

Preprinting and Publishing in the Life and Biomedical Sciences

I: Introduction to the evolving
publication landscape



In today's lesson we will discuss:



The importance of communication in scientific progress



The history of scientific communication and how the current traditional, journal-based publication process works



Challenges within the current publication system



Emerging solutions and innovations in scientific communication and how new models integrate with the traditional publication process



Introduction to lessons and goals of the course

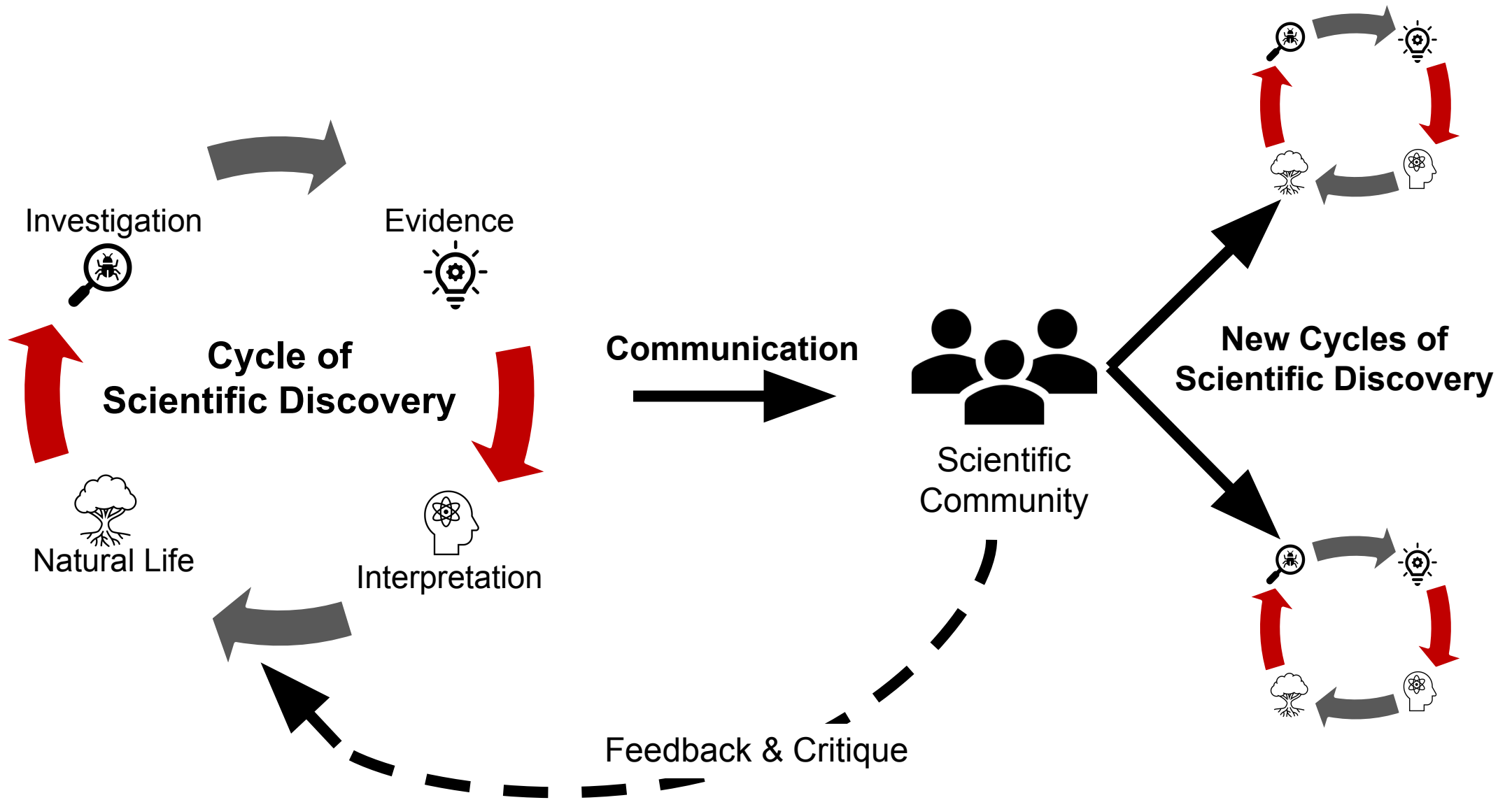
Things you should know:

1. **What is a 'research article'?** As scientists, we share our work through written 'research articles' that describe the rationale for our study, the methods we used, the results of our experiments, and the interpretation of our findings.
2. **What is 'publishing'?** 'Publishing' is a process in which a written work is evaluated, edited, and prepared to be released to the public as a 'publication'.
3. **What is a 'scholarly journal'?** Research articles are submitted to 'scholarly journals' to be evaluated by 'editors' and prepared for publication.
4. **What is 'peer review'?** Prior to publication, 'research articles' are 'peer-reviewed', i.e., assessed by other scientists relevant the field for 'quality', 'validity', and 'originality' of the scientific work.
5. Publication of research articles in scholarly journals is currently the primary method for scientists to communicate their research findings to other scientists.

How do we achieve scientific
progress?

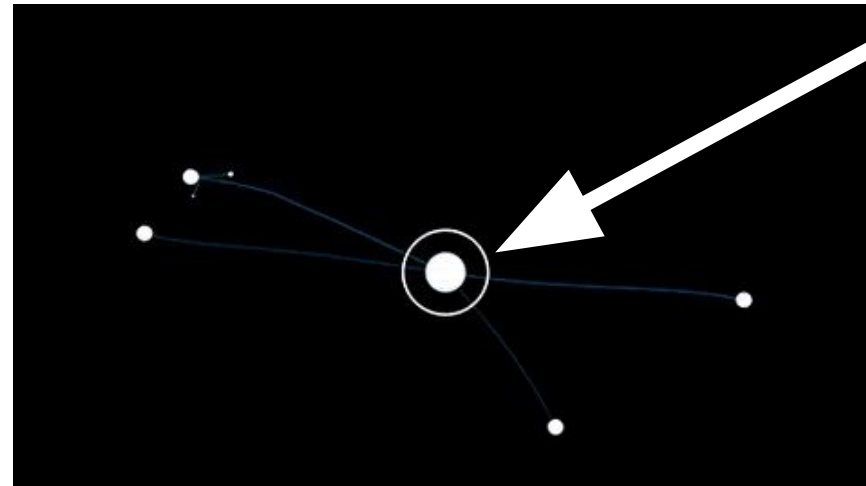


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Scientific progress is a collective endeavor

