathione (GSH), which maintains cellular redox balance and is involved in signaling and xenobiotic and heavy metal detoxification (Rothauer et al., 2008). Further, GSH is a component of prosthetic groups of various enzymes, such as glutathione S-transferase (GST), which is involved in detoxification of xenobiotics.

Sulfate uptake and distribution within the organism is facilitated by sulfate transporters. For assimilation, the inert and stable sulfate is activated by ATP sulfur-lyase (ATPS) by transferring it onto an  $\alpha$ -phosphate residue of ATP and yielding in adenosine-5'-phospho-

```
##### CREATE #####
#####
#####
pathDict = {}

### assign template path for specific "Course Title"
if pathDict.get("Course Title") == "Fundamentals of scienc
    pathDict.update({"Template Path" : "/local/home/s.g

### UPDATE THIS PART IF NECESSARY ###
elif pathDict.get("Course Title") == "Metadata for data
    pathDict.update({"Template Path" : "another/File/Path
elif pathDict.get("Course Title") == "Introduction to l
    pathDict.update({"Template Path" : "another/File/Path

pathDict = {key: value}

### convert course title to json
pathJsonOut = json.dumps(pathDict)

### save metadata to json file
jsonFile = open("pathDict.json", "w")
jsonFile.write(pathJsonOut)
```

ax	ay	az	Scf
0	0.3931848	-0.1593144	-0.4178078999999999
0.0100000000000019	0.3957354	-0.15696	-0.4242825
0.0400000000000021	0.4138839	-0.1547037	-0.4296780000000001
0.0500000000000011	0.4415481	-0.1512702	-0.4325229
0.0600000000000002	0.4741173	-0.1488177	-0.434583
0.0800000000000013	0.5021739	-0.1521531	-0.4285007999999999
0.1000000000000023	0.5247369	-0.1669662	-0.4208489999999999
0.1100000000000014	0.5421987	-0.1813969	-0.4160421000000001
0.1400000000000015	0.5556353	-0.1947295	-0.4094694000000001
0.1500000000000006	0.5538726	-0.203067	-0.4057416000000001
0.1599999999999997	0.5534802	-0.2035575	-0.4056435
0.1700000000000016	0.5527935	-0.1961019	-0.4098617999999999
0.2000000000000017	0.558189	-0.1908045	-0.4121181000000001
0.2100000000000008	0.5764356	-0.1865862	-0.4162383
0.2199999999999999	0.5895821	-0.18639	-0.4258521
0.25	0.6049827	-0.1941399	-0.4243806000000001
0.2600000000000019	0.6198992	-0.2069991	-0.4192794
0.2700000000000001	0.6320583	-0.2191554	-0.4092732
0.3000000000000011	0.6392196	-0.2279844	-0.3975993
0.3100000000000002	0.6465771	-0.2317122	-0.3908304000000001
0.3200000000000022	0.6583491	-0.2291616	-0.3950487
0.3400000000000003	0.6725736	-0.2220984	-0.4050549
0.3600000000000014	0.6905259	-0.2168001	-0.4137858000000001
0.3700000000000005	0.7047504	-0.2139561	-0.4142763

```
"abstract": "The data describes the biomechanical",
"format": "text/csv",
"date": "2022-02-28",
"creator": {
  "creatorName": "Bruce Wayne",
  "creatorAffiliation": "Institute for Vigilance",
  "creatorName": "Selina Kyle",
  "creatorAffiliation": "Institute for Vigilance"
},
"experimentalParameters": {
  "testRide": {
    "rideName": "Flight of the Bat",
    "location": "Gotham City, New Jersey",
    "rideType": "roller coaster"
  },
  "testPerson": {
    "sex": "male",
    "height": 180
  },
  "recording": {
    "testDevice": "iPhone X",
    "testDeviceFixture": "left upper arm",
    "testApp": "Physics Toolbox Suite by Vieyra Software"
  }
}
```





# The Dublin Core

**Dublin Core** and its extensions are widely used and referenced today. The Dublin Core Metadata Initiative (DCMI) states to work openly, with a paid-membership model. [3] The 15 Dublin Core metadata elements have been formally standardized for cross-domain resource description as e. g. **ISO 15836-1:2017**. [4]

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Description  
Identifier  
Relation  
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Type  
Coverage  
Rights

[1] <https://www.dublincore.org/resources/metadata-basics/>

[2] <https://www.dublincore.org/specifications/dublin-core/dcmi-terms/#section-3>

[3] <https://www.dublincore.org/about/>

[4] <https://www.iso.org/standard/71339.html>

https://www.science.org/

Search HTML

```
/moatframe.js"></script>
<meta name="pbContext" content=";issue:issue:doi\ :10.1126/science.2023.379.issue-6
ring:Publication Websites;pageGroup:string:Publication Pages">
<link rel="schema.DC" href="http://purl.org/DC/elements/1.0/">
<meta name="citation_journal_title" content="Science">
<meta name="dc.Title" content="USB1 is a miRNA deadenylase that regulates hematopo
<meta name="dc.Creator" content="Ho-Chang Jeong">
<meta name="dc.Creator" content="Siddharth Shukla">
<meta name="dc.Creator" content="Wilson Chun Fok">
<meta name="dc.Creator" content="Thao Ngoc Huynh">
<meta name="dc.Creator" content="Luis Francisco Zirnberger Batista">
<meta name="dc.Creator" content="Roy Parker">
<meta name="dc.Description" content="Mutations in the 3' to 5' RNA exonuclease USB
U6 small nuclear RNA maturation, the molecular m...">
<meta name="Description" content="Mutations in the 3' to 5' RNA exonuclease USB1 c
small nuclear RNA maturation, the molecular m...">
<meta name="dc.Publisher" content="American Association for the Advancement of Sci
<meta name="dc.Date" scheme="WTN8601" content="2023-03-03">
<meta name="dc.Type" content="research-article">
<meta name="dc.Format" content="text/HTML">
<meta name="dc.Identifier" scheme="publisher-id" content="abj8379">
<meta name="dc.Identifier" scheme="doi" content="10.1126/science.abj8379">
<meta name="dc.Language" content="EN">
```

