

**Lesson Manuscript Planning Worksheet**

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**From Problem Introduction to Lesson Description**

The following items help to record the pieces that will become part of your published work.

1. Identify which course(s) or strand of high school mathematics is/are most aligned with your Lesson*.* (*Examples*: Algebra I, Geometry, Calculus, Statistics)

Please list the course(s) here, marking the course(s) in which you taught the lesson with an asterisk:

1. Please write Learning Goals for your Lesson. If your state or school has learning goals that you are required to include, please include them. [Common Core](http://www.corestandards.org/Math/) standards might be appropriate. Goals might address either mathematical content or mathematical practices.

Note: Learning goals are typically rather abstract and use words like “know,” “understand,” and “value.” The next item asks you for Learning Objectives or Learning Outcomes.

1. Please write Learning Objectives or Learning Outcomes for your Lesson.

Note: Learning objectives typically define what students who have successfully accomplished the learning goal can actually do. Learning objectives describe student behaviors that are observable, measurable, and testable. Learning objectives should document students’ progress or test students’ mastery of the material and use words like “define,” “predict,” “design,” and “evaluate.”

1. Please write a *brief* (2-4 sentence) description of the lesson activity.
2. How does your lesson address mathematical modeling? What aspects of the modeling process (e.g., deciding variables, making assumptions, validating a model, reporting to a client) are highlighted in your project?
3. Use the information from prompts 1-5 to construct a short paragraph that will serve as an abstract for your publication. This paragraph should help the reader determine at a glance whether this activity (or some adaptation of it) would be suitable for their educational setting.

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**Capturing the Lesson Flow**

1. **Lesson Plan**

*MMHub* articles share, among other things, ideas about mathematical modeling problems and lessons centered on MM problems.Here in Part I of this form is where you write a description of the Lesson that is complete and sufficiently detailed so that a teacher with less skill or expertise than yours would be able to teach the lesson. This section should capture how you would explain to a colleague how to teach your class for you. Focus on how you actually taught the Lesson.

1. It is a good idea to reference your Supporting Materials as you are writing the Lesson Plan section. Please list your Supporting Materials here so you can be thinking about them as you are writing this section. Think about what you would need to include in order for someone else to teach the Lesson as you have. Some examples may include presentation slides, worksheets, physical props or images related to the context, and assessment questions. It is helpful if the names listed correspond to the titles of the documents. It might also be helpful to include file names in this list.
2. List any physical or technological requirements for this lesson. Does the activity require students to go outside? Will the physical space need to be configured in a particular way? Will students need devices with internet access? Will students be utilizing a particular type of software? Will a particular type of instrumentation be needed for gathering data? These are the sorts of questions that should be addressed here.

1. Write your lesson plan below. Make sure your description is complete and sufficiently detailed. Think of what level of detail you would need to tell a busy colleague who is teaching this Lesson for the first time. Statements such as, “We then gave a mini lecture about DNA,” “Students chose an original research paper,” and “Students worked in groups” are too vague to be replicable. Examples of more helpful statements are “We then give a presentation that included how to use the DNA model software (see DNA model software slides in the Supporting Materials)” and “Students share written statements of the local community problem as they understand the problem after attending the township supervisors’ meeting.”
2. Each Lesson article includes a recommended Teaching Timeline Table. Below is an example; feel free to replace the information in the example with the relevant details from your Lesson. You can continue to add rows as you work on the Lesson Description. We all know that math modeling lessons can vary greatly across different groups of students; the idea here is to give a general timeline based on your experience in teaching the lesson.

|  |
| --- |
| Teaching Timeline Table |
| Activity | Description | Estimated Time | Notes |
| Preparation for Class |
| Prepare models to hand out in class | 1. Make one copy of Handout 1 for each group of 4-6 students2. Cut along dotted lines to create strips3. Place one set of strips into an envelope that is large enough to hold the strips without folding4. Add a roll of removable scotch tape to the envelope | About 15 minutes to prepare 10 sets | · Handout 1 is provided in Supporting File S3.· Using a large paper cutter to cut multiple sheets at once saves time, but the strips are narrow and can easily slip.· If you have time, students can cut the strips themselves in class; add a small scissors to the envelope.· Make sure to tell students to return the tape (and scissors if used) in the envelope at the end of class.· Tyvek envelopes are nearly indestructible and can be reused dozens of times. |
| Check PCR video | 1. Check <https://whateveritis.com/PCR> for the latest video.2. Load on LMS | About 5 minutes to locate and check |  |
| Class Session 1 |
| Mini-lecture on PCR | Interactive lecture on what PCR is, with 2 checks for understanding questions and a video | ~10 minutes | Lecture slides with notes are in Supporting File S4. |
| Brainstorming | Small groups prepare questions to ask local auto supply store manager | ~10 minutes | Capture questions in Google Slides |

1. Describe how student work/learning is assessed or evaluated in connection with this lesson. (If you have sample instruments or rubrics, these would be very useful as supporting materials. See item #7 above.)

