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What's in a picture?

or

"The Temptation of Image Manipulation"

Mike Rossner, Ph.D.

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Former Managing Editor, *The Journal of Cell Biology*

rossner@rockefeller.edu

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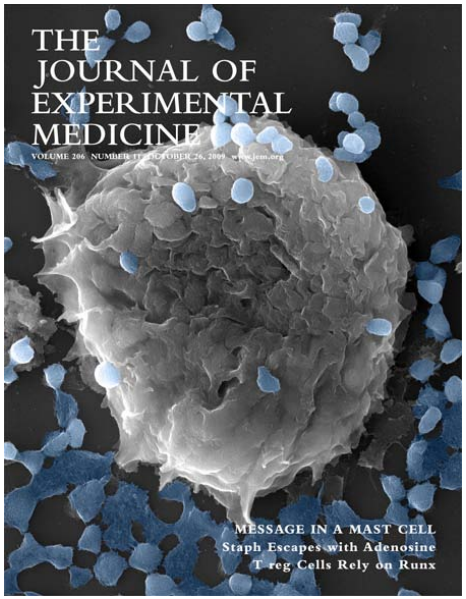

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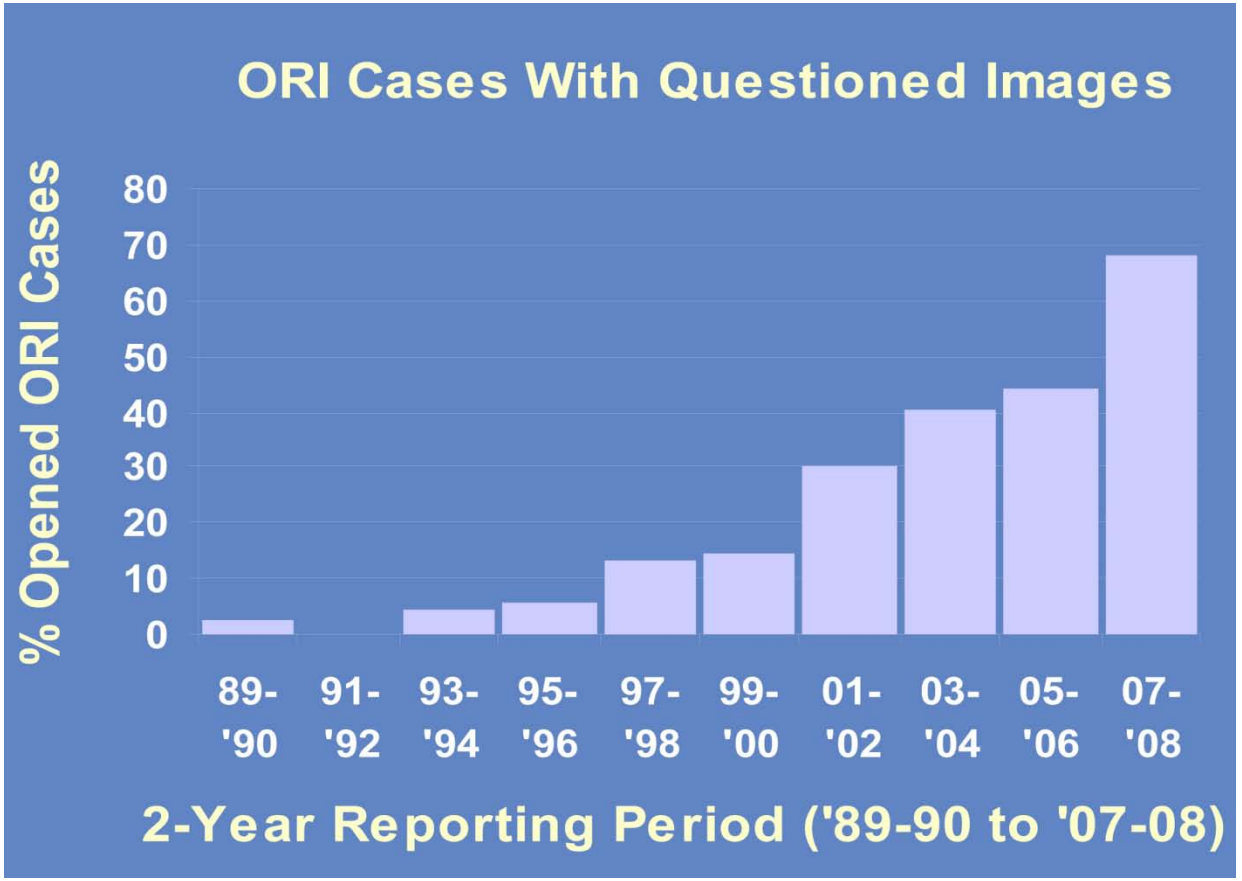
Factors affecting frequency of image manipulation by authors:

- Culture of image manipulation: perceived acceptability?
- Ease of image manipulation

Data from the Office of Research Integrity



From J. Krueger, ORI

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Manipulation of scientific images in perspective

- Images are only one form of scientific data.

  Numerical data (tabular, graphical).

- Data manipulation by scientists is only one form of misconduct.

  Plagiarism, failure to disclose financial conflicts of interest, failure to protect human research participants.

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Manipulation of scientific images in perspective

- Data manipulation by scientists is not a recent phenomenon.
- Manipulation of images not a recent phenomenon.

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Issues to be addressed:

- Why is it wrong to manipulate images?
- Detecting image manipulation
- Guidelines for handling digital images
- Investigating image manipulation
- Defining misconduct
- Reporting misconduct

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Why is it wrong to manipulate images?

Expect and assume basic scientific honesty

Accurate representations

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Why is it wrong to manipulate images?

If the data are not accurate representations:

- Potentially deceiving your audience.
- Potentially damaging the reputations of your colleagues.
- Potentially limiting progress in the field.
- Potentially misusing funds.
- Potentially endangering patients.

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Why is it wrong to manipulate images?

An image usually carries information beyond the specific point being made.

1. Reproducibility

The quality of an image has implications about:

- The care with which the data were obtained.
- The number of times the experiment was repeated.

For example, spliced gels. Repeat?

Why is it wrong to manipulate images?

An image usually carries information beyond the specific point being made.

2. “Background”

Cleaning up an image may deprive you and your colleagues of seeing other information that is often hidden in a picture.

That “background” band may mean something to someone else!

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Detecting Image Manipulation

Who can do it?

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Detecting Image Manipulation

- Reader
- Principal Investigator: compare all prepared figures to the original data! Instruct trainees in the proper handling of image data.
- Reviewer
- Journal Editor: production editor and managing editor in consultation with academic editor.

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Detecting Image Manipulation

Editors can detect manipulation of images in figures submitted for publication.

- Adjustments to brightness and contrast can reveal inconsistencies in background, which are clues to manipulation.

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Detecting Image Manipulation

2002 – JCB requires submission of electronic files.

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Detecting Image Manipulation

Examine all figure files of all accepted manuscripts for evidence of manipulation.

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Detecting Image Manipulation

Although Photoshop makes it easier for an author to manipulate images, it also makes it easier for the journal editor to detect manipulation.

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Guidelines for handling digital images

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Guidelines for handling digital images

"No specific feature within an image may be enhanced, obscured, moved, removed, or introduced. The grouping of images from different parts of the same gel, or from different gels, fields, or exposures must be made explicit by the arrangement of the figure (i.e., using dividing lines) and in the text of the figure legend. If dividing lines are not included, they will be added by our production department, and may result in production delays. Adjustments of brightness, contrast, or color balance are acceptable if they are applied to the whole image and as long as they do not obscure, eliminate, or misrepresent any information present in the original. Non-linear adjustments (e.g., changes to gamma settings) must be disclosed in the figure legend. All digital images in manuscripts accepted for publication will be scrutinized by our production department for any indication of improper manipulation. Questions raised by the production department will be referred to the Editors, who will request the original data from the authors for comparison to the prepared figures. If the original data cannot be produced, the acceptance of the manuscript may be revoked. Cases of deliberate misrepresentation of data will result in revocation of acceptance and will be reported to the corresponding author's home institution or funding agency."

