Maker Literacies Competencies

The Maker Literacies competencies articulated in this document are intended to function as a tool for mapping transferable skills to subject-based learning outcomes. This type of curriculum mapping enables instructors to make visible the learning acquired through project-based assignments and courses that situate students as creators.

This revised iteration of the Maker Literacies competencies reduces redundancy and clarifies scope as compared to previous iterations of the competencies:

> 1 - Identify and articulate a need to create.
>
> 2 - Analyze and explore ideas, questions, problems, and potential solutions.
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> 3 - Create effectively and safely.
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> 4 - Assess the availability and appropriateness of tools and materials.
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> 5 - Prototype using iterative design principles.
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> 6 - Develop a project management plan.
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> 7 - Engage in effective teamwork.
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> 8 - Employ effective knowledge management practices.
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> 9 - Apply knowledge gained into other situations.
>
> 10 - Understand ethical and intellectual property issues surrounding making.

Framework for Using the Maker Literacies Competencies

Additionally, we have developed a framework to assist instructors in selecting competencies that address the categories of the cognitive domain that best align with their learning goals. Note that this framework utilizes some competencies multiple times and not necessarily in order.

Selecting and mapping competencies to courses and assignments is an individualized process and every instructor is encouraged to apply the unique selection of these competencies that makes their use meaningful to them and their students. The following process may be helpful:

- Begin by focusing on the category(s) of competencies that best align with course or assignment goals and Student Learning Objectives.
- Identify competencies or sub-competencies that directly relate to cognitive activities students will need to engage with in order to successfully complete the assignment(s).
- Narrow this selection by determining what will actually be addressed through learning and instructional experiences in the course.
- Consider which of these competencies and/or sub-competencies will result in **observable** and **measurable** artifacts of learning.

Inquiry

These are the initial contemplative and research activities makers must address before beginning any project:

1. Identify and articulate a need to create.

1a. Recognize unmet needs and inaccessible situations that might be solved by making

1b. Tinker and hack to learn how things are made and how they work

1c. Isolate a specific, manageable issue to focus on

1d. Evaluate the costs and benefits of making and/or upcycling as an alternative to buying or hiring

2. Analyze and explore ideas, questions, problems, and potential solutions.

2a. Define an idea, question, and/or problem

2b. Break an idea, question, and/or problem into its constituent parts for closer analysis

2c. Investigate how others have approached similar situations

2d. Question assumptions

2e. Brainstorm a variety of solutions and pursue the most promising

4. Assess the availability and appropriateness of tools and materials.

4a. Research various equipment and materials to determine limitations and suitability for specific applications

4b. Consider environmental sustainability/impact when making, including upcycling and recycling materials

4c. Determine the most ideal tools, materials, and method(s) of creation (physical, digital, and rhetorical) for the project

4d. Secure access to the necessary tools, materials, and space/facilities

4e. Investigate alternatives when a desired tool or material is not available or resource intensive

4f. Fabricate necessary tools, reimagine material choices, develop alternate workflows, and/or revise project scope when initial ideas are not feasible

10. Understand ethical and intellectual property issues surrounding making.

10a. Scrutinize the ethical implications of making

10b. Demonstrate an understanding of intellectual property rights and protections

10c. Weigh the costs & benefits of seeking intellectual property protections vs. making project outputs open and freely available to others

10d. Examine the potential viability of both proprietary and open source systems to adopt/adapt

10e. Respect the intellectual property rights of others

Foundational Practice

These are the fundamental practices central to all making efforts:

3. Create effectively and safely.

     3a. Seek training, information, and necessary certifications when planning to work with dangerous equipment and materials

     3b. Wear personal protective gear when appropriate

     3c. Reinforce safety precautions with others

     3d. Accustom self with location-specific emergency procedures, egress and disaster plans

     3e. Transfer safety principles covered in training to real-world contexts

4. Assess the availability and appropriateness of tools and materials.

     4a. Research various equipment and materials to determine limitations and suitability for specific applications

     4b. Consider environmental sustainability/impact when making, including upcycling and recycling materials

     4c. Determine the most ideal tools, materials, and method(s) of creation (physical, digital, and rhetorical) for the project

     4d. Secure access to the necessary tools, materials, and space/facilities

     4e. Investigate alternatives when a desired tool or material is not available or is too resource intensive

     4f. Fabricate necessary tools, reimagine material choices, develop alternate workflows, and/or revise project scope when tools or materials are not feasible

5. Prototype using iterative design principles.

     5a. Specify measurable criteria for a successful prototype vs desired finished product

     5b. Divide design into individual components to facilitate testing

     5c. Take intelligent risks, use trial and error, and learn from failures

     5d. Test measurable criteria to determine whether creation meets needs

     5e. Gather prototype feedback and input from stakeholders and mentors

     5f. Revise and modify prototype design over multiple iterations

Managed Practice

These are the practices typically employed when making takes place in more structured contexts (and certainly can be part of a personal maker experience):