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**Preparing for the Lesson**

**II. Introduction**

The introduction should provide the origin and rationale for the design of the Lesson and provide enough background information to allow the reader to evaluate the Lesson without referring to extensive outside material. The reader should be able to use the Introduction to decide if this material has a context and lesson that they might want to use with their students.

1. What contextual information is needed to teach your Lesson? Where can you find it?

Some open source options:

* Article accurately describing the event, situation, or challenge
* Online or print article describing factual information about the context
* Images (with permission as needed) of places and things involved in the context
* Video of people or practices related to the context
1. What additional primary literature should be included? Are there important popular press articles about your Lesson? Included here might be literature that crosses into other disciplines if your lesson addresses an interdisciplinary problem or learning expectations in areas other than math.
2. Are there other lessons publicly available that are similar to yours? Describe similar lessons below. These might be lessons that others might think are similar to your lesson before they look carefully at the lessons.

Some examples of places to search for similar lessons are:

* [MMHub](https://qubeshub.org/community/groups/mmhub/resources_page) (an online community)
* [MathWorks Math Modeling Challenge](https://m3challenge.siam.org/) (MathWorks-SIAM)
* [COMAP contest problems](https://www.comap.com/undergraduate/contests/mcm/previous-contests.php)
* [*Mathematics Teacher: Learning and Teacher PK-12*](https://pubs.nctm.org/view/journals/mtlt/mtlt-overview.xml)(NCTM)
* [*Mathematics Teacher*](https://www.nctm.org/publications/mathematics-teacher/) (NCTM)
* [Google](https://www.google.com/) and [Google Scholar](https://scholar.google.com/) (for searches)
* [3-Act Tasks](https://tapintoteenminds.com/3act-math/) (among other sites with 3-act tasks)
* Textbooks and curriculum materials
1. In what ways is your Lesson different from similar lessons? Why are the differences important?
2. Please use your answers from questions 12-15 as a guide to organize your introduction section paragraphs. Write your introduction paragraphs here:
3. Intended Audience. Describe the student population(s) that were taught the Lesson, including their level and course information. For example: first-year algebra students at the beginning of the course, students in a blended biology and algebra course, or students working on a probability lesson at the end of either a geometry course or a second-year algebra course.
4. What is the overall Required Learning Time? One 50-minute class period? A three-hour laboratory? You do not need to worry about the detailed timeline here, just list the overall time. It would also help to include any significant amount(s) of time that students would spend outside class time.
5. Prerequisite Student Knowledge. What assumptions were made about what students need to know in order to be ready for your Lesson? The answer should not be “nothing,” even if the lesson was designed to introduce students to new mathematical ideas and tools or if the lesson helps students to understand previously introduced ideas and tools better. What topics must be familiar to students before your Lesson? Are there helpful readings or videos? Can you find open source resources? Prerequisite knowledge may include both skills and background content knowledge. Example are (a) knowing the effects of changes in parameters on graphs of quadratic functions with [graphical illustrations](https://www.geogebra.org/m/RVF4GYcX), (b) an understanding of r2 and R2 with a reference to a [*Mathematics Teacher* article by Gloria Barrett](https://www.jstor.org/stable/27971342?seq=1#metadata_info_tab_contents), and (c) the need to use matrix operations in Matlab with a link to [this help sheet](https://www.mathworks.com/help/matlab/learn_matlab/matrices-and-arrays.html).
6. Prerequisite Teacher Knowledge. What resources do you use to prepare to teach this Lesson? Think of a busy colleague who is teaching a class for the first time and wants to teach this Lesson in a few days, what resources should they look at? Are there any open source resources? [Supplies and materials needed for the lesson are implicitly included in the Teaching Timeline Table in question 7.]
7. Engaged Learning: what instructional strategies or approaches do you use during this Lesson to engage students? Please list them here. Some examples are think-pair-share, jigsaw, gallery walk, and pre-recorded reports.

1. Inclusive Teaching: How is the Lesson designed to include all participants and acknowledge the value of diversity in science? List and/or explain how the Lesson is inclusive and how it leverages diversity in the classroom and beyond.