Communication is central to scientific progress



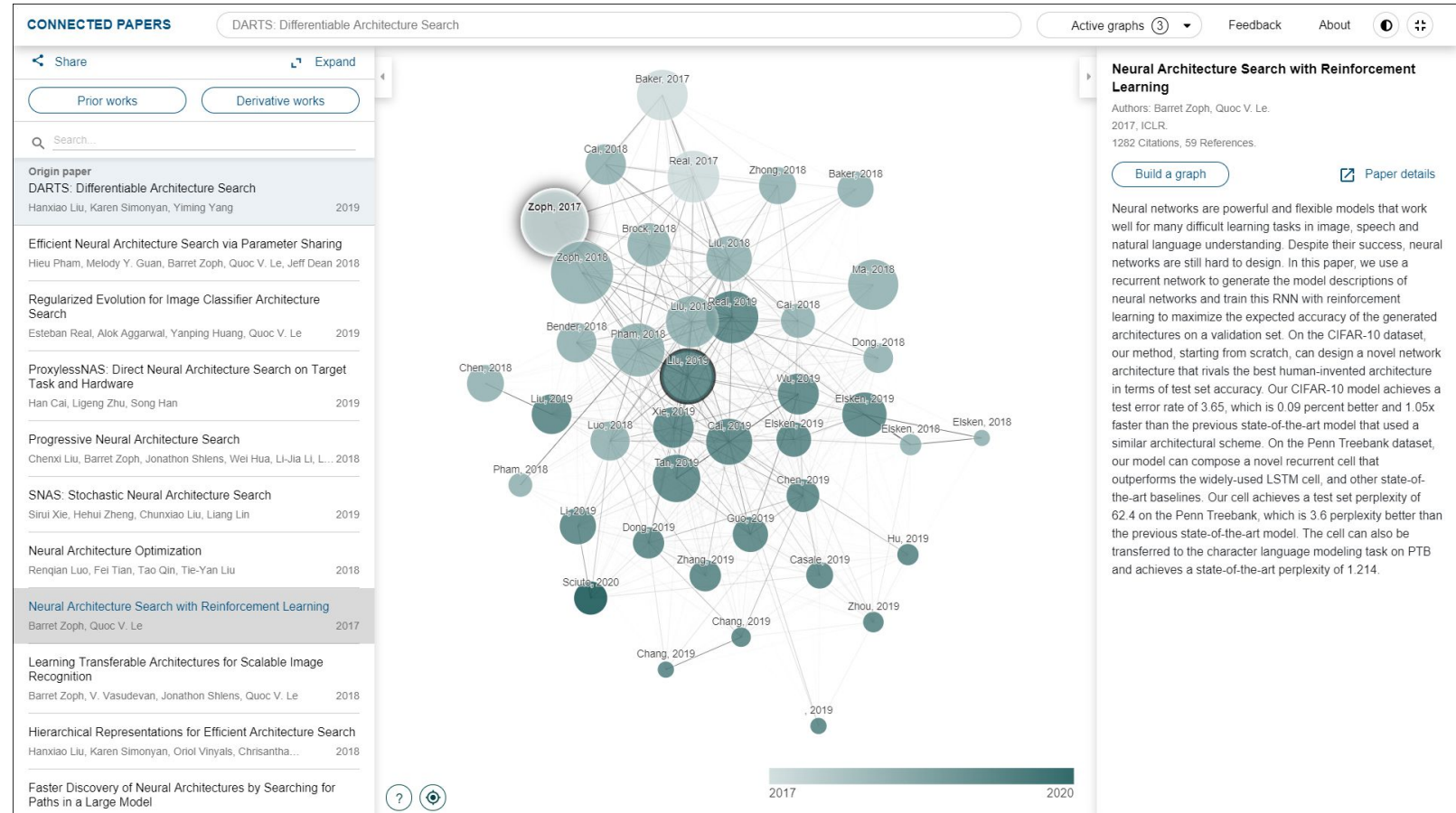
**Your scientific
discovery**



More communication = More scientific progress?

Connected papers exercise

1. Go to www.connectedpapers.com
2. Insert an identifier of your favorite paper (Title, DOI, etc)
3. Build a network graph of your favorite paper!
4. See the 'prior works' that formed the basis of your favorite paper and the impact of it in 'derivative' works



Scientific progress requires communication over space and time



Path to the CRISPR Gene Editing Revolution

- 1** **1993** Discovery of CRISPR
- 2** **2003** CRISPR is an adaptive immune system
- 3** **2006** Experimental evidence that CRISPR confers adaptive immunity
- 4** **2008** Programming CRISPR
- 5** **2008** CRISPR targets DNA
- 6** **2010** Cas9 is guided by crRNAs and creates double-stranded breaks
- 7** **2010** Discovery of tracrRNA
- 8** **2011** Reconstituting CRISPR in a distant organism
- 9** **2012** Studying CRISPR in vitro
- 10** **2012** Genome editing in mammalian cells

2020
Nobel prize awarded to Jennifer Doudna and Emmanuelle Charpentier

How have we communicated
our science throughout
history?



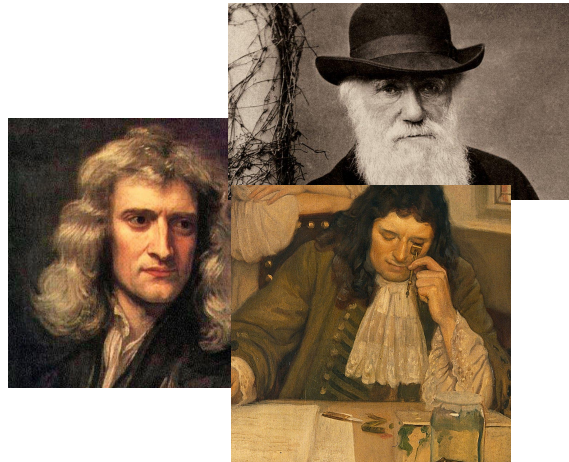
Origins and evolution of the academic journal



- Prior to journals, communication was largely through individual letters and conversation through *learned societies*
- **17th Century** – The journal as a “centralized” form of communication
 - FUN FACT: *Philosophical Transactions of the Royal Society of London*’s Henry Oldenburg was not merely editor, but also author, translator, and reviewer

First two scientific journals:
Journal des Sçavans and
*Philosophical Transactions of the
Royal Society of London*

1665



Origins and evolution of the academic journal



- **18th Century** – first fully peer-reviewed journal
 - FUN FACT: *Formal* journal-dependent peer review was not widely accepted until after WWII (>1945)

*Medical Essays and
Observations*, the first fully
peer-reviewed journal
1731

First two scientific journals:
Journal des Sçavans and
*Philosophical Transactions of the
Royal Society of London*
1665



Origins and evolution of the academic journal



- **19th Century** – Thousands of journals come on the scene, most funded publicly through learned societies, as well as some commercial publishers



THURSDAY, NOVEMBER 4, 1869

NATURE: APHORISMS BY GOETHE

NATURE: We are surrounded and embraced by her; powerless to separate ourselves from her, and powerless to penetrate beyond her. Without asking, or warning, she marches us up into her crating dance, and while we are still we are lifted, and drop from her arms. She is ever changing new forms; what is, has never yet been; what has been, cannot be again. Everything is new, and yet sought but the old. We live in her midst and know her not. She is incessantly speaking to us, but hushes our ear. We constantly act upon her, and yet have no power over her.

The one thing she seems to aim at is Individuality; yet she cares nothing for individuality. She is always building up and destroying; but her workshop is inseparable.

Her life is in her children; but where is the mother? She is the only unit; everything else must adhere to her, or perish. She is the most exacting, though always veiled under a certain softness.

Each of her works has an essence of its own; each of her phenomena a special classification; and yet their diversity is in unity.

She performs a play; we know not whether she sees it herself, and yet she acts for us, the Individual.

Innocent life, development, and movement are in her, but she never ceases to change for ever and ever, and never rests a moment. Outside of her, she has laid her course upon you. She is, in fact, Her steps are measured, her exceptions rare, her laws unchangeable. She has always thought, and always thinks; though not as a man, but as Nature. She broods over an

all-comprehending idea, which no searching can find out. Mental death is her and she is them. With all this she plays a game for love, and rejoices the more they win. With many, her moves are so hidden, that they guess it over before they know it.

That which is most unusual in still Nature; the singular phenomenon has a touch of her genius. Whoso cannot see her everywhere, sees her nowhere rightly.

She loves herself, and her innumerable eyes and affections are fixed upon herself. She has divided herself that she may be her own delight. She carries an endless succession of new capacities for enjoyment to spring up, that her insatiable sympathy may be satisfied.

She rejoices in illusion. Whoso deceives it in himself and others, him she punishes with the sternest tyranny. Whoso follows her in faith, him she takes as a child to her bosom.

Her children are numberless. To none is she altogether kindly; but she has her favorites, on whom she squanders much, and for whom she makes great sacrifices. Over grandma she squanders her shield.

She takes her enemies out of nothingness, and tells them not whence they came, nor whither they go. It is their business to see, she knows the road.

Her mechanism has few springs—but they never wear out, nor are they greasy and rusted.

The spectacle of Nature is always new, for she is always renewing the spectacle. Life is her most exquisite invention; and death is her sweet convenience to get plenty of life.

She wags her tail in mischief, and makes him for ever long for light. She creates him dependent upon the earth, full and heavy; and yet is always making him until he attempts to soar above it.



Medical Essays and Observations, the first fully peer-reviewed journal

1731

Nature publishes its first issue.

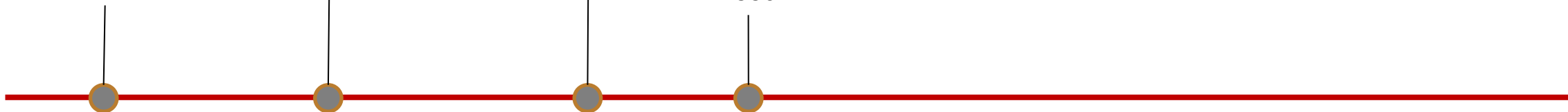
1869

Science publishes its first issue.