6. Develop a project management plan.

6a. Specify actionable and measurable project goals and requirements

6b. Utilize time management and project management tools

6c. Outline project milestones, including sequential action items and anticipating time for multiple prototype iterations

6d. Work effectively within project constraints, be they financial, material, spatial, and/or temporal

7. Engage in effective teamwork.

7a. Gauge the costs & benefits of "Doing-it-Yourself" (DIY) or "Doing-it-Together" (DIT)

7b. Recognize opportunities to collaborate with others who provide diverse experiences and perspectives

7c. Recruit team members with diverse skills appropriate for specific project requirements

7d. Join a team where one's skills are sought and valued

7e. Listen and communicate attentively to learn from and with others

7f. Follow through on commitments and contribute to culture of accountability

8. Employ effective knowledge management practices.

8a. Restate technical and maker jargon for the layperson

8b. Document steps clearly with sufficient detail for others to follow and replicate workflows

8c. Use version control to manage project outputs and documentation

8d. Preserve project outputs and documentation for long-term access

Transferred Knowledge

These focus on the ability to reapply and/or disseminate what has been learned in maker contexts:

8. Employ effective knowledge management practices.

    8a. Restate technical and maker jargon for the layperson

    8b. Document steps clearly with sufficient detail for others to follow and replicate workflows

    8c. Use version control to manage project outputs and documentation

    8d. Preserve project outputs and documentation for long-term access

9. Apply knowledge gained into other situations.

    9a. Teach skills and share insights with other makers

    9b. Recognize and cultivate transferrable skills

    9c. Transfer knowledge, skills, and methods of inquiry across disciplines and activities

    9d. Familiarize self with skillsets of others

    9e. Connect those seeking to learn something with those who have relevant experience

10. Understand ethical and intellectual property issues surrounding making.

    10a. scrutinize the ethical implications of making

    10b. demonstrate an understanding of intellectual property rights and protections

    10c. weigh the costs & benefits of seeking intellectual property protections v. making project outputs open and freely available to others

    10d. examine the potential viability of both proprietary and open source systems to adopt/adapt

    10e. respect the intellectual property rights of other makers

Maker Literacies Competency #1: Identify and articulate a need to create.

	Expert	Proficient	Developing	Emerging
1a. Recognize unmet needs and inaccessible situations that might be solved by making	Identifies a specific, focused, and manageable need that can be addressed by making; is able to articulate the significance of the problem and impact of the potential solutions.	Identifies a relevant need and accurately evaluates whether potential maker solutions will practically address that need.	Identifies a need but focuses either too narrowly or too broadly; does not consider aspects of the need which are relevant to seeking a solution.	Needs help identifying potential projects; is missing the critical ability to recognize opportunities to employ making to solve problems.
1b. Tinker and hack to learn how things are made and how they work	Analyzes all aspects of designed objects to delineate between form and function; identifies design/manufacturing factors such as critical engineering tolerances, cost-savings, intended purpose, etc. that led those designers to make those decisions.	Comfortable with disassembly and analysis of existing designed objects; solid grasp of how to glean knowledge of object functionality, with a firm understanding of how objects are designed and produced.	Able to reasonably determine the important features of a designed object and how they operate, though is less refined in perceiving details that optimize the functional part, and/or secondary parts that support critical functions or serve aesthetic purposes.	Demonstrates lack of familiarity with analyzing designed objects. May poke and prod tentatively or take apart recklessly; unable to reliably come to meaningful conclusions about the nature of objects without guidance.
1c. Isolate a specific, manageable issue to focus on	Adept at identifying aspects of a broader issue that are appropriate for the specific design context. Demonstrates clear understanding of what is within the scope of the project and adheres to these goals; keeps notes of related ideas that come up which may be taken on in a later design process.	Able to identify aspects of a broader issue that are appropriate for specific design context. Communicates understanding of project scope, though needs some reminding of scope of the design context; may tend to think too narrowly or too broadly.	Ideates relevant ideas to address the broader issue, but struggles to delineate between which ideas would be accomplishable within the specific design context and ideas that are either too broad or too narrow in scope.	Has difficulty identifying elements of a broader issue that would be appropriately addressed through making; is unfamiliar with how to break a broad issue down into smaller, more manageable sub-projects.
1d. Evaluate the costs and benefits of making and/or upcycling as an alternative to buying or hiring	Able to accurately forecast the time and effort required for the iterative design cycle. Conducts thorough market analysis, analyzes all costs and benefits of making vs. commercial solutions contextualized to other commitments and priorities, and makes appropriate choice based off of all relevant factors.	Aware of time and effort required to design, prototype, and resolve issues, as well as the benefits of experiential learning; evaluates how these costs and benefits compare to thoroughly researched commercial solutions.	Defines costs and benefits simplistically as the retail value of a purchased solution vs. the material costs of a made solution, but fails to analyze other factors, such as time, ability, benefit of learning, etc.	Needs assistance identifying purchasable solutions and/or ideating how to approach making a similar fabricated solution; is unfamiliar with how to accurately assess costs/benefits between making/buying/hiring.