The Journal of Cell Biology, Instructions to Authors, http://www.jcb.org/misc/ifora.shtml

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Guidelines for handling digital images

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Guidelines for handling digital images

- The grouping of images from different parts of the same gel, or from different gels, fields, or exposures is acceptable but must be made explicit by the arrangement of the figure (i.e., using dividing lines) and in the text of the figure legend.

- If the original data cannot be produced when requested by an editor, the acceptance of the manuscript may be revoked.

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Investigating Image Manipulation

Enforcing guidelines!

Systematic screening.

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Investigating Image Manipulation

If we suspect guidelines have been violated, we conduct an initial investigation.

- Obtain the original data:
  - *Does it match the prepared figure?*
  - *Is the manipulation acceptable or does it constitute misconduct?*

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Defining Misconduct

- Inappropriate manipulation
  - *Manipulation does not affect the interpretation of the data.*
  - *Author is asked to remake figures with the original data.*
- Fraudulent manipulation
  - *Fabrication or falsification that affects the interpretation of the data. Not legal elements of intent or damage to 3rd party.*
  - *Acceptance of the paper is revoked.*
  - *Do we report the misconduct?*

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Defining Misconduct

- Inappropriate manipulation

>25% of all accepted manuscripts have at least one figure that has to be remade

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Defining Misconduct

- Fraudulent manipulation
  - 1% of all accepted manuscripts at the JCB.
  - Lower for our journals that publish fewer images.

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Defining Misconduct

- Fraudulent manipulation

1% of all accepted manuscripts at the JCB.

	# papers since 2002
Total screened	3192
Original data obtained	474
Acceptance revoked	33

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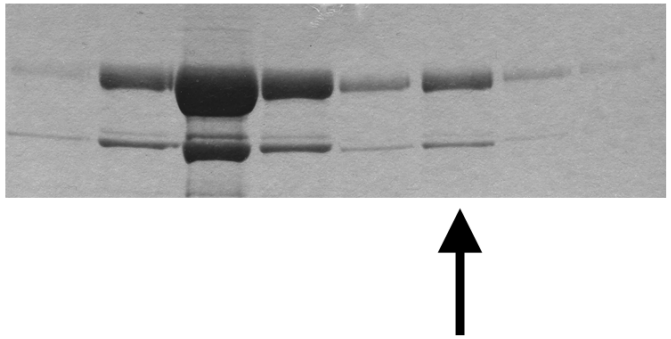
Manipulation Examples