1880

First two scientific journals:
Journal des Sçavans and
Philosophical Transactions of the Royal Society of London

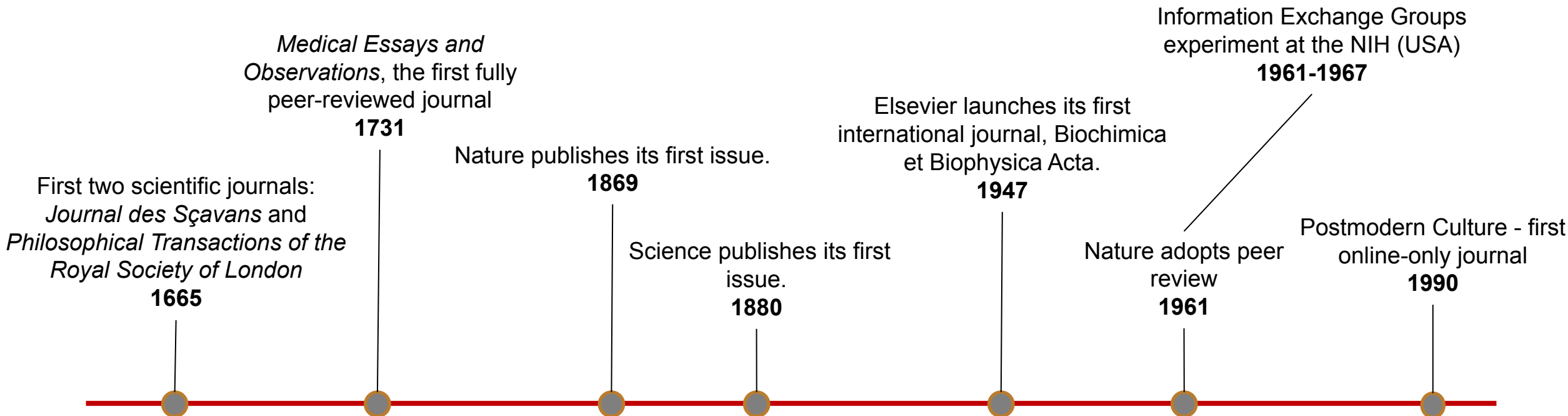
1665



Origins and evolution of the academic journal



- **20th Century** - Boom in scientific funding and academic research following WWII
 - Internationalization of publishing
 - Commercial publishing becomes a highly profitable industry
 - Journal-dependent peer review is widely adopted
 - Experimental efforts for open scientific communication models hit roadblocks (IEGs)
 - “Digital age” opens avenues for online journals



Academic publishers and scientific journals Today...



Business Models

- Non-profit, subscription-based, Open-access optional (\$\$)
- Non-profit, Open-access
- For-profit/Commercial, subscription-based, Open-access optional (\$\$)
- For-profit/Commercial, subscription-based, Open-access

Modalities

- Online and print, Online only

Topical

- General and field specific

Functions of academic journals have evolved beyond communication:



Archiving: permanently storing scholarship for later access.



Registration: time-stamping authors' contributions to establish precedence.



Dissemination: getting scholarly products out to scholars who want to read them.



Certification: assessing contributions and giving “stamps of approval.”

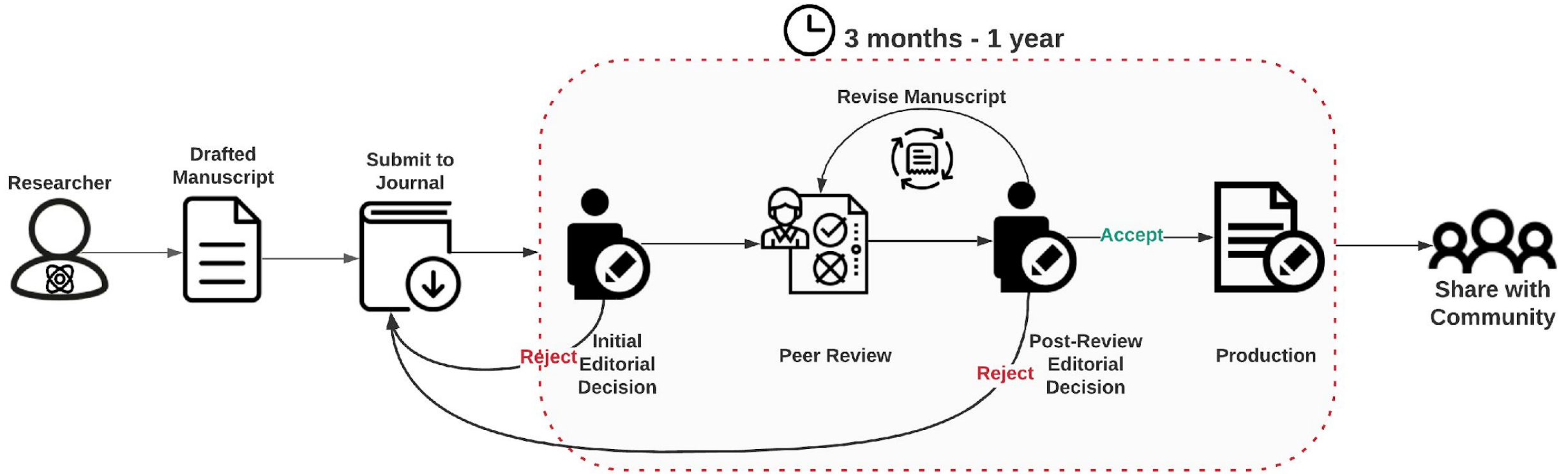


Research evaluation: define metrics to evaluate research “impact” of scientific works

How does the traditional
journal-based publication process
currently work?