Maker Literacies Competency #2: Analyze and explore ideas, questions, problems, and potential solutions.

	Expert	Proficient	Developing	Emerging
2a. Define an idea, question, and/or problem	Demonstrates the ability to construct a clear and insightful articulation of an idea, question, and/or problem with evidence of all relevant contextual factors.	Demonstrates the ability to articulate an idea, question, and/or problem with evidence of most relevant contextual factors, and this articulation is adequately detailed.	Begins to demonstrate the ability to articulate an idea, question, and/or problem with evidence of most relevant contextual factors, but the statement of the idea, question, and/or problem is superficial.	Demonstrates a limited ability in identifying a problem statement or related contextual factors.
2b. Break an idea, question, and/or problem into its constituent parts for closer analysis	Comprehensively defines the scope of the idea, question, and or problem. Identifies a comprehensive selection of key components essential by which to analyze the idea, question, and/or problem.	Defines the scope of the idea, question, and/or problem. Identifies many key components by which to analyze the idea, question, and/or problem, but is not exhaustive.	Definition of the scope of the idea, question, and/or problem is incomplete. Identifies a narrow selection of key components by which to analyze the idea, question, and/or problem.	Has difficulty defining the scope of the idea, question, and/or problem. Has difficulty identifying key components by which to analyze the idea, question, and/or problem.
2c. Investigate how others have approached similar situations	Conducts exhaustive research analysis to evaluate the solutions others may have come up with in similar circumstances; includes comprehensive analysis or synthesis. Viewpoints and previous approaches of others are questioned thoroughly; gives appropriate credit to inspirational ideas, designs, and solutions.	Thoroughly researches and incorporates findings of others' solutions to similar problems into the design process, questions their approach and viewpoint, and offers coherent analysis or synthesis. Consistently credits other ideas, designs, and solutions but may be inconsistent regarding attribution of inspiration.	Superficial research practice in the early stages of design process, though interpretation/evaluation, is insufficient to develop a coherent analysis or synthesis. Viewpoints and previous approaches of experts are taken as mostly fact, with little questioning. May be unfamiliar with common resources for open/free files; inconsistent attribution when using found files and/or sources of inspiration.	Does not make an effort to research existing designs unless instructed to do so. Unaware of open/free design file repositories; Viewpoints and previous approaches of experts are taken as fact; unaccustomed to thinking about existing objects as having been designed by another person(s).

2d. Question assumptions	Systematically and methodically analyzes own and others' assumptions and carefully evaluates the relevance of contexts when determining the idea, question, and/or problem.	Identifies own and others' assumptions and several relevant contexts when determining the idea, question, and/or problem.	Begins questioning assumptions. Identifies several relevant contexts when determining the idea, question, and/or problem. May be more aware of others' assumptions than one's own (or vice versa).	Shows an emerging awareness of readily apparent assumptions (sometimes labels assertions as assumptions). Begins to identify context when determining the idea, question, and/or problem.
2e. Brainstorm a variety of solutions and pursue the most promising	Brainstorms and thoroughly considers the strengths and weaknesses of multiple solutions that have the potential to solve the problem. Not only develops a logical, consistent plan to solve problem, but recognizes consequences of solution and can articulate reason for their choices.	Brainstorms and explores multiple solutions with the potential to solve the problem; is able to articulate why/how these potential solutions would be practical and efficient. Having selected from available alternatives, develops a logical, consistent plan to solve the problem.	Brainstorms potential solutions, but struggles to differentiate between effective and less acceptable approaches to solving problem.	Struggles to brainstorm possible solutions that have the potential to solve the problem.

Maker Literacies Competency #3: Create effectively and safely.

	Expert	Proficient	Developing	Emerging
3a. Seek training, information, and necessary certifications when planning to work with dangerous equipment and materials	Always proactively pursues thorough training and information on best practices from multiple sources whenever preparing to use a new technique with potential hazards.	Consistently seeks information on standard operating procedures before using potentially hazardous equipment and materials.	Requests training and information on equipment and material processes that are overtly dangerous, though may approach some processes without sufficient caution.	Attempts to use equipment and materials that they have not received proper training on and/or without researching best practices or potential hazards.
3b. Wear personal protective gear when appropriate	Unwaveringly consistent in their use of safety glasses, hearing protection, and other appropriate PPE. Keenly aware to avoid use of protective equipment in inappropriate circumstances (ie, gloves when operating rotary equipment).	Habitual use of personal protective equipment; employs sound judgement in determining suitability of specific PPE in each circumstance.	Regular use of personal protective equipment (PPE) when using power tools, but may be comfortable performing small and/or quick jobs without all appropriate safety gear.	Requires reminding to wear safety glasses, hearing protection, and other basic personal protective equipment (PPE). Irregular use of other safety gear whether working with power tools or hand tools.
3c. Reinforce safety precautions with others	Steadfast exemplar of best practices regarding safe operation of all tools. Exhibits strong situational awareness and exhibits the social awareness, accountability, and initiative to comfortably remind others of appropriate safety concerns whenever potentially unsafe scenarios are observed.	Reliable with personal safety in the operation of tools; willing to remind others of relevant safety considerations when situations are overtly unsafe.	Occasionally adheres to best practices for safe operation of tools; prefers not to engage others in discussion of safety concerns, but will do so in certain circumstances. May report unsafe situation to authority figure to reinforce with others rather than addressing it directly.	Regardless of their own consistency with the safe operation of tools, only discusses safety protocol with others when an action or perceived neglect threatens themselves or the functionality of a needed/preferred tool.
3d. Accustom self with location-specific emergency procedures, egress and disaster plans	Proactively seeks information on emergency contingencies; exhibits clear awareness of expectations in the event of an emergency; exhibits leadership to guide and educate others when needed.	Attentive and engaged during orientations to emergency contingency plans; able to recall what they are expected to do in various scenarios.	Aware of emergency contingencies, though has incomplete recollection of specific details surrounding emergency plans and procedures in the makerspace.	General understanding of emergency procedures, though unfamiliar with the specific emergency-response plans for the makerspace being used.