html.pb-page.js > head > script

Filter Styles

:hov .cls +



Layout

Computed

Changes

https://www.science.org/

## Dublin Core Elements



```
    /moatframe.js"></script>
    <meta name="pbContext" content=";issue:issue:doi\ :10.1126/science.2023.379.issue-6
ring:Publication Websites;pageGroup:string:Publication Pages">
    <link rel="schema.DC" href="http://purl.org/DC/elements/1.0/">
    <meta name="citation_journal_title" content="Science">
    <meta name="dc.Title" content="USB1 is a miRNA deadenylase that regulates hematopo
    <meta name="dc.Creator" content="Ho-Chang Jeong">
    <meta name="dc.Creator" content="Siddharth Shukla">
    <meta name="dc.Creator" content="Wilson Chun Fok">
    <meta name="dc.Creator" content="Thao Ngoc Huynh">
    <meta name="dc.Creator" content="Luis Francisco Zirnberger Batista">
    <meta name="dc.Creator" content="Roy Parker">
    <meta name="dc.Description" content="Mutations in the 3' to 5' RNA exonuclease USB
    U6 small nuclear RNA maturation, the molecular m...">
    <meta name="Description" content="Mutations in the 3' to 5' RNA exonuclease USB1 c
    small nuclear RNA maturation, the molecular m...">
    <meta name="dc.Publisher" content="American Association for the Advancement of Sci
    <meta name="dc.Date" scheme="WTN8601" content="2023-03-03">
    <meta name="dc.Type" content="research-article">
    <meta name="dc.Format" content="text/HTML">
    <meta name="dc.Identifier" scheme="publisher-id" content="abj8379">
    <meta name="dc.Identifier" scheme="doi" content="10.1126/science.abj8379">
    <meta name="dc.Language" content="EN">
```

html.pb-page.js > head > script

Filter Styles

:hov .cls +



Layout

Computed

Changes



<https://www.theguardian.com>



Open Graph Protocol

[schema.org](https://schema.org)

A screenshot of a web browser's developer tools interface. The 'Inspector' tab is active, showing the HTML structure of a page. A search bar at the top of the inspector is set to 'Search HTML'. The code is expanded to show a series of meta tags. One meta tag, `<meta property="og:image:width" content="1200">`, is highlighted with a yellow rectangular box. Other visible meta tags include `og:url`, `article:author`, `og:image`, `al:ios:url`, `article:publisher`, `og:title`, `fb:app_id`, `article:modified_time`, `og:image:height`, `og:description`, `og:type`, `al:ios:app_store_id`, `article:section`, `article:published_time`, `article:tag`, and `al:ios:app_name`. The breadcrumb at the bottom of the developer tools shows the path: `html > body`.

```
<script type="application/ld+json">...</script>
<!--TODO make this conditional when we support more content types-->
<link rel="amphtml" href="https://amp.theguardian.com/world/2023/mar/05/greek-pm-s
<link rel="preload" href="https://assets.guim.co.uk/static/frontend/fonts/guardian
<link rel="preload" href="https://assets.guim.co.uk/static/frontend/fonts/guardian
<meta property="og:url" content="https://www.theguardian.com/world/2023/mar/05/gre
<meta property="article:author" content="https://www.theguardian.com/profile/helen
<meta property="og:image:width" content="1200">
<meta property="og:image" content="https://i.guim.co.uk/img/media/1d3542de00b22bab
<meta property="al:ios:url" content="gnmguardian://world/2023/mar/05/greek-pm-sorr
<meta property="article:publisher" content="https://www.facebook.com/theguardian">
<meta property="og:title" content="Greek PM 'sorry' over train crash that killed d
<meta property="fb:app_id" content="1804444840287">
<meta property="article:modified_time" content="2023-03-05T15:54:53.000Z">
<meta property="og:image:height" content="720">
<meta property="og:description" content="Parlous state of rail system in spotlight
<meta property="og:type" content="article">
<meta property="al:ios:app_store_id" content="409128287">
<meta property="article:section" content="World news">
<meta property="article:published_time" content="2023-03-05T15:53:52.000Z">
<meta property="article:tag" content="Greece,Rail transport,Europe,World news">
<meta property="al:ios:app_name" content="The Guardian">
<meta property="og:site_name" content="the Guardian">
```



# DISCLAIMER

This slide deck is part of the Lesson

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Why Context Matters**

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You can find more information about this course on **Github**.



image:  
[https://c.pxhere.com/photos/35/f5/coffee\\_notebook\\_wooden\\_backgr\\_ound\\_orange\\_work\\_table\\_office-1222115.jpgld](https://c.pxhere.com/photos/35/f5/coffee_notebook_wooden_backgr_ound_orange_work_table_office-1222115.jpgld)