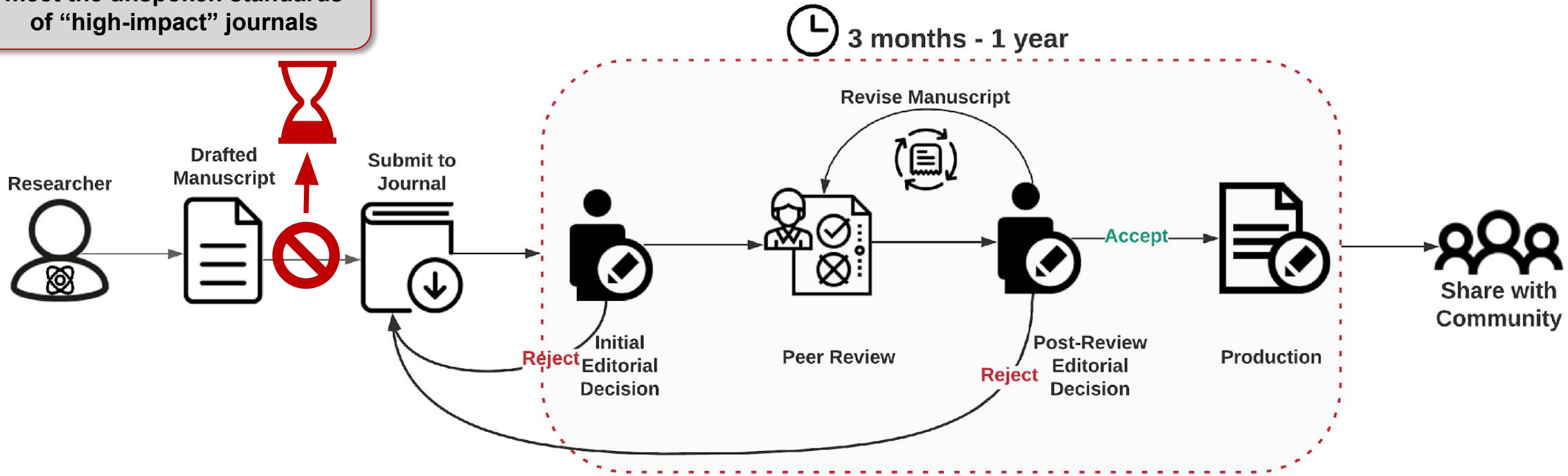


The traditional journal-based publication process

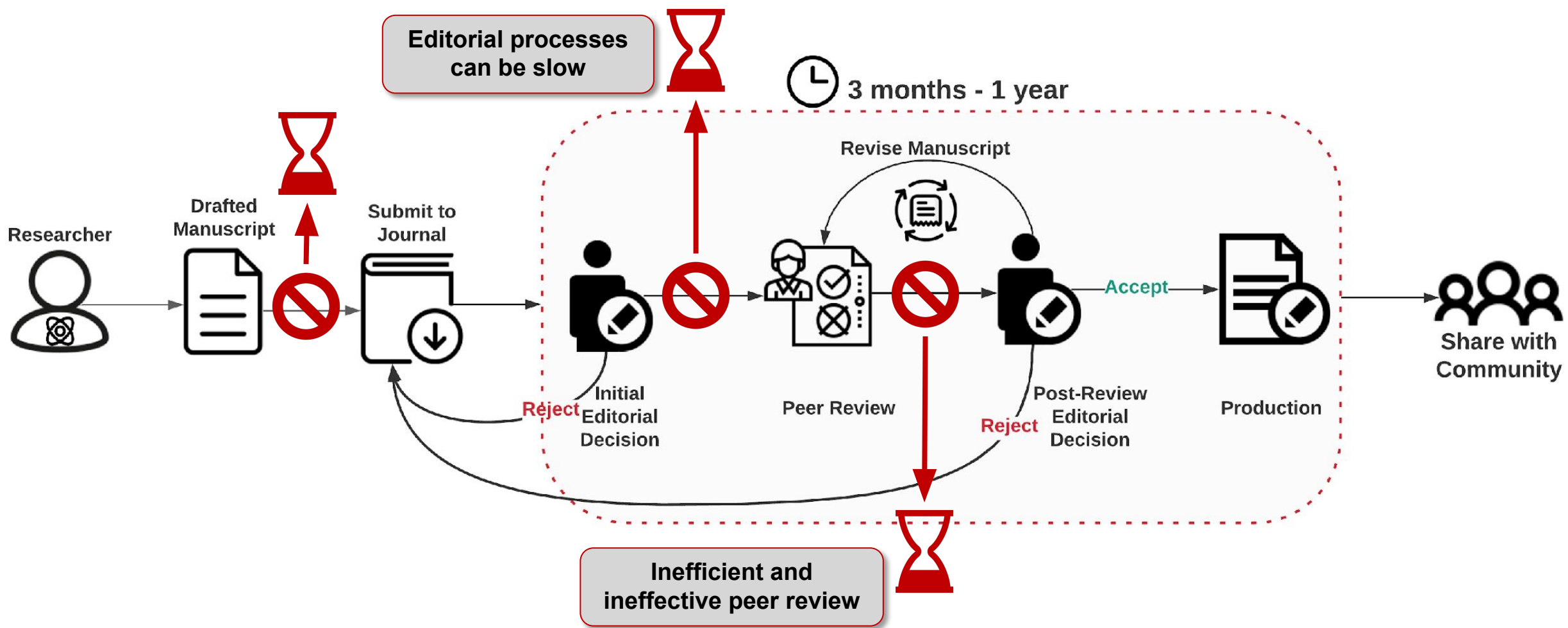


Challenges in the traditional journal-based publication process

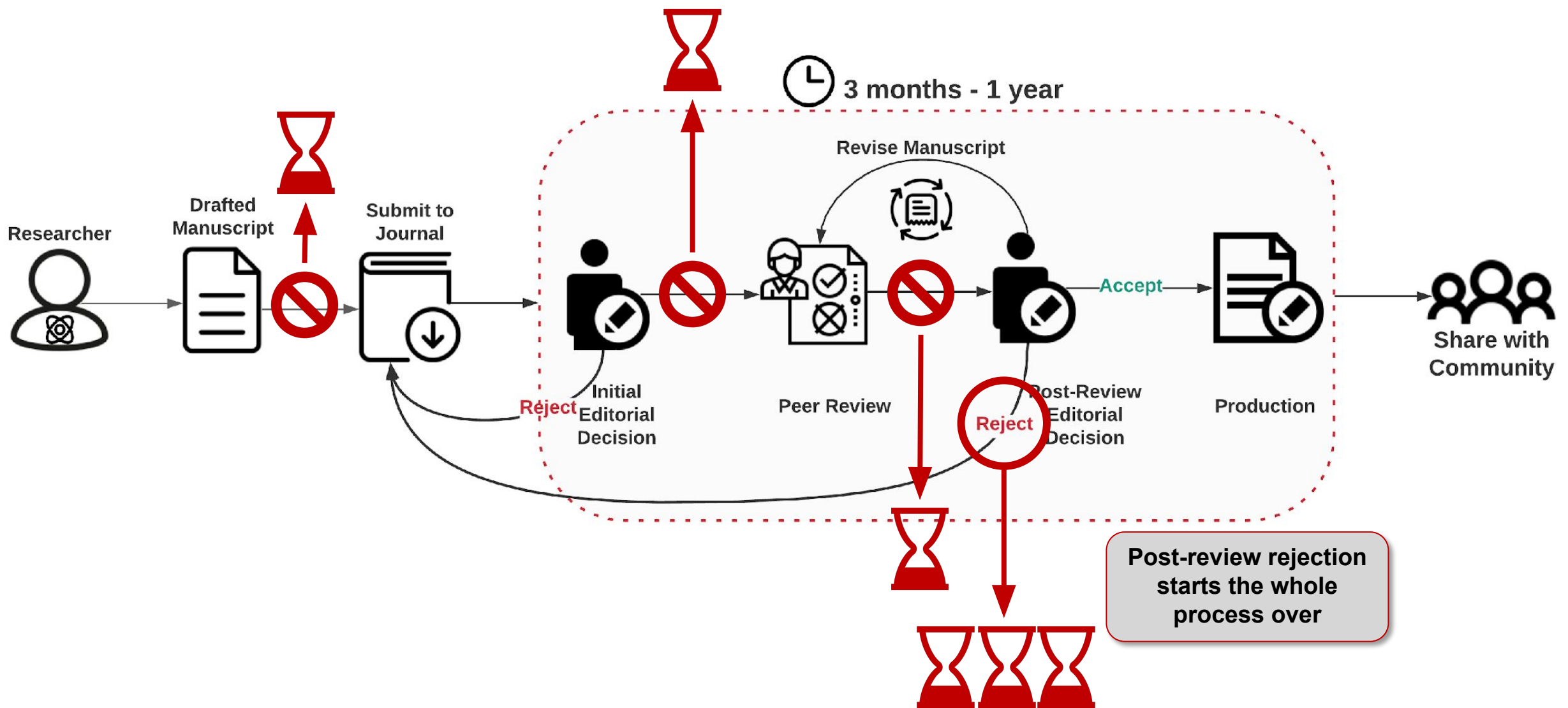
Author's wait for publication to meet the unspoken standards of "high-impact" journals



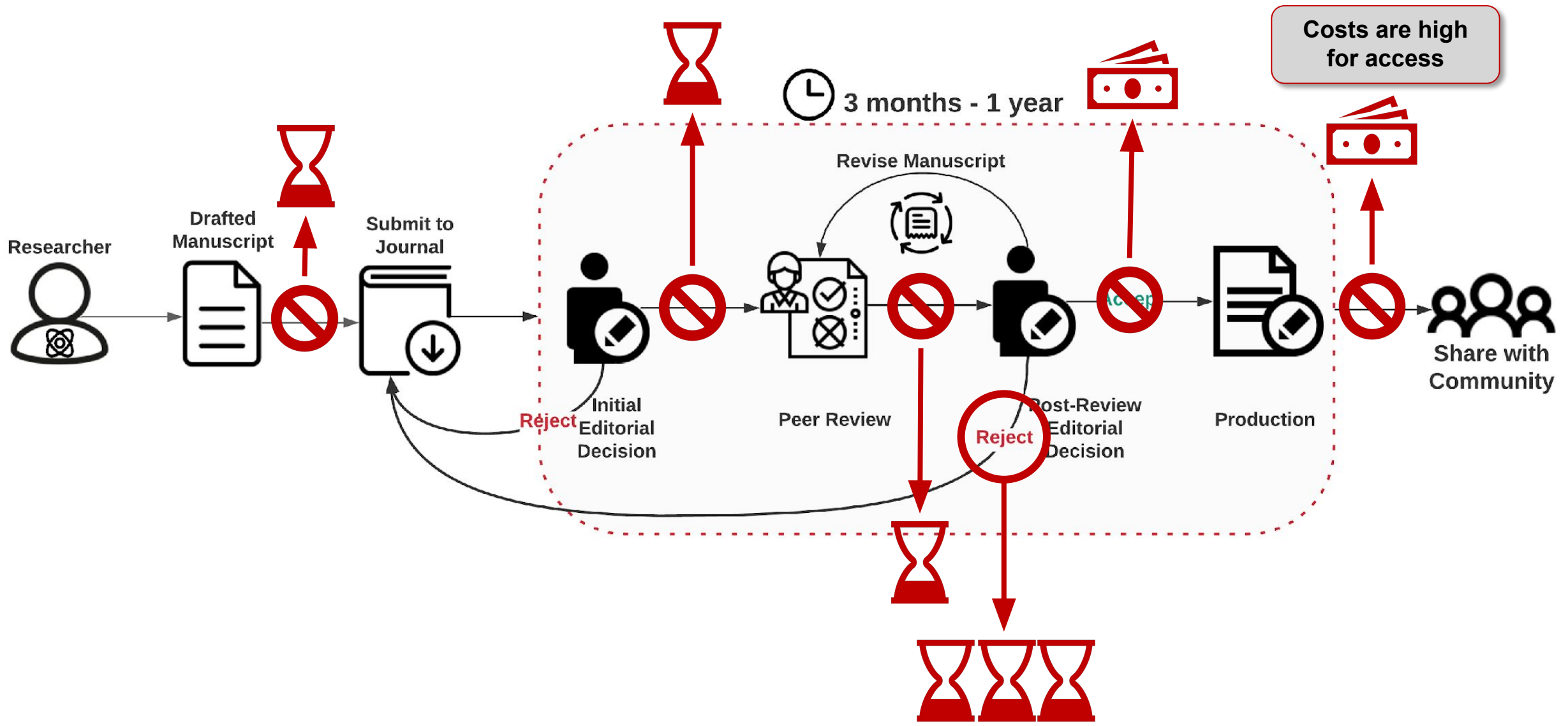
Challenges in the traditional journal-based publication process