3e. Transfer safety principles covered in training to real-world contexts	Manifests clear application of the safety concepts covered in training sessions to situations beyond the scope of the training curriculum. Consistently adheres to protocol covered in the safety training when working on their own projects, both within and beyond the makerspace.	Exhibits understanding of how safety concepts covered as part of training curriculum can be appropriately applied to other situations, and follows safety procedures covered in trainings when working on their own projects.	Solid grasp of safety principles covered in trainings and somewhat aware of transferability of concepts; may articulate comprehension of how concepts learned in training could apply to other tools. Mostly abides by safety training protocol when working on their own projects.	Seems to understand safety protocol during training, but does not consistently incorporate those concepts into their workflow when working on their own projects.

Maker Literacies Competency #4: Assess the availability and appropriateness of tools and materials.

	Expert	Proficient	Developing	Emerging
4a. Research various equipment and materials to determine limitations and suitability for specific applications	Investigation of various equipment and materials receives comprehensive analysis regarding limitations and applicability for current project. Can articulate how their research can be utilized to select the best equipment and materials; communicates existing gaps in commonly shared knowledge and questions for which no data currently exists.	Investigation of various equipment and materials receives adequate analysis regarding limitations and applicability for current project. Incorporates research of others into evaluation of the suitability of equipment and materials after competently evaluating their expertise and competence.	Superficial investigation of relevant equipment and materials. Viewpoints and previous knowledge of experts are taken as mostly fact, with limited questioning or additional exploration.	Relies upon limited previous knowledge of a tool rather than researching other potential equipment and materials to see what is most suitable. Viewpoints and previous knowledge of others are taken as fact without additional exploration.
4b. Consider environmental sustainability/impact when making, including upcycling and recycling materials	Demonstrates how sustainability and upcycling is relevant in their lives as citizens. Advocates for and leads initiatives as part of which materials choices reflect careful analysis of sustainability contextualized to the project goals.	Describes environmental integrity, social equity, and economic vitality aspects of a maker project leveraging sustainability ideals; provides examples of how they are interrelated. Chooses the materials for their making project so that it reflects careful analysis sustainability contextualized to the project goals.	Identifies ethical and ecologically responsible business practices and interrelates with individual making project.	Identifies ecological processes and how choices in recycling and upcycling in the making process potentially affect the environment.
4c. Determine the most ideal tools, materials, and method(s) of creation (physical, digital, and rhetorical) for the project	Choices are based on evaluation of several aspects of suitability to achieve desired outcome, including availability, learning curve, and functionality. Recognizes consequences of choice and can thoroughly articulate reason for choosing.	Considers and rejects most tool and material options after evaluating some aspects of their suitability to achieve desired outcome but may overlook a few significant factors. Can articulate reason for choosing.	Considers and rejects a few unacceptable options but does not look at all available options and does not comprehensively evaluate suitability of choices.	Only selects materials and equipment with which they are familiar, or which are conveniently available even though they may not be suitable for the job.