Some possible resources:

* [NCTM’s Supporting Each and Every Student: Equity and Diversity](https://www.nctm.org/conferences-and-professional-development/Tips-for-Teachers/Tips-on-Supporting-All-Students_-Equity-and-Diversity/)
* NCTM’s [Equitable Classroom Practices Observation Checklist](https://drive.google.com/drive/u/0/folders/1QhsWUcn703MaAQK-hOd6PWLOpZvA4Tvx)

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**Including the Teaching Experience**

**III. Teaching Discussion**

1. What information do you have about the effectiveness of the Lesson? Observations from teaching? Pre/post test results? Reactions from students?
2. Are there any extensions/modifications to the Lesson that you would suggest for different classroom characteristics, such as for a different math course or for a larger or smaller class? Thoughts about what students learned in this Lesson that could be expanded upon in future lessons, in math or in other subjects? Are there other opportunities to emphasize or build on related material?
3. Are there any additional Tables or Figures you would like to include in your manuscript? Include ideas for these here.

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**V. Wrap-up**

1. Answer the following questions:
* What teaching challenge do you address in your Lesson?
* What is the key background information specific to the Lesson?
* Briefly describe the Lesson.
* What conclusions have you drawn?

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**Congratulations!**

**Congratulations - you’re well on your way to submitting your Lesson manuscript to *the MMHub*!**

Once you have completed this worksheet the next step is to download the Lesson Article template. This article template is very similar to the worksheet template, the worksheet template just provided a bit more scaffolding.

When you have finished your Lesson manuscript, please look at the Review Rubric for Lesson Articles.The reviewers will be using this rubric to give you feedback on your manuscript and it provides a great way to double check that you have included all the relevant information in your article.

**Supporting Materials: Helpful hints!**

Please note authors often incorrectly reference Supporting Materials. The following guidelines might help.

**Title for Supporting Materials**

1. Begin with the letter “S” and the number representing the order in which the material is referenced in the article (S1, S2, S3…).
2. Follow with a short version of your Lesson title (so that readers can easily tell the article associated with the supporting material after it has been downloaded). For example, shorten “Why Meiosis Matters: The case of the fatherless snake,” to “Why Meiosis Matters.”
3. Include a description of the resource

Examples:

S1. Why Meiosis Matters - Lecture Presentation Slides

S2. Bad Cell Reception - Assignment 1 Worksheet

1. When naming the supporting file that will be uploaded to the website, please save the file as the same title as above.
2. When referencing supporting files within the text, please use the same title as above.
3. When possible, please use editable file formats: Word, PowerPoint, Excel, and so on. Avoid PDFs if possible; PDFs are difficult to be made accessible as well as hard for reviewers, editors, and readers to edit.
4. In supporting files that contain lecture slides, it is helpful to include notes about materials and transitions to help the reader teach the lesson.
5. IMPORTANT: Ensure that no copyrighted materials are included in your Lesson or in your Supporting Materials.

To help the reviewers, throughout the manuscript note which images you drew, which ones are open source (with citation), and which ones are reprinted with permission (with citation and indication of how permission was obtained). If none of these categories apply, you can put in the URL and a brief description of the image. For example, “Put image of DNA here, example can be found at: <<add URL>>.”]

Please make sure you reference your Supporting Files throughout the manuscript. Sometimes authors provide paragraphs of information and write see Supporting File S1 at the very end. When authors do this, readers need to work hard to match up the paragraph information with the correct part of the Supporting File. The more specifics you can provide the reader, generally the better. Feel free to reference the Supporting Files often and reference specific pages, for example: (Supporting File S1: Untangling the central dogma - Lecture slides, slides 2-5).

One question we frequently get is, “do I need to provide an answer key to my Supporting Materials?” The Supporting Materials are behind a login and the keys are very useful to readers. If you feel uncomfortable with this approach, then you can submit the keys for peer review only and let readers know how to contact you for the key (typically an email).

Another common question is, “what if I copied images from another source, can I include them?” We need to be very careful about not violating copyright. Here are some options:

* Redraw the image and say it is based on the image from an original source with a citation.
* Search for a similar open source image and cite the URL where you got the image.
* See if the image can be reprinted with permission and try to get that permission. You can write to organizations and ask them: 1) if you could use the image and 2) how they would like to be given attribution. Most organizations are happy to have the educational publicity.
* If none of these categories apply, you can put in the URL and a brief description of the image. For example, “Put an image of DNA here, an example can be found at: *add URL.”*