Challenges in the traditional journal-based publication process



Challenges in the traditional journal-based publication process



Unintended consequences...

- If the time it takes to go through the publication process is unjustifiably slow...
- If peer review is ineffective...
- If publication and access is only privileged to those that can afford it...
- If scientific careers and funding are dependent on an ineffective publication process...

How does this impact scientific progress?

Challenges in publishing with CRISPR

Mojica et al., 2005

~1.5 years manuscript-ready > publication

- **Rejected by:**
 - Nature – “key idea was already known”
 - PNAS – “lacked sufficient novelty and importance”
 - Molecular Microbiology
 - Nucleic Acid Research
- **Published in Journal of Molecular Evolution (1 year in review/revision)**

Pourcel et al., 2005

- **Rejected by:**
 - PNAS
 - Journal of Bacteriology
 - Nucleic Acid Research
 - Genome Research
- **Published in Microbiology**



Siksnys et al., 2012

~5 months manuscript-ready > publication

- **Rejected by:**
 - Cell
- **Published in PNAS**

Publication

CRISPR

8 2011 Reconstituting CRISPR

2020

Jinek et al., 2012

~20 days manuscript-ready > publication

- **Published in PNAS**

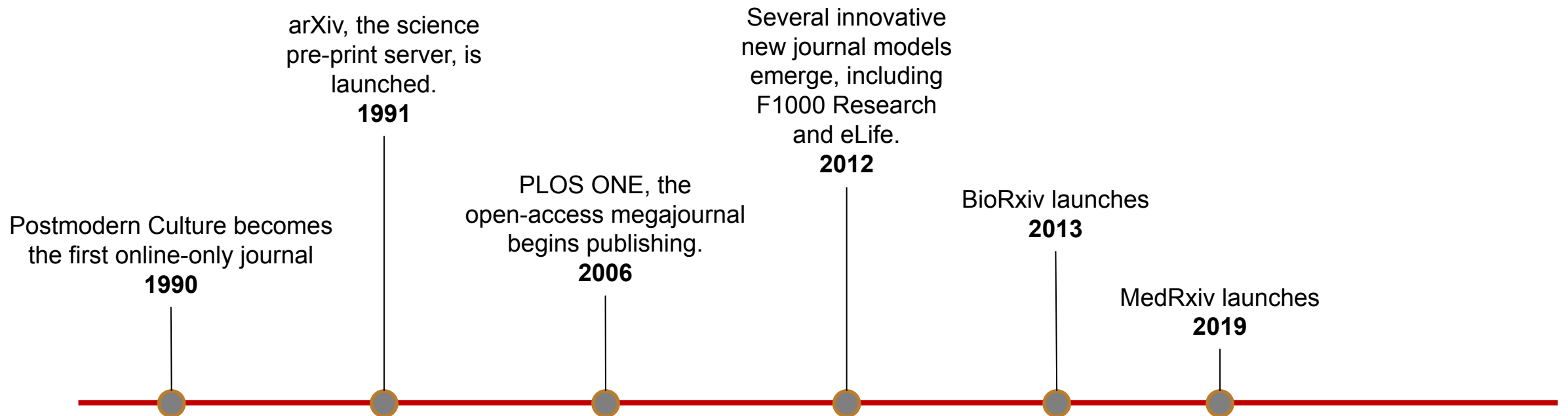
3 2006 Experimental evidence that CRISPR confers adaptive immunity

6 2010 Cas9 is guided by crRNA to create double-strand breaks

7 2010 Discovery of tracrRNA

Emerging solutions and innovations: New models for scientific communication

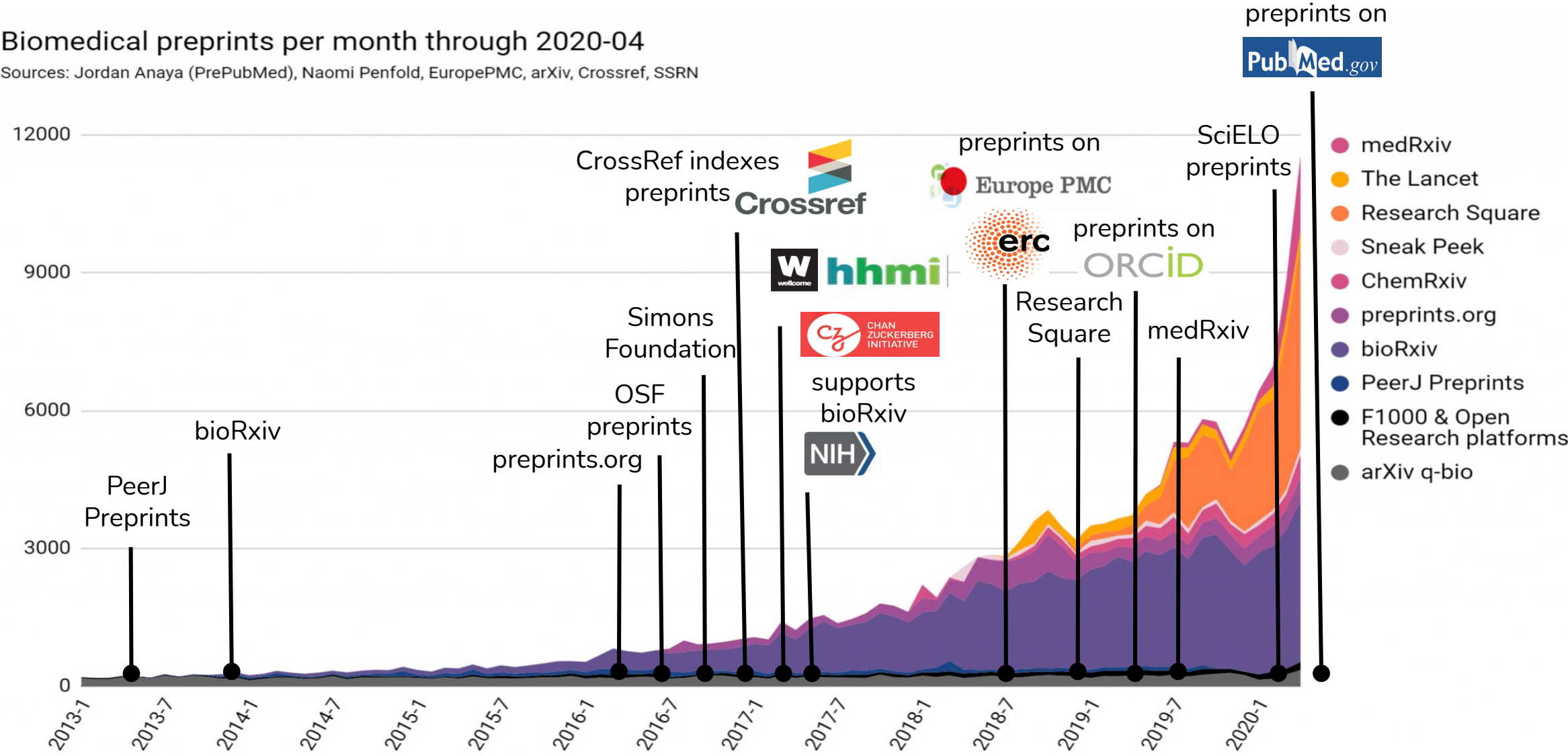
- “Digital age” facilitates innovation in open scientific communication
- **21st Century** - Journals start experimenting with new forms of peer review, new business models, and new funding sources
- Preprint servers offer new hope for open access