4d. Secure access to the necessary tools, materials, and space/facilities	Acquires all necessary tools and materials in an appropriate time frame considering all impacting factors such as project timeline, budget and tool sharing needs of the makerspace and its' other users. Considers employing underutilized tools, or repairing damaged tools, to meet these needs.	Acquires all necessary tools and materials, taking into consideration some, though not all, of the following factors: the project timeline, budget and other impacting forces including tool sharing needs of the makerspace and its' other users.	Acquires the appropriate tools and materials, but does not take into consideration the project timeline, budget and other impacting factors when evaluating where to purchase or obtain tools/materials. Does not factor in the need/responsibility to share tool access with other makerspace users.	Acquires materials and equipment that are most convenient even though they may not be suitable for the job.
4e. Investigate alternatives when a desired tool or material is not available or is too resource intensive	Investigation of various equipment and materials receives comprehensive analysis regarding limitations and applicability for current project. Can articulate how their research can be utilized to select the best equipment and materials, but can also communicate existing gaps in commonly shared knowledge and questions for which no data currently exists.	Investigation of various equipment and materials receives coherent analysis regarding limitations and applicability for current project. Incorporates research of others into evaluation of the suitability of equipment and materials after competently evaluating their expertise and experience.	Superficial research practice in investigation of relevant equipment and materials. Viewpoints and previous knowledge of experts are taken as mostly fact, with little questioning or additional exploration.	Relies upon limited previous knowledge of a tool rather than researching other potential equipment and materials to see what is most suitable. Viewpoints and previous knowledge of others are taken as fact without additional exploration.
4f. Fabricate necessary tools, reimagine material choices, develop alternate workflows, and/or revise project scope when tools or materials are not feasible	Demonstrates intellectual flexibility through comprehensive analysis of available tools and materials and subsequent revision of workflows, resources, or project scope based on analysis, stakeholder and peer input, and desired project outcome. Recognizes consequences of choice and can articulate reason for choosing.	Develops revised workflows, resources, or project scope based on a coherent analysis of available tools and materials, stakeholder and peer input, and desired project outcome.	Develops revised workflows or project scope based on some evaluation of available tools and materials but lacks a coherent analysis to support any changes or action. Changes are made based on information taken at face value.	Does not independently recognize alternative processes or materials to employ when encountering design or fabrication challenges.

Maker Literacies Competency #5: Prototype using iterative design principles.

	Expert	Proficient	Developing	Emerging
5a. Specify measurable criteria for a successful prototype vs desired finished product	Explicit and thorough definition of the critical tolerances, functions, and/or needs that must be met by the design. Comprehensive and objective critical analysis of how the created object fulfills stated goals. Undaunted by failures; actively seeks them out in order to create ever more-ideal prototypes. Thoroughly considers appropriate design choices required for prototyping, articulates the delineation between these choices and the requirements needed for the final product, and articulates how the prototype will inform design decisions for the finished product.	Clear definition of all aspects of the problem the design is attempting to solve. Thorough analysis of the creation to determine how well it lives up to the vision the designer had at the beginning of the project; subjectivity may inhibit honest criticism of their own work. Considers multiple factors to determine appropriate functional requirements for a prototype vs. finished product. Reasoning for specifications may be superficial or does not account for all needs of the final product.	Definition of the problem is developed, but has not considered all aspects of the intended use for the created object. Analysis of the object's successes and failures tends to focus on what went well or extenuating circumstances rather than owning failures as inherent and opportunities for growth. Understands the need for prototyping and seeks assistance to think through what design elements could appropriately be altered for creating an effective prototype. Sometimes specifies prototype requirements that will lead to difficulties in creating the final product.	Problem is unclear and solutions are similarly unfocused. Difficulty understanding and articulating whether a creation actually does what it is supposed to do, or just looks like something that could do what it is supposed to do. Does not understand how a prototype informs the creation of a finished product, and therefore struggles to parameterize the different needs for a prototype vs. needs for the finished product.
5b. Divide design into individual components to facilitate testing	Accurately identifies how each prototype component should function and chooses appropriate mechanisms to test for the desired functionality.	Determines all design components for testing; Methodology to functionally test some components may be flawed.	Parses out some, but not all, design components for testing; Needs assistance in determining how to test the functionality of different components they've identified.	Still emerging in their understanding of how to break down an idea into testable prototype components.

5c. Take intelligent risks, use trial and error, and learn from failures	Ideates new possibilities and formulates testing plan to explore potentials. Mindful of the factors involved with each test; ensures safety and relative control of variables while remaining open to serendipity. Eager to assess prior projects to glean insights on methodological improvements; clear pattern of building on experience in pursuit of expertise.	Comes up with fresh takes on the issue at hand and demonstrates ability to test feasibility of ideas. Careful consideration of safety and control of variables may limit ability to take meaningful risks; iterations demonstrate tendency to creep up on a solution without enough risk to yield failures that need to be dialed back.	Able to identify variables after the fact, though foresight may be under-developed; admirable willingness to engage with the unknown but does not consistently test for functional insights into the problem being solved by the design. May overshoot or undershoot the target; stays engaged with the process though does not demonstrate clear trajectory towards solutions.	Either limited enthusiasm for risk-taking or concerning pattern of taking risks without considering the variables being tested and/or safety concerns. Tendency to seek one-and-done solutions; not intrinsically interested in reflecting on the process once the project is completed.
5d. Test measurable criteria to determine whether creation meets needs	Comprehensive assessment of all aspects of the designed component, taking into account the full spectrum of useability and user experience; thorough exploration of how to measure/assess suitability for intended purpose(s) with explicit notation of each measurable aspect and respective tolerances of fidelity required for each.	Detailed assessment of most aspects of the designed component, with good awareness of functionality of each aspect as well as the whole; utilizes several appropriate measurement/assessment strategies with clear descriptions of what success looks like for core design aspects.	Assesses the major functionalities required for basic useability, though may be overly focused on raw functionality to the detriment of practical useability; good assessment strategy for some aspects, though may rely on basic measurement and assessment strategies that are not all optimized for the analysis of the aspects assessed.	Assesses only the most critical aspects of the design to pass basic functionality, exhibiting little awareness of design features beyond the minimum viable product; basic assessment strategy utilized across the board, and may omit assessment of several aspects of the design that meaningfully contribute to the creation's useability
5e. Gather prototype feedback and input from stakeholders and mentors	Proactively solicits insights and advice from professors, TAs, makerspace staff, other professionals, peers, and those who may be using the creation. Deft balance of the appropriateness of requested feedback from each mentor based on progress made on the problem and the domain expertise of those asked for feedback; respectful of others' time and shows clear evidence of preparation for meetings. Guides conversations to garner criticisms and suggestions for improvement when feedback is positive.	Actively engages in conversation with all relevant stakeholders and mentors and solicits insights from peers. Prepared for meetings; may occasionally overstep bounds when asking for design feedback but is generally mindful of the social forces at play. Content to receive praise when others give it; accepts negative feedback and criticisms with grace.	Participates in discussion of their project with others, though may be somewhat more complacent than proactive on scheduling these meetings at the appropriate intervals and checkpoints throughout the project. More focused on the project than the process of gathering feedback from others, resulting in some discussions being less productive due to progress made between conversations and/or proximity to deadline.	Waits for external sources of initiation for feedback and/or waits for a crisis in the design process before asking others for insight. May seem to make their own design problems into headaches for others to solve rather than taking true ownership. Sporadic preparation for meetings; relevant stakeholders are neglected. Uncomfortable with negative feedback and criticisms of their design process.