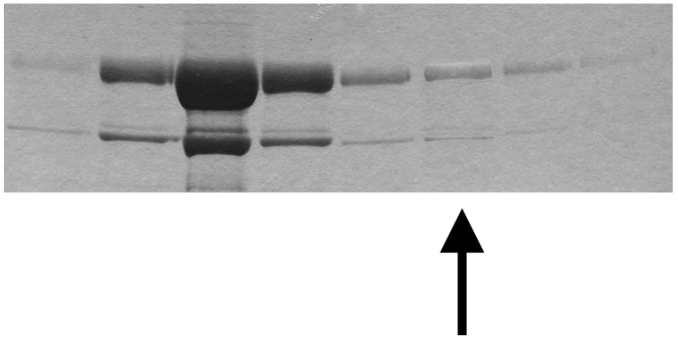
Inappropriate Manipulation Examples

- Adjustment of specific feature: altering intensity

Original image



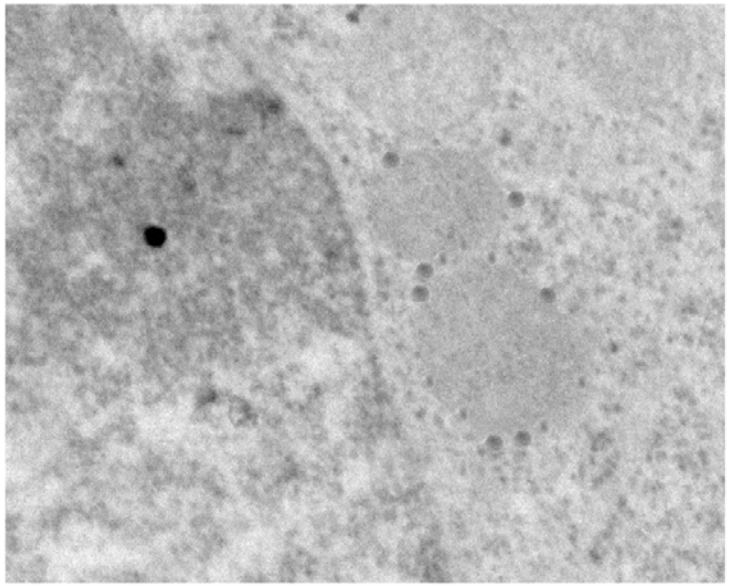
Manipulated image



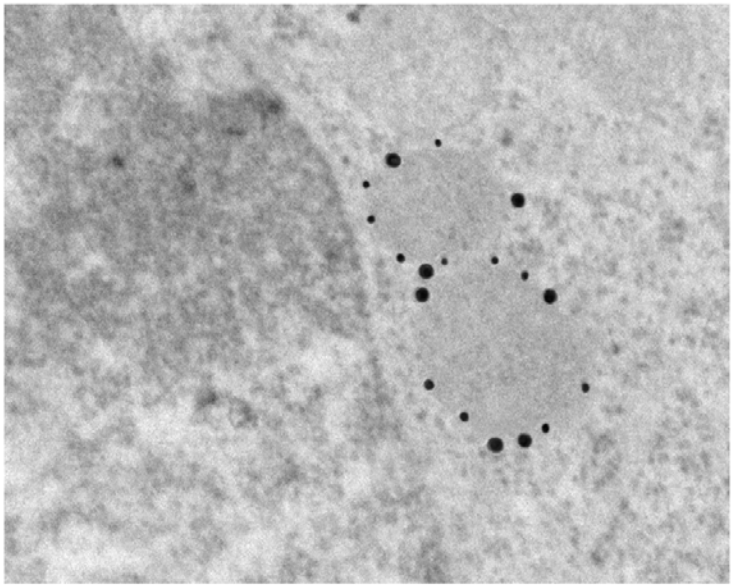
Inappropriate Manipulation Examples

- Adjustment of specific feature: altering intensity

Original image

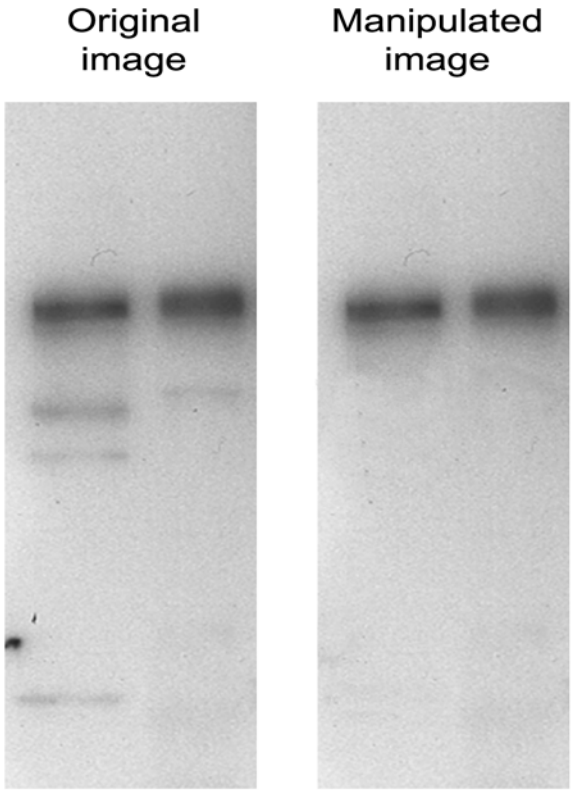


Manipulated image



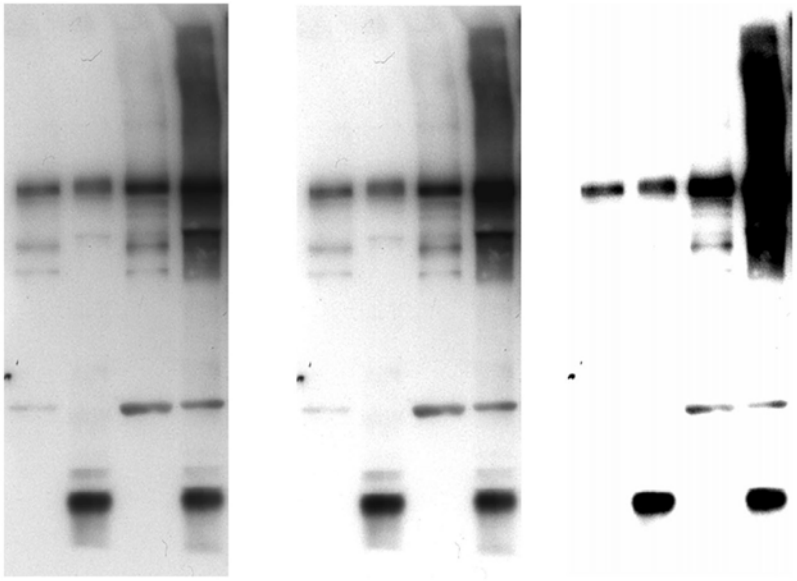
Inappropriate Manipulation Examples

- Cleaning up background – adjustment of a specific feature



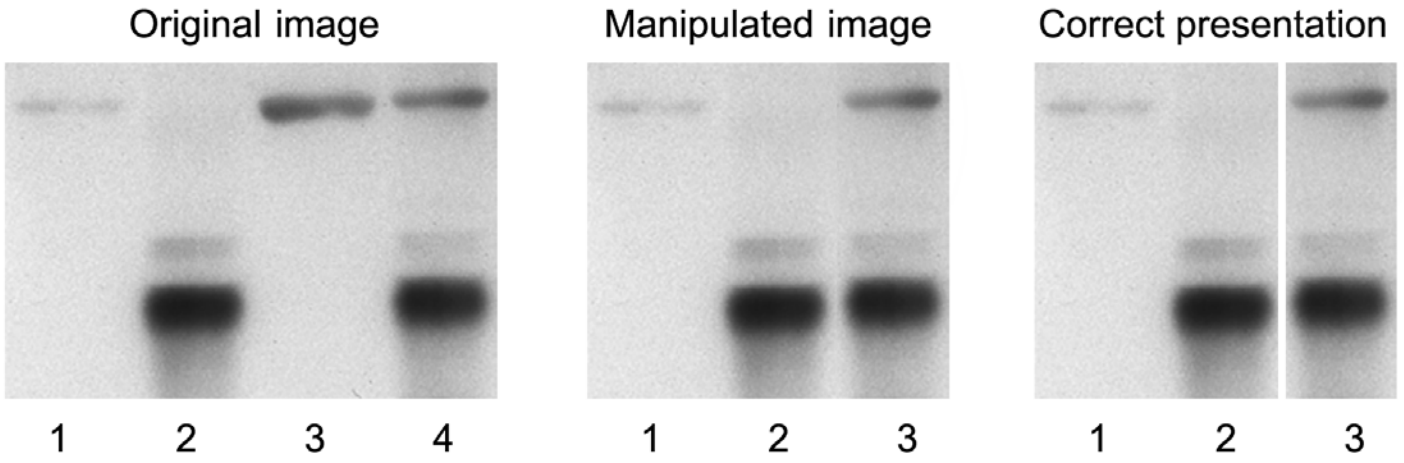
Inappropriate Manipulation Examples

- Adjustment of contrast: elimination of data



Inappropriate Manipulation Examples

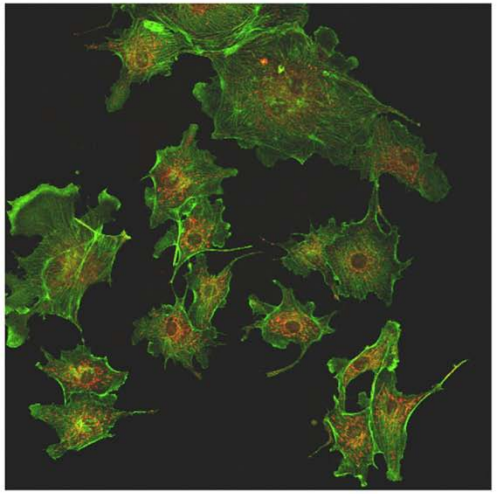
- Splicing:



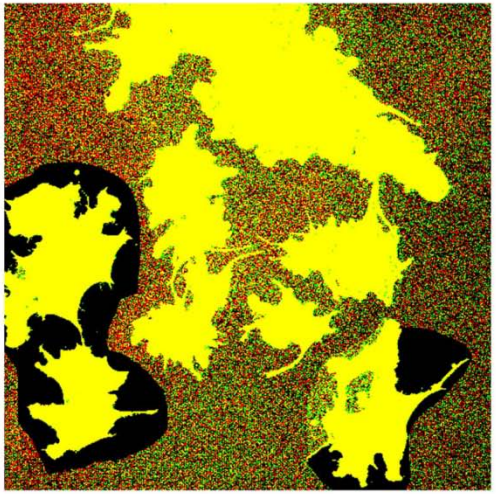
Inappropriate Manipulation Examples

- Splicing:

Manipulated Image



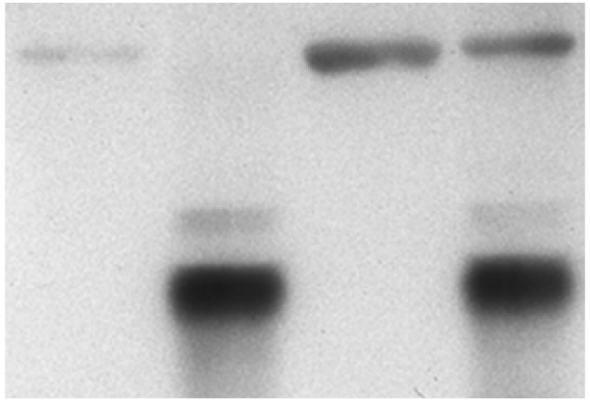
Manipulation Revealed by Contrast Adjustment



Fraudulent Manipulation Examples

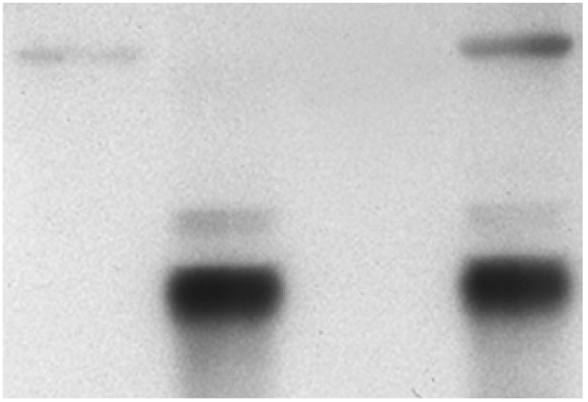
- Deleting a band:

Original image



1 2 3 4

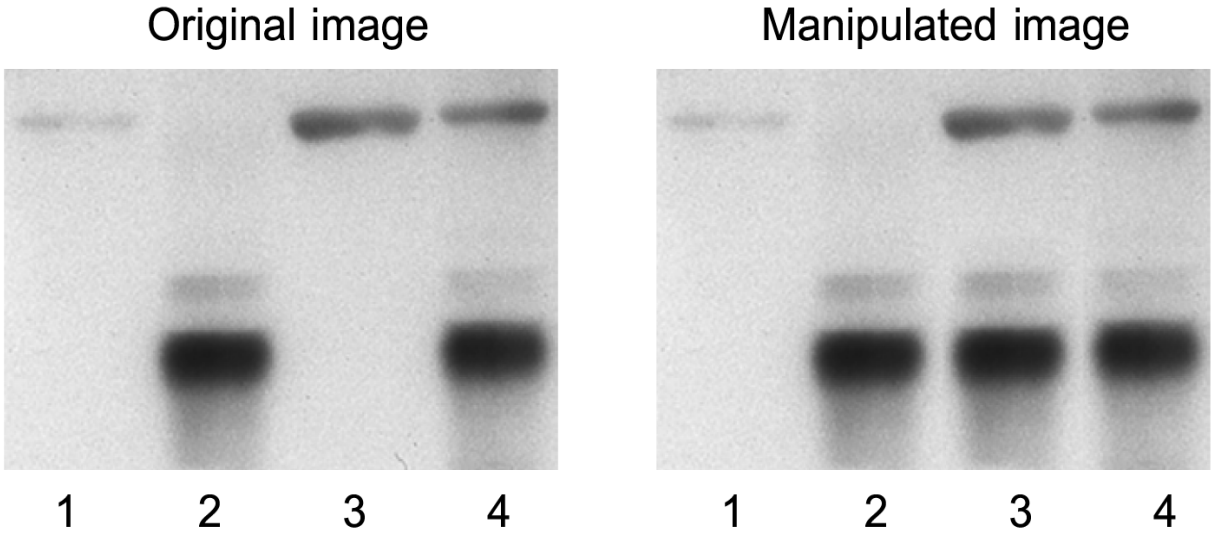
Manipulated image



1 2 3 4

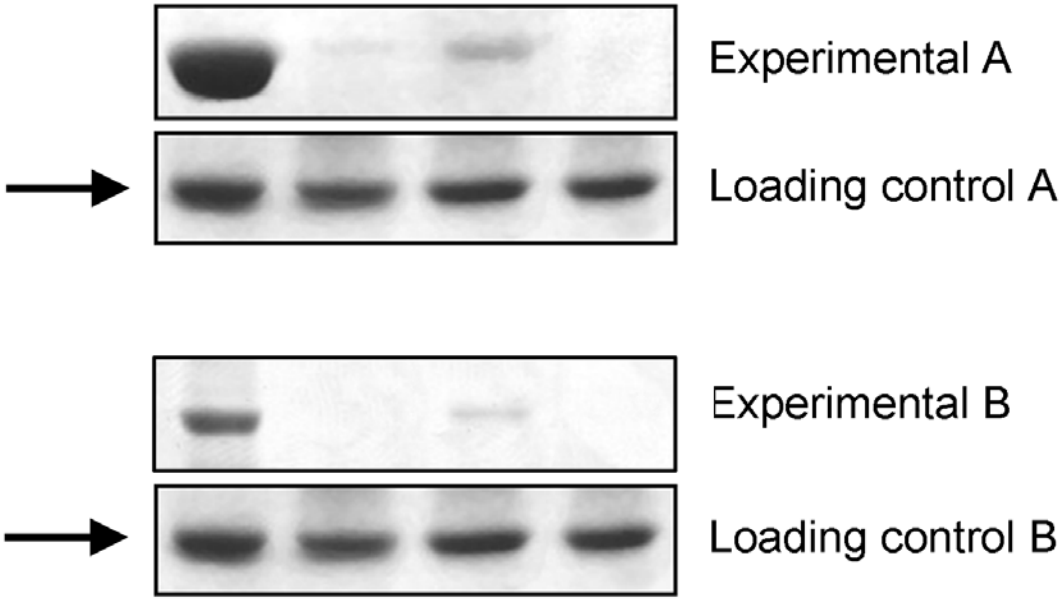
Fraudulent Manipulation Examples

- Adding a band:



Fraudulent Manipulation Examples

- Duplicating Data:



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Summary 1

Some rules of thumb for file storage

- Keep your original file. Proprietary file and original conversion to standard format.
- Note export settings. Preserve resolution.
- Do not use JPEG compression.
- Store images in TIF format. Use LZW compression to reduce file size.
- Back up your data.
- Keep track of different versions of your figures.

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Summary 2

Some rules of thumb for handling image files

- Note image dimensions and resolution (dpi). Do not create pixels with software.
- Apply the same adjustment to every pixel.
- Apply the same adjustment to your control and experimental images.
- Disclose all adjustments in your figure legends.

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Summary 3

If possible, publish your original data!

JCB Data Viewer

jcb-dataviewer.rupress.org

- Browser-based application for viewing original image files - from various types of light microscopes and gel-documentation systems - associated with JCB articles.
- It is the first browser-based system for viewing multi-dimensional light microscope image data.

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Summary 3

If possible, publish your original data!

JCB Data Viewer jcb-dataviewer.rupress.org

Authors

- Present original data as acquired. [Link from published paper]
- Share data that were not possible to share previously.

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Summary 3

If possible, publish your original data!

JCB Data Viewer
jcb-dataviewer.rupress.org

GLENCOE SOFTWARE

Users

- See data they could not see previously.
- Interact with the data within the browser (scrolling through a z stack or time series), make your own movie, and perform simple analyses (e.g. line plots).
- Download the data for complex analyses

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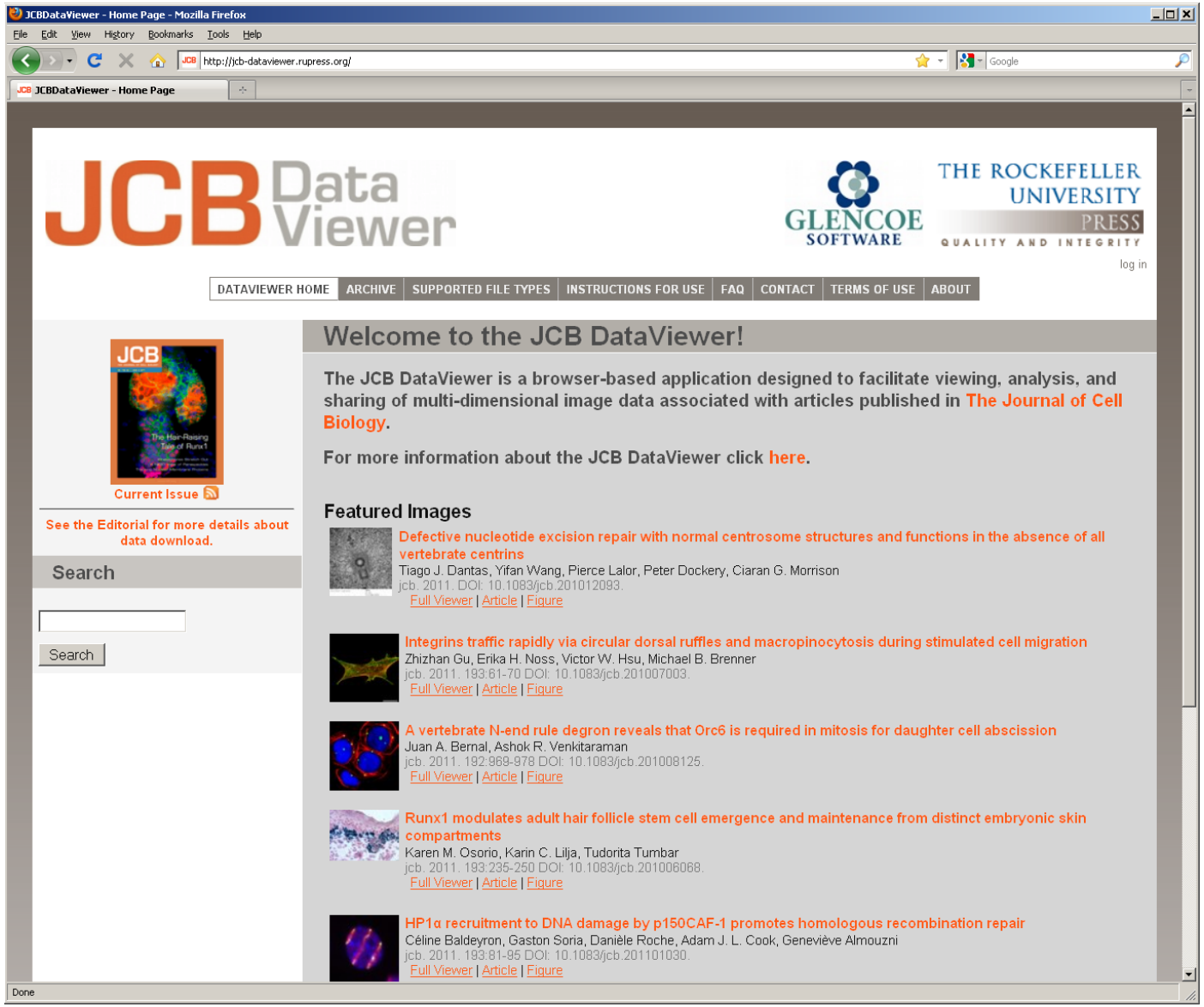
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The JCB DataViewer is a browser-based application designed to facilitate viewing, analysis, and sharing of multi-dimensional image data associated with articles published in The Journal of Cell Biology.
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Defective nucleotide excision repair with normal centrosome structures and functions in the absence of all vertebrate centrins
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jcb. 2011. DOI: 10.1083/jcb.201012093.
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Integrins traffic rapidly via circular dorsal ruffles and macropinocytosis during stimulated cell migration
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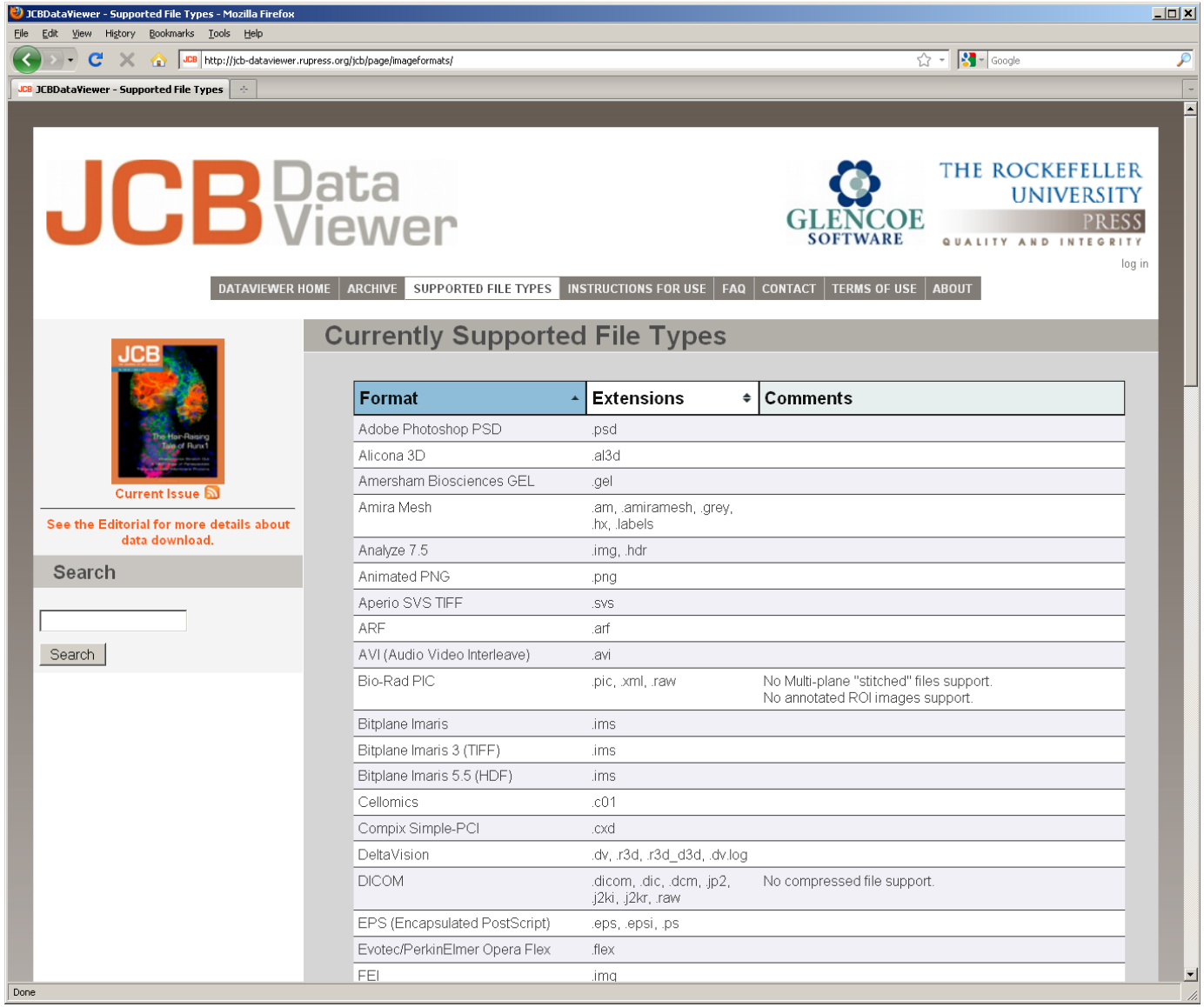
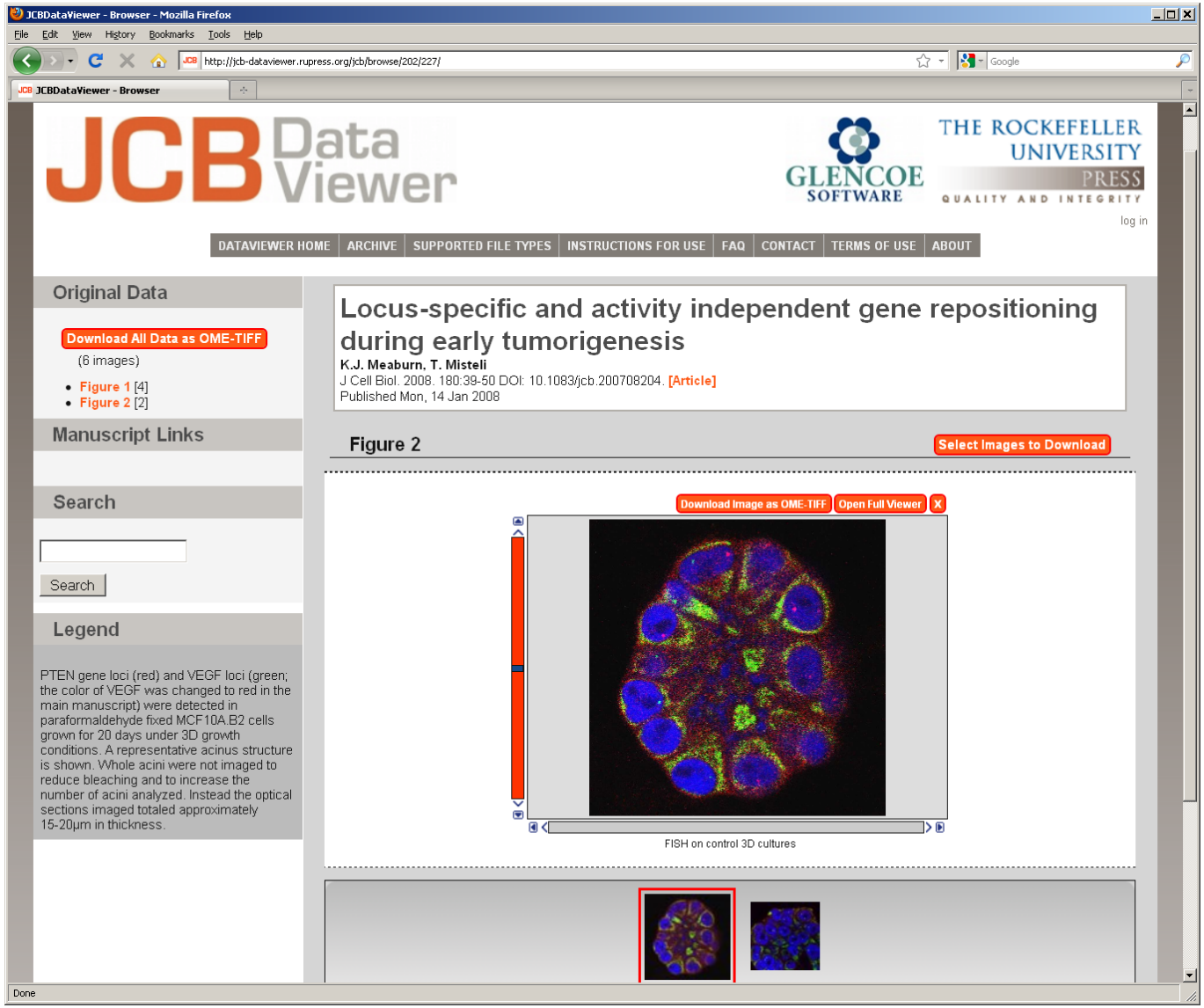
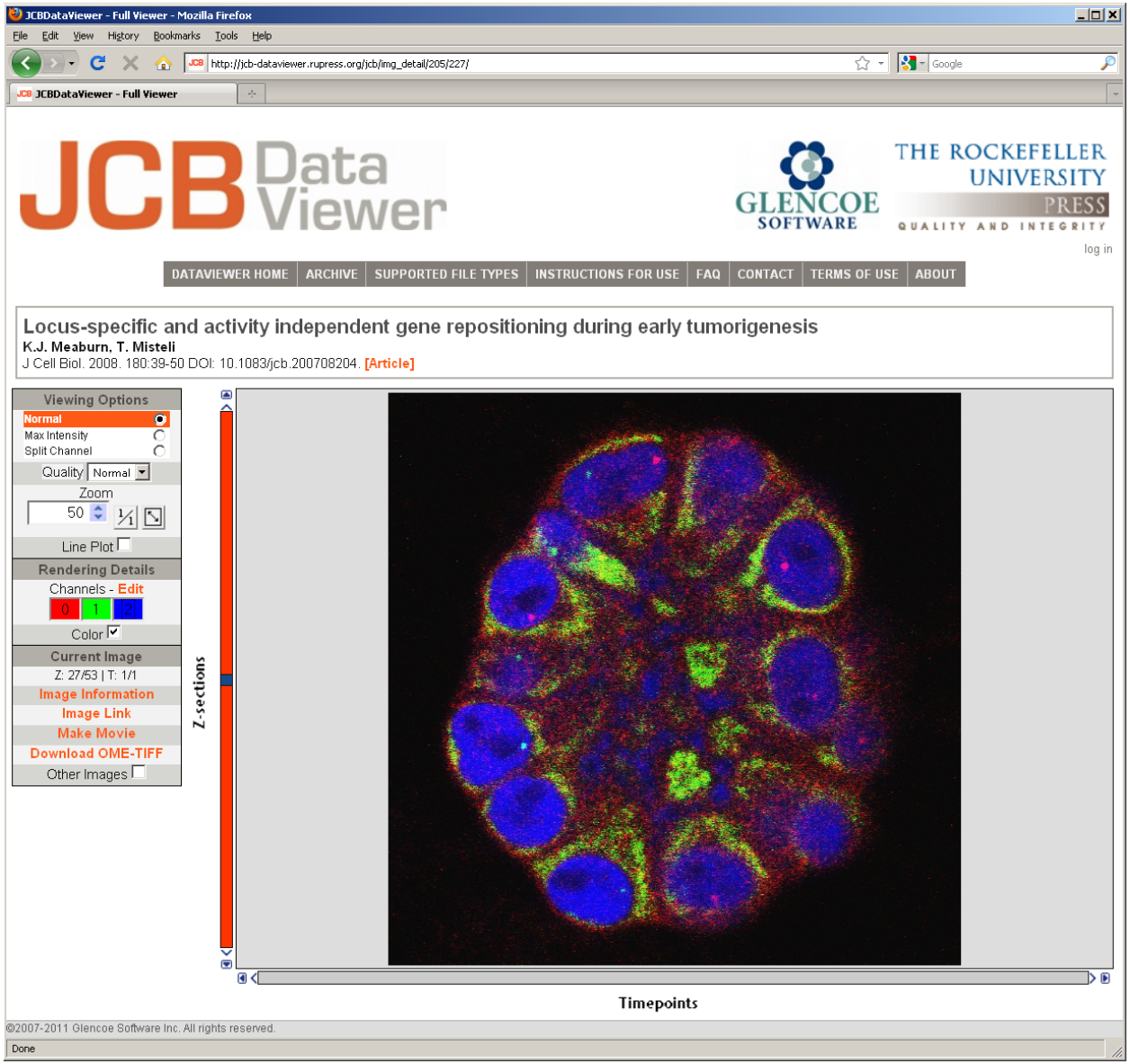


Main data page / minimal viewer



Full Viewer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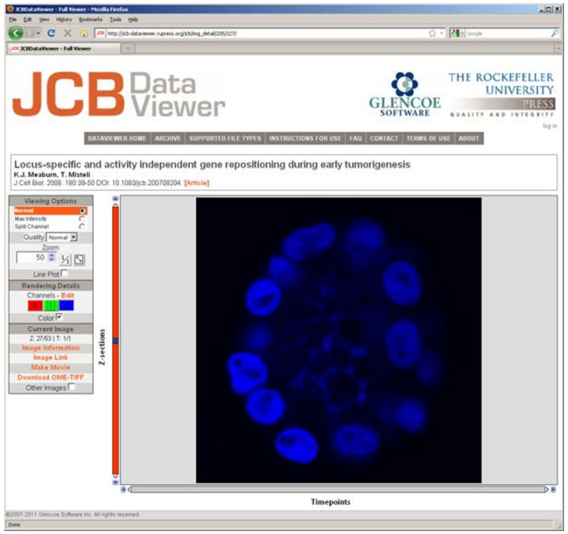
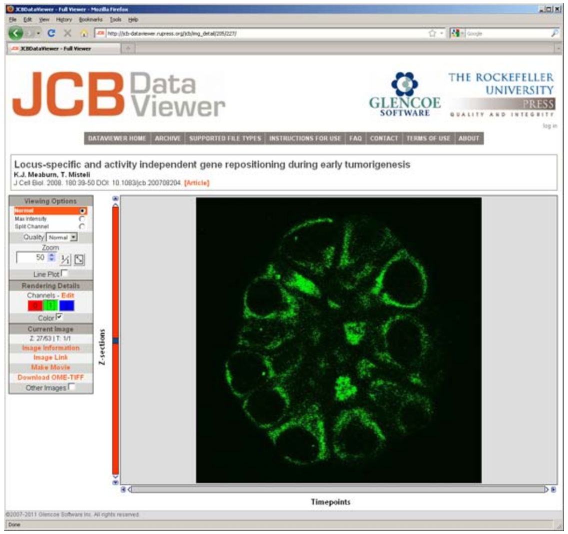
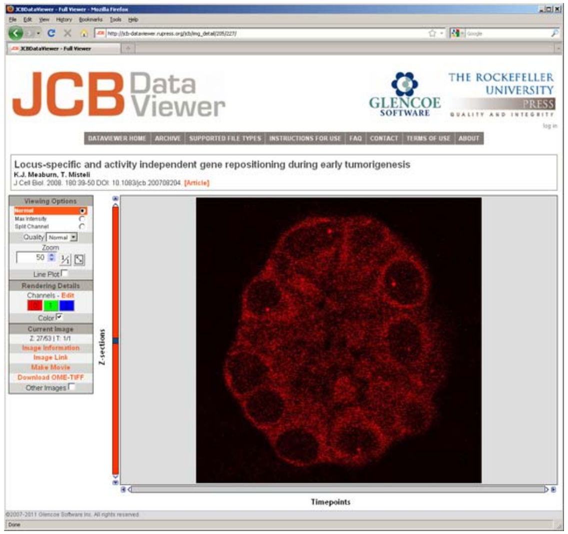
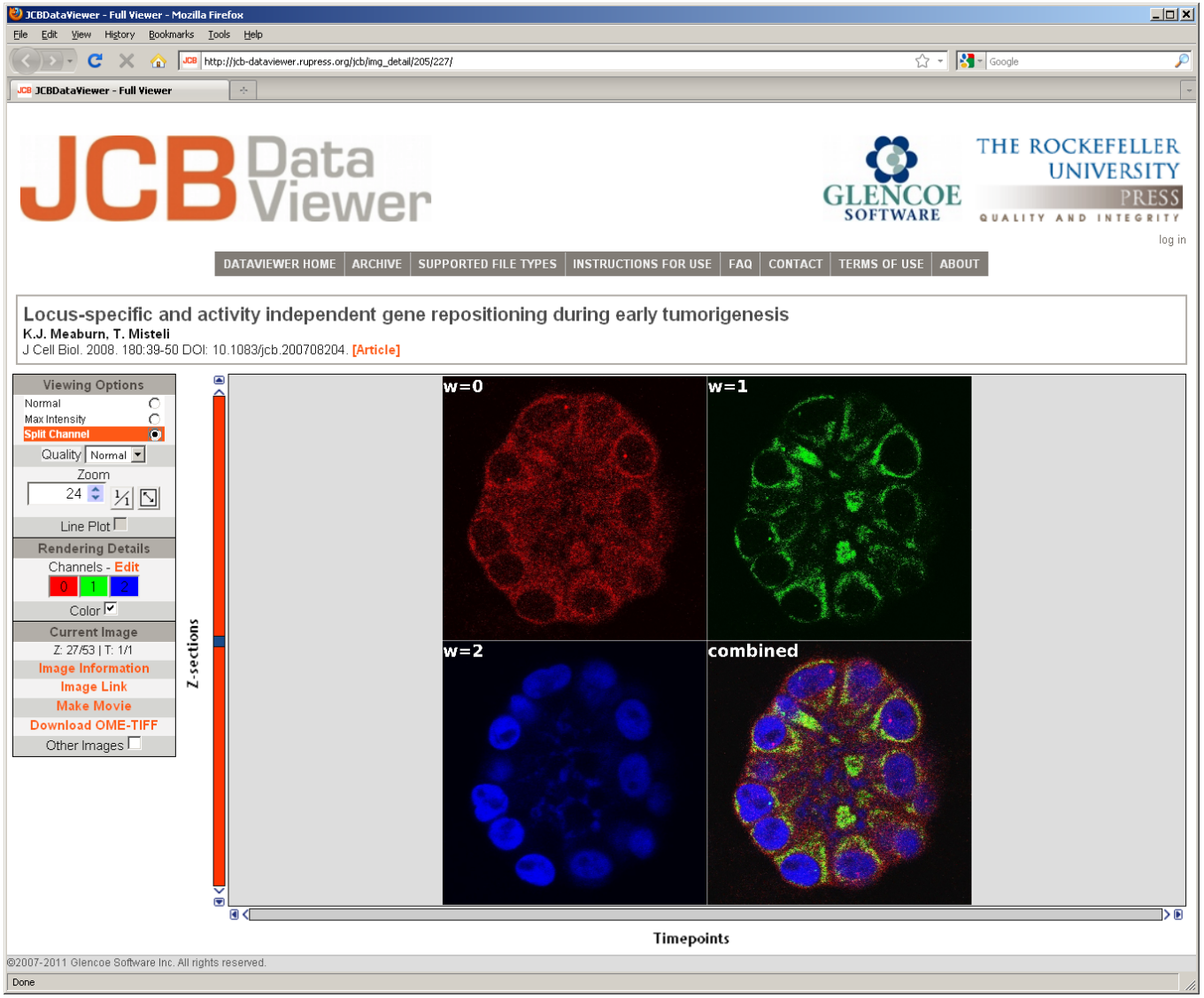
Individual channel view



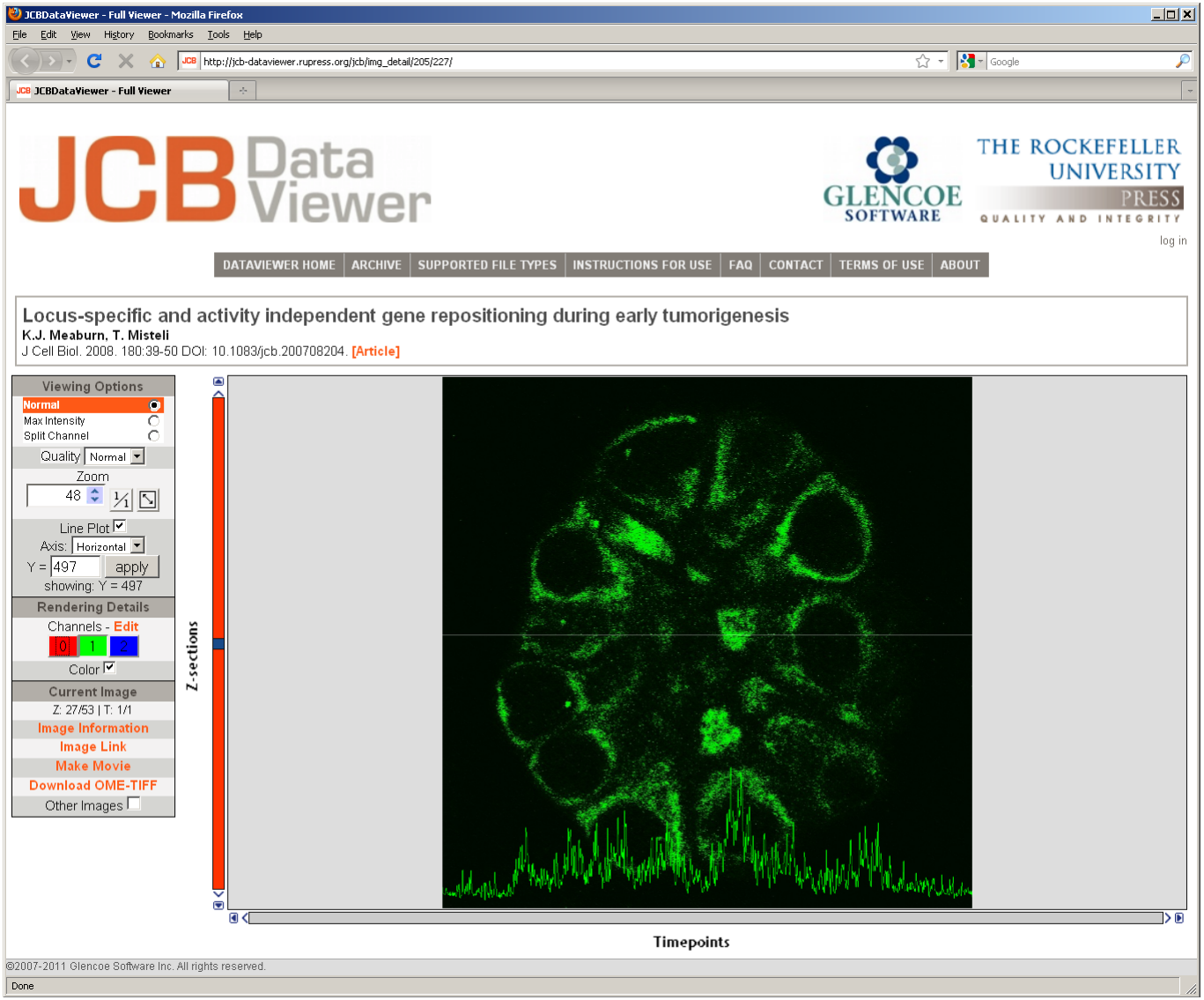




Split Channel View



Line Plots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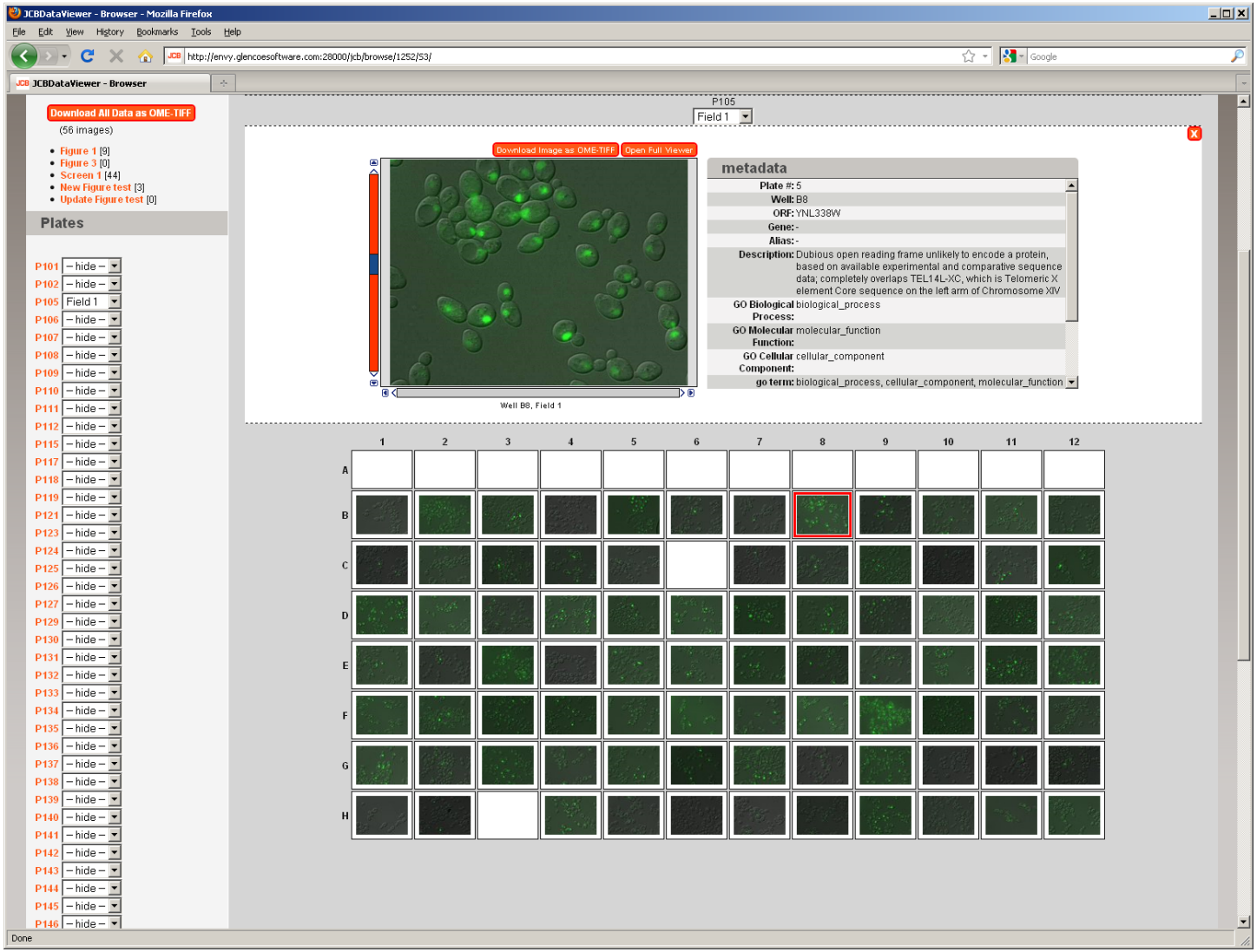
High Content Screening



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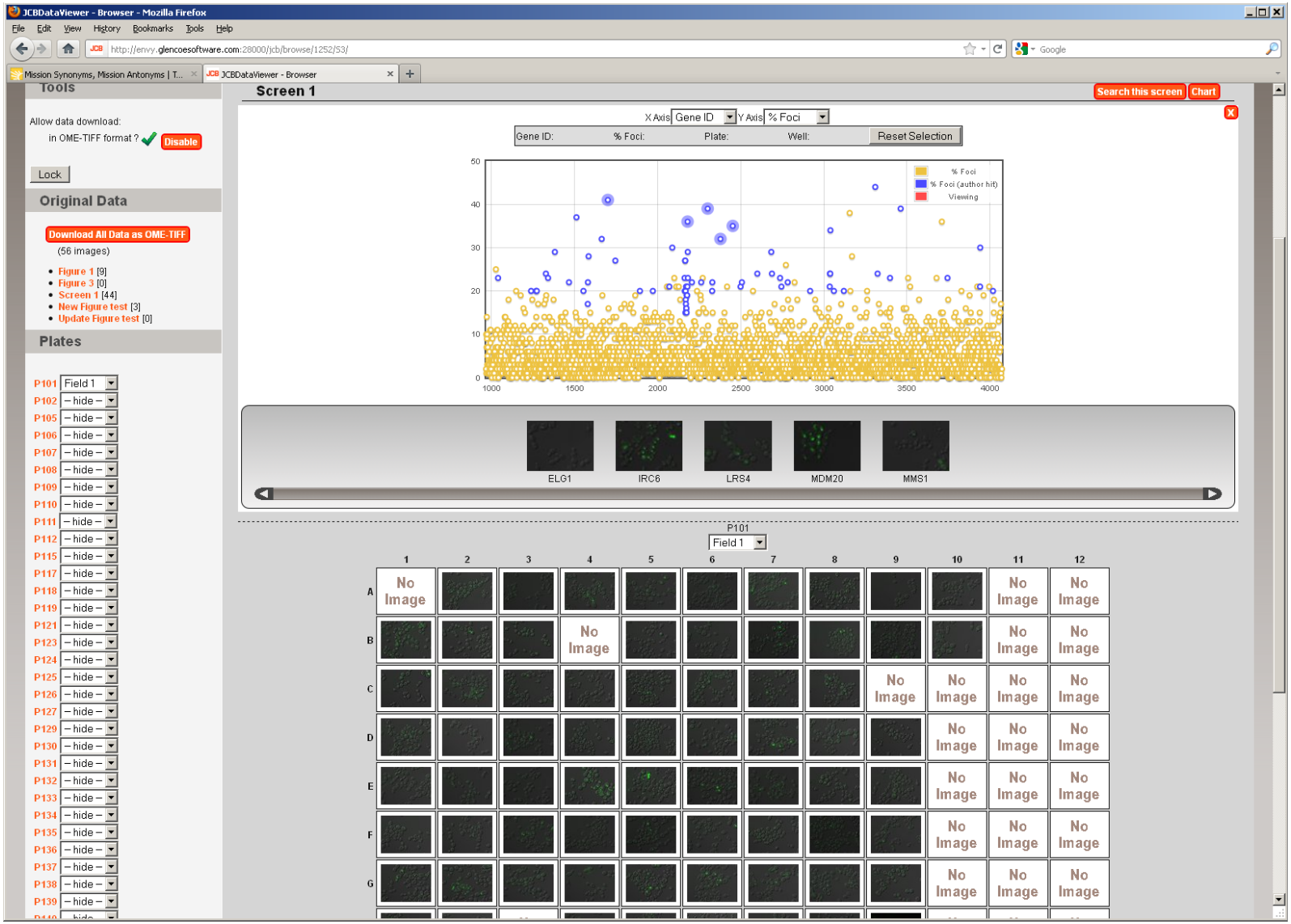

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Summary 3

If possible, publish your original data!

JCB Data Viewer

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- Standard for publication of image data.
- Precursor to an international repository of original image data?

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Summary 4

- Science ≠ Art
- Accuracy, not aesthetics! If you don't like how it looks, do the experiment again.
- This is only post-acquisition. Ethical practices when acquiring data are another whole issue!