Adoption of preprinting in the life sciences

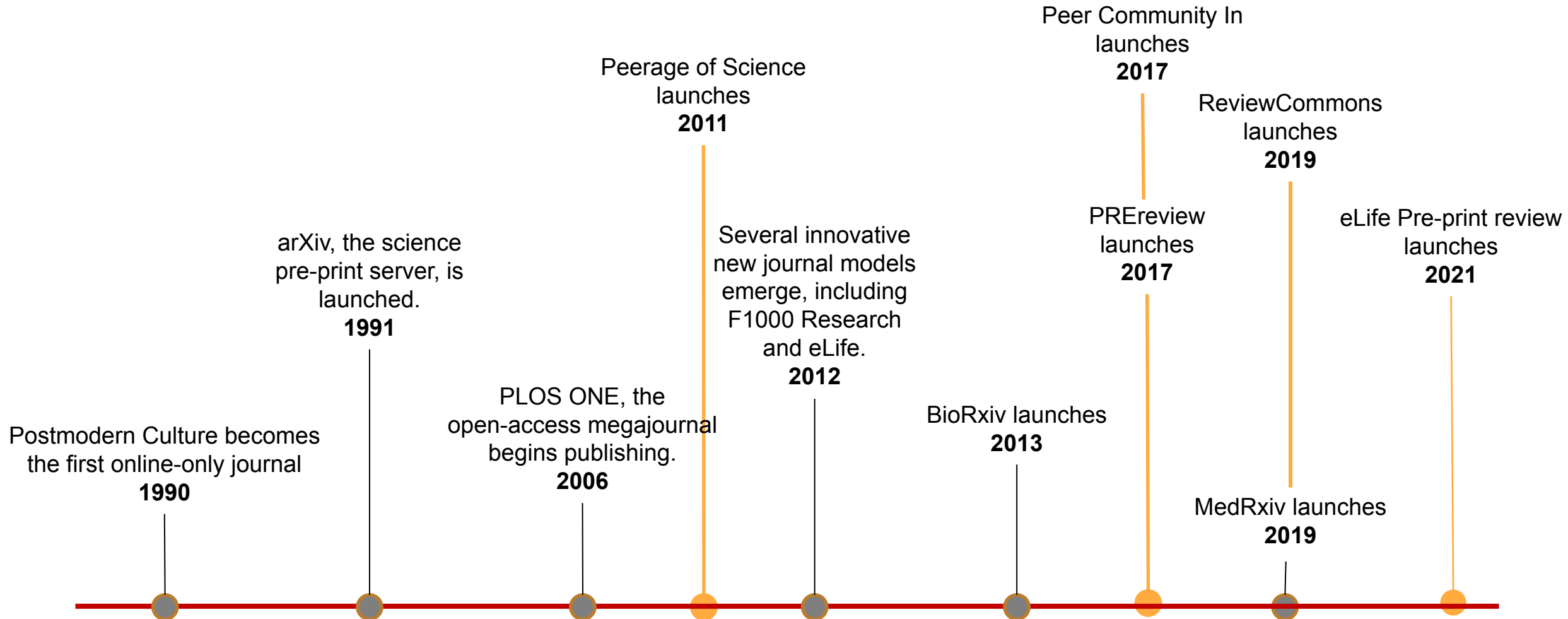
Biomedical preprints per month through 2020-04

Sources: Jordan Anaya (PrePubMed), Naomi Penfold, EuropePMC, arXiv, Crossref, SSRN



Emerging solutions and innovations: New models for scientific communication

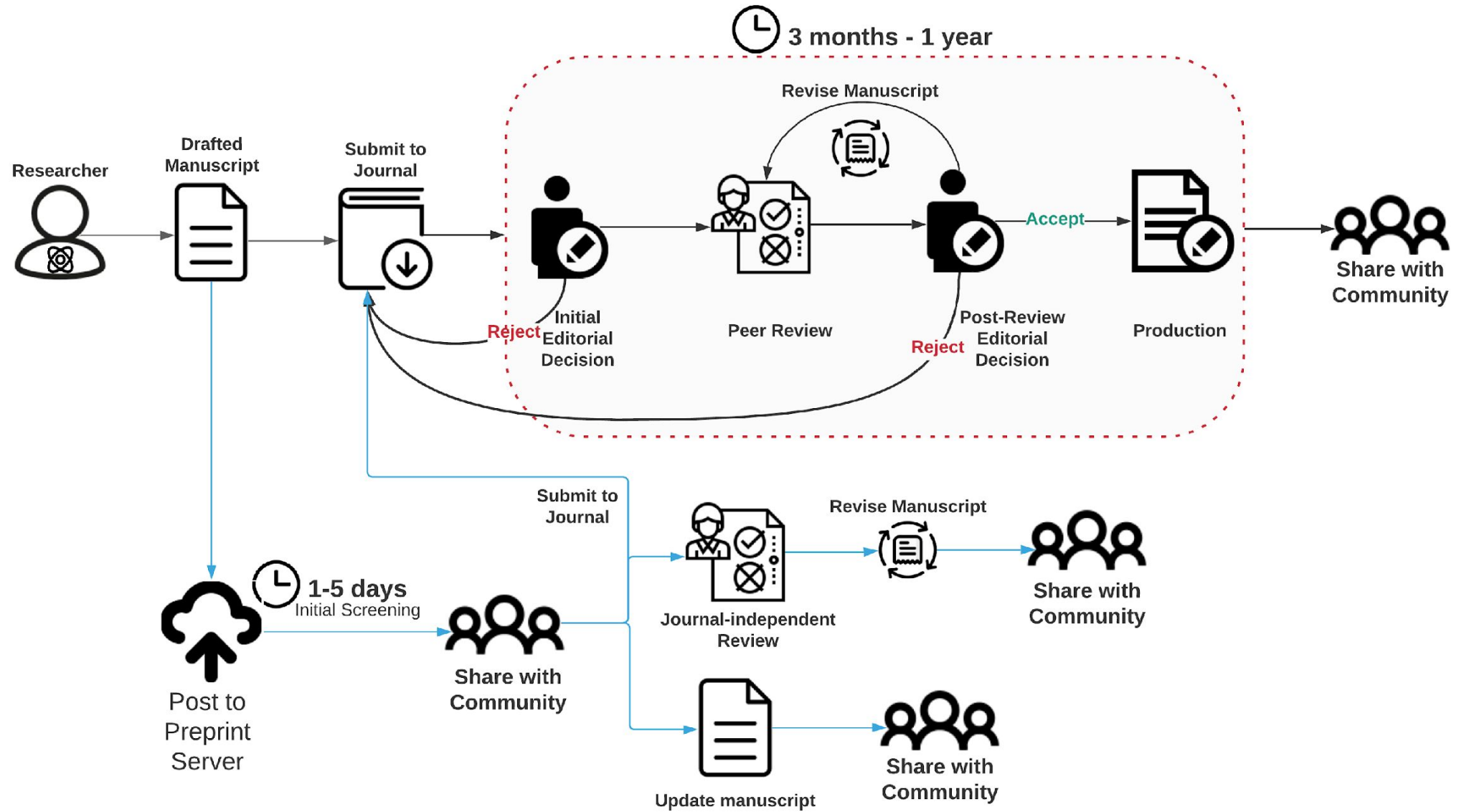
- **21st Century** – Innovations in peer review emerge