			Prefers positive feedback about their work.	
5f. Revise and modify prototype design over multiple iterations	Internally driven to produce multiple prototypes until a successful solution is made. Savvy with optimizing prototypes to isolate variables in early stages; documents prototyping process and decision making thoroughly.	Motivated throughout the prototyping process; maintains steady progress despite setbacks. Makes use of optimization strategies to save time and materials when prototyping fitment variables in early stages; consistent documentation of work along the way.	Makes multiple iterations, though is not particularly excited about it; frustrations with inevitable failures in the prototyping process seem to inhibit the progress between drafts. Inconsistent with documentation and use of optimization strategies.	Produces prototypes sparingly; exhibits tendencies of wanting the first draft or two to be the finished product. Trouble dissecting design into component features; does not optimize variables (prints entire part to test isolatable variables). Sparse documentation.

Maker Literacies Competency #6: Develop a project management plan.

	Expert	Proficient	Developing	Emerging
6a. Specify actionable and measurable project goals and requirements	Articulates an achievable goal(s) for the project that reflects stakeholders' expectations. Includes criteria to measure whether the end product has met the goal. Comprehensively identifies the actionable steps, task dependencies, and contingencies for when things do not go to plan.	Articulates an achievable goal(s) for the project, including criteria to measure whether the end product has met that goal. Project plan comprehensively identifies the actionable steps required to achieve the goal.	Articulates an achievable goal(s) for the project. Project plan includes significant gaps in the actionable steps required to achieve that goal.	Articulates a goal(s) for the project but is unable to identify actionable steps that will achieve that goal.
6b. Utilize time management and project management tools	Utilizes time and project management tools that are not only aligned with the needs of the project, but also facilitate documentation of the project and the creation of institutional knowledge and/or sharing of best practices.	Utilizes time and project management tools that are aligned with the needs of the project.	Utilizes time and project management tools, but does not select methods/products that align with the needs of the project.	Does not use time and project management tools to track their project.
6c. Outline project milestones, including sequential action items and anticipating time for multiple prototype iterations	Comprehensively identifies the actionable steps and task dependencies required to complete the project, including contingencies for when things do not go to plan.	Comprehensively identifies the milestones and actionable steps required to complete the project.	Identifies project milestones, but there are considerable gaps in the actionable steps that will achieve those milestones.	Is unable to identify meaningful milestones or action steps that will lead to the completion of the project.
6d. Work effectively within project constraints, be they financial, material, spatial, and/or temporal	Accounts for constraints both within their control and outside their influence. Includes contingencies for those things that are not in their control and effectively problem solves when things do not go as planned.	Accounts for constraints both within their control and outside their influence but struggles to problem solve when things do not go as planned.	Completes the project only considering constraints over which they have direct control.	Does not think through nor plan for the multitude of contingencies that have the potential to impact or delay the project.

Maker Literacies Competency #7: Engage in effective teamwork.

	Expert	Proficient	Developing	Emerging
7a. Gauge the costs & benefits of "Doing-it-Yourself" (DIY) or "Doing-it-Together" (DIT)	Comprehensively understands the design parameters of the project, their own skills relative to those of potential teammates, and the tangential benefits of DIY vs. DIT to make a well-informed decision regarding what method to employ; Is able to articulate how they determined and evaluated this information.	Analyzes many, though not all, of the following factors: time to complete the project, efficiency, relative abilities of self and potential team members, benefit of learning from each other, etc.	Gauges overall costs and benefits too simplistically by evaluating only one of two of the following factors: time to complete the project, efficiency, relative abilities of self and potential team members, benefit of learning from each other, etc.	Does not critically evaluate costs and benefits of working together vs. working alone; Selects an approach based off of convenience or without analyzing the rationale behind their choice.
7b. Recognize opportunities to collaborate with others who provide diverse experiences and perspectives	Seeks to build or join teams in which there is a variety of experience and perspectives and debate is encouraged and supported. Actively contributes to an environment in which all team members feel empowered to share their ideas and opinions.	Seeks to build or join teams in which there is a variety of experience and perspectives, but that is not the primary motivation for those selected to the team. Explores perspectives other than their own.	Creates and/or joins collaborative working groups that include diverse experiences and perspectives, but hesitates to participate when others counter their ideas.	Chooses to collaborate only with those who have a shared perspective, experiences, expertise, and communication style.
7c. Recruit team members with diverse skills appropriate for specific project requirements	Articulates desired skill sets for a specific project and identifies individuals with those skills. Successfully recruits team members that fulfill the specific skills needs for the project. Accounts for both hard skills and emotional intelligence when recruiting team members.	Articulates desired skill sets for a specific project and identifies individuals with those skills, but is not persistent in recruiting those who will most benefit the team.	Articulates desired skill sets for a specific project but struggles to identify and recruit individuals with those skills. Favors personal acquaintance over demonstrable skills.	Identifies potential team members based on personal acquaintance with the individual and/or personality alone.
7d. Join a team where one's skills are sought and valued	Comprehensively evaluate teams' skill needs and value dynamics via questioning and information gathering to identify fit with one's own skills. Viewpoints are questioned thoroughly.	Coherently evaluate teams' skill needs and value dynamics via questioning and information gathering to identify fit with one's own skills. Viewpoints are subject to question.	Minimally evaluates teams skill needs and value dynamics in regards to identifying the fit with one's own skills. Viewpoints are taken at face value with little questioning.	Joins a team based on factors other than where skills are sought and valued, such as existing familiarity/friendship.

7e. Listen and communicate attentively to learn from and with others	Modifies communication strategies to effectively express, listen, and adapt to others to establish relationships for collaboration; actively invites reticent team members into discussions. Interprets and applies the experiences and knowledge sets from others into daily practice and demonstrates the ability to advocate on the behalf of other makers who may have an underrepresented voice in the community. Exhibits an in-depth understanding of multiple modes of communications, including verbal and non-verbal, from difference populations and cultures; takes initiative to broker new relationships and foster shared understanding between varying stakeholder groups.	Demonstrates ability to actively listen to varying viewpoints and apply recommendations, even when outside of personal belief system, to a maker project; asks clarifying questions to seek understanding, and begins to synthesize ideas. Recognizes value of different perspectives, worldviews and creative approaches, and makes substantive effort to collaborate with others and incorporate these differences into own workflow and worldview. Seeks out and participates in conversations and activities representing multiple intellectual and cultural perspectives, and begins to negotiate shared understanding between team members and project stakeholders.	Demonstrates listening without interrupting and taking turns with other team members and stakeholders; respectfully approaches cultural differences and differing viewpoints. Identifies components of other intellectual, cultural and creative perspectives, and begins to incorporate into personal workflows. Identifies key differences in communication styles and modes, based on cultural context and project type/scope; navigates multiple communication avenues to appropriately communicate specifics of maker project including community impact, funding, and resources needed, with selected stakeholders.	Receptive to interacting with team members who exhibit different perspectives; may exhibit difficulties in suspending judgement of differing viewpoints and maintains value preference for own position. Recognizes experiences of others from differing perspectives and worldview, but does do through own cultural lens and makes little to no effort to learn from the experience of others or to collaborate. Recognizes experiences of others from differing perspectives and worldview, but does do through own cultural lens and makes little to no effort to learn from the experience of others or to collaborate.

| 7f. Follow through on commitments and contribute to culture of accountability | Pursues educational opportunities beyond the classroom/regular course assignment(s) that lead to additional knowledge related to the project or maker community.

Leads group coordination and/or pursues intergroup and interrelated maker community learning opportunities to advance the maker team project; actively addresses conflicts that arise throughout the course of the project.

Critically evaluates individual and team member contributions to project goals and outcomes; demonstrates that appraisal and feedback was provided to team members throughout the lifetime of the project, not just at the conclusion. | Meets all deadlines for individual contributions to shared team project with quality; proactively leads other team members to ensure overall project success.

Completes required work as an individual member of a maker team and participates in group work coordination; actively seeks out opportunities for personal and group expansion of knowledge, maker skills, and abilities relevant to the maker team project.

Reviews personal contributions to the shared team project and demonstrates evidence of critical evaluation of team member contributions, indicating whether key goals/objectives were met through shared group activities and contributions, and difficulties encountered. | Meets deadlines for individual contributions to shared team project with quality; expresses interest in overall team project timelines, dynamic, and how efficiencies in workflow could be realized.

Completes required work as an individual member of a maker team and engages in systematic partner/group-checking with other team members to ensure deadlines and group project timelines are met.

Reviews personal contributions to the shared team project with some depth, indicating whether key goals/objectives were met through individual work/contributions; begins to provide feedback on others' contributions. | Makes little effort to meet shared timelines for the completion of group work; work submitted is not always as substantive or thorough as required.

Completes most required work as an individual member of a maker team.

Goals/objectives of team work are unclear or poorly understood, resulting in lack of member commitment to completion of shared project work; does not provide constructive feedback regarding contributions of other team members. |

Maker Literacies Competency #8: Employ effective knowledge management practices.

	Expert	Proficient	Developing	Emerging
8a. Restate technical and maker jargon for the layperson	Clearly and fluently expresses ideas, defines terms, and employs visual aids to convey technical and maker concepts simply through multiple communication methodologies.	Clearly expresses ideas and defines terms to communicate technical and maker concepts in more simplified language.	Identifies and restates most technical and maker jargon; attempts to avoid niche or uncommon vocabulary.	Identifies and restates some technical and maker jargon; does not recognize need for some concepts to be further simplified.
8b. Document steps clearly with sufficient detail for others to follow and replicate workflows	Clearly and articulately records work process in detail within an organized and coherent structure, employing formatting and stylistic choices for ease of finding information; includes visual aids.	Records each step of work process in detail within an organized and coherent structure.	Records each step within an organized and coherent structure; usually provides sufficient detail within each step for others to complete stages with accuracy.	Documents most steps taken, but omits some; does not always provide sufficient detail within each step for others to complete stages with accuracy.
8c. Use version control to manage project outputs and documentation	Demonstrates evaluation and appropriate selection of a platform that allows for managing versions of work; consistently employs use of versioning to maintain all iterations of project outputs and documentation, clearly delineating what changes have been made within each version.	Selects appropriate version control method for the project and consistently uses it for all stages of project	Is aware of and employs a knowledge management tool for project outputs; consistently saves most versions of the project separately.	Learns about different methods for managing different versions of project outputs; incorrectly or inconsistently employs these tools.
8d. Preserve project outputs and documentation for long-term access	Is aware of, evaluates, and employs the use of an appropriate knowledge repository or other system to broadly share project outputs and documentation globally and for permanent storage. Uses effective metadata practices to ensure searchability and findability of resources.	Shares project outputs and documentation broadly through posting on websites, forums, or other presentations; may use effective metadata practices to ensure searchability and findability of resources.	Shares project outputs and documentation within a class, organization, or relevant user group; learns of other methodologies for preserving and sharing out work more broadly.	Saves project outputs and documentation locally; does not demonstrate awareness or importance of long term or external knowledge preservation systems or methodologies.

Maker Literacies Competency #9: Apply knowledge gained into other situations.

	Expert	Proficient	Developing	Emerging
9a. Teach skills and share insights with other makers	Clearly outlines and documents all stages and pertinent details of a process and communicates clearly to others, avoiding jargon while still educating learners on official terminologies; uses visual or instructional aides to assist in delivery of content.	Clearly understands and accurately conveys all stages and pertinent details of a process to others; is consistent and detailed in approach, but may occasionally use jargon.	Understands steps for each major stage of a process and communicates those steps to others; may not always be consistent or timely in their delivery of relevant information or remember pertinent details.	Grasps basic concepts of processes and is able to convey rudimentary steps to others; does not use accurate terminology or remember all requisite steps.
9b. Recognize and cultivate transferrable skills	Recognizes, understands the value of, and is able to clearly articulate what transferrable skills they have garnered; Identifies which skills they could continue to grow, and actively seeks mentorship and opportunities to become more proficient.	Clearly articulates transferable skills acquired through maker work and what skills they could continue to further develop; does not demonstrate active effort to broaden skillset independently.	Initiates reflective exercise to identify and articulate the transferrable skills they are gaining; has a nascent recognition of skill sets that others possess but has not yet begun working to acquire the skills they lack.	Has an emerging understanding that they are developing transferable skills through maker work; cannot yet fully articulate those skills, or intentionally work to further develop them.
9c. Transfer knowledge, skills, and methods of inquiry across disciplines and activities	Utilizes prior-gained knowledge, skills, or methods of inquiry gleaned from other experiences, disciplines, and projects when encountering new situations, and recognizes how they can be adapted and applied in new settings	Employs knowledge and skills across disciplines; may struggle to modify previously used practices within differing situations.	Applies directly related skills to new, similar situations; may struggle to recognize connections or parallels between more distinctly incongruent tasks or scenarios.	Applies prior-gained knowledge and skills to new activities or problems, but does so unwittingly; Does not reflect on past experiences to inform the approach taken in new scenarios, regardless of discipline.
9d. Familiarize self with skillsets of others	Proactively inquires about the skillsets and proficiencies of others, and seeks opportunities to engage and learn from their expertise; seeks the input of others with aptitudes and knowledge different from their own.	Familiar with the skillsets of others; seeks their input, but defers to