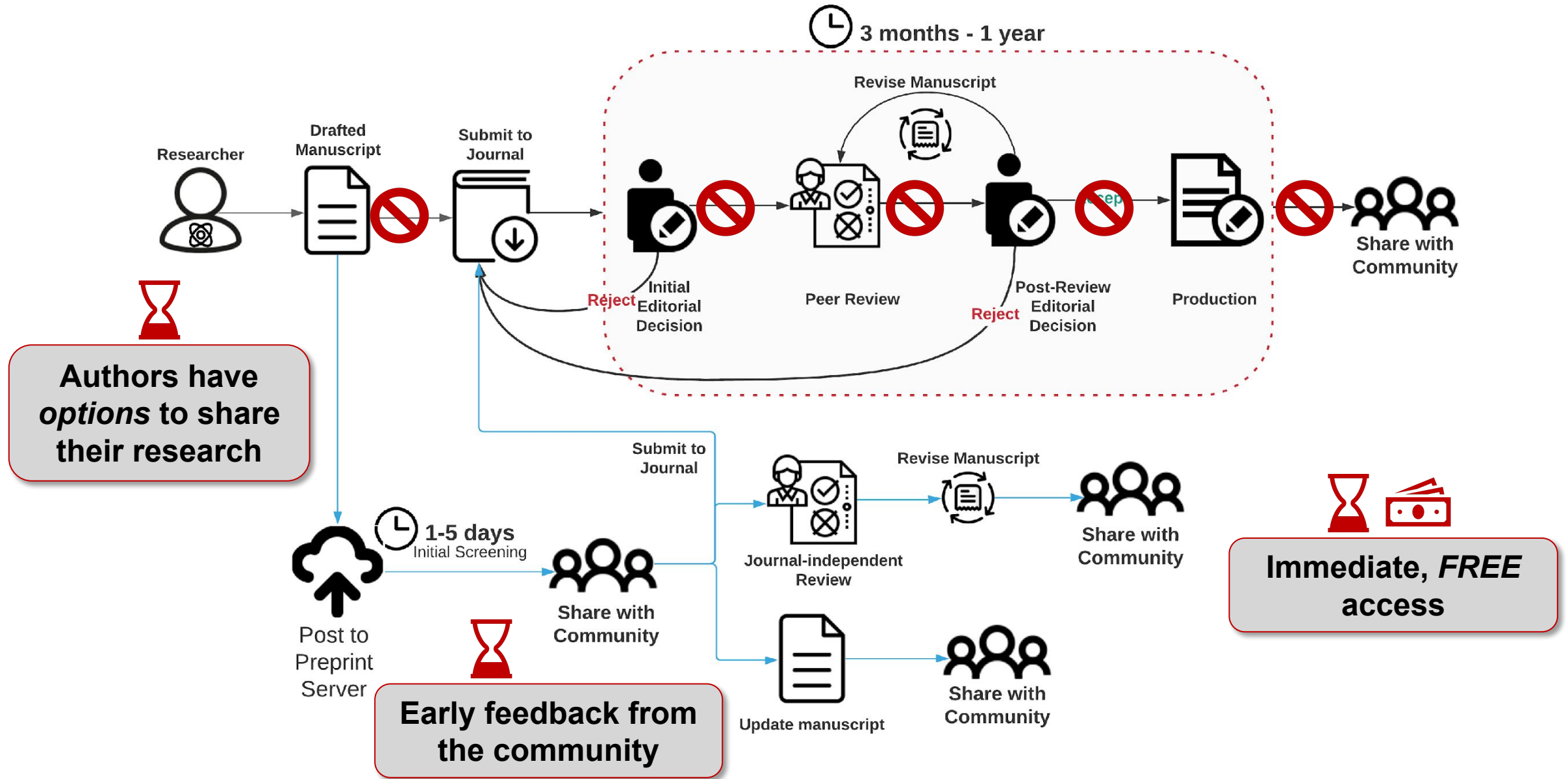
Transitioning: How do new models integrate with the traditional publication process?



Preprinting + the traditional publication process



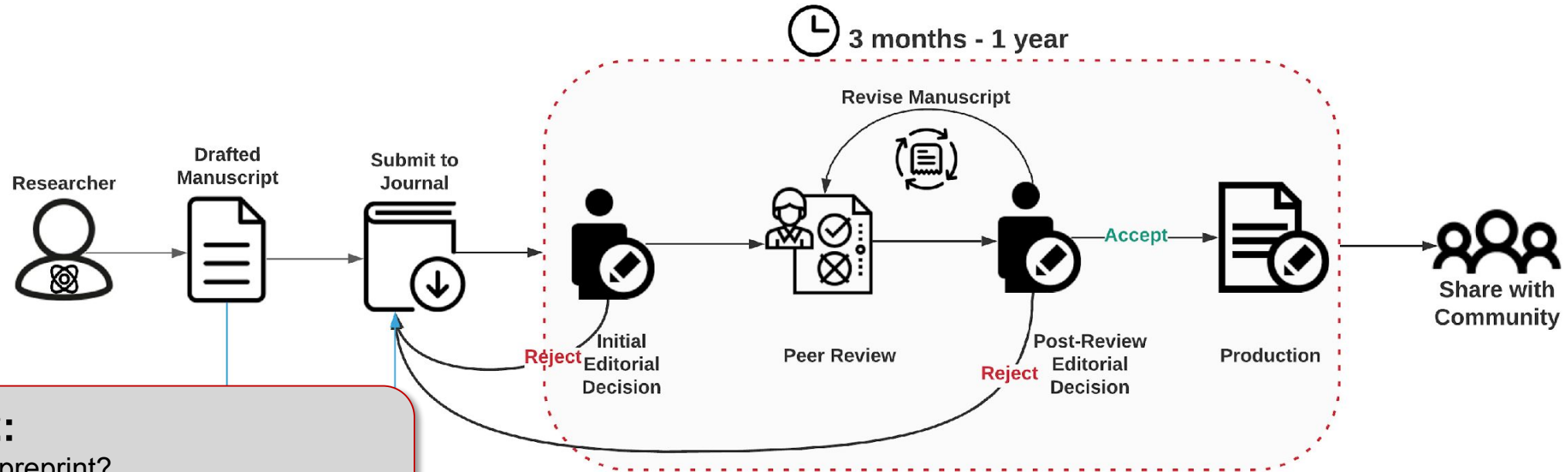
Preprinting solves some challenges in the traditional publication process



Intro to the lessons: Preprinting and publishing in the life and biomedical sciences

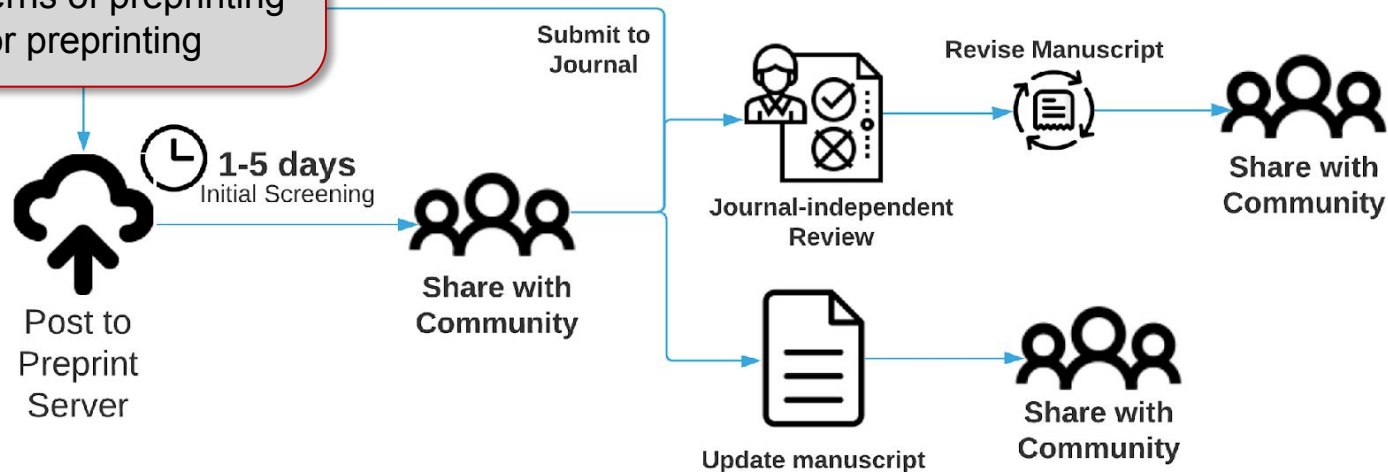


Preprinting and publishing in the life and biomedical sciences



Lesson 2:

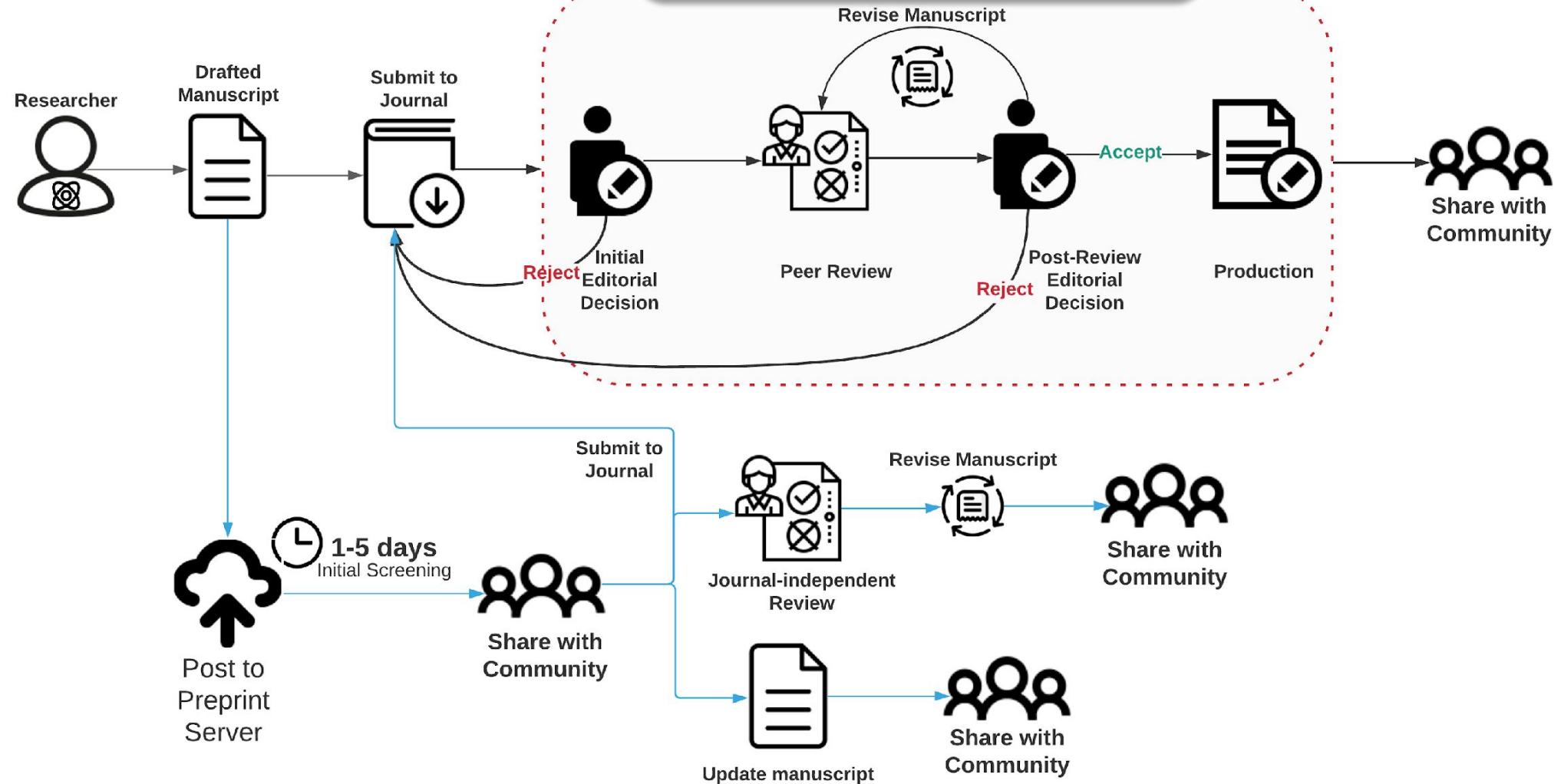
- What is a preprint?
- Top benefits and concerns of preprinting
- A step-by-step guide for preprinting



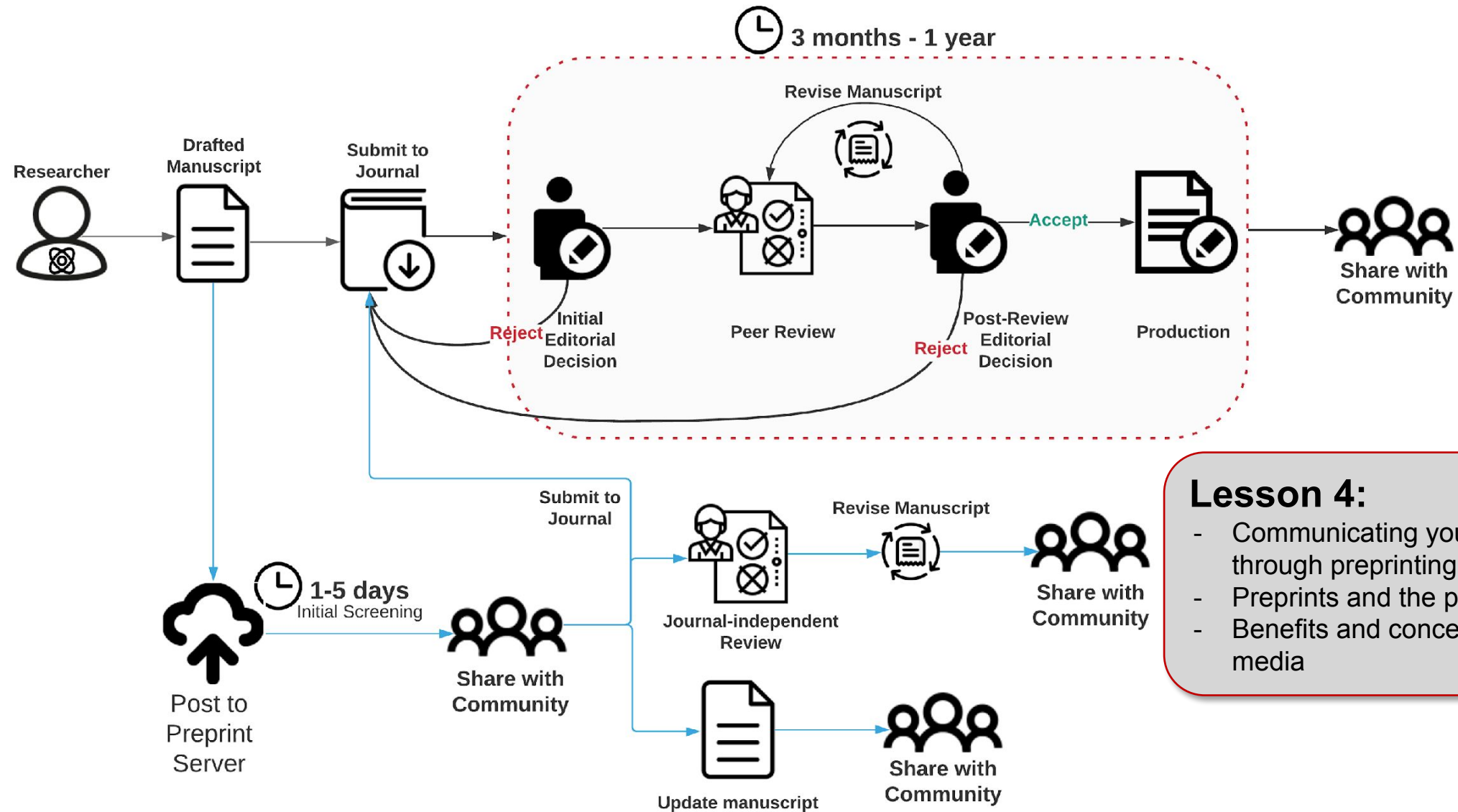
Preprinting and publishing in the life and biomedical sciences

Lesson 3:

- How do editors make decisions?
- How does peer review work?
- How to peer review: best practices



Preprinting and publishing in the life and biomedical sciences



Lesson 4:

- Communicating your research through preprinting
- Preprints and the public
- Benefits and concerns of social media

Discussion #1

What has your experience been
(good and bad) with the
traditional, journal-based process?

Discussion #2

How might you design a communication process to advance scientific progress?

References

- <https://doi.org/10.1016/j.cell.2015.12.041>
- <https://blogs.scientificamerican.com/information-culture/the-birth-of-modern-peer-review/>
- <https://www.aje.com/arc/scholarly-publishing-brief-history/>
- <https://zenodo.org/record/546100#.YAgV3ZNKjMJ>
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- <https://doi.org/10.3389/fncom.2012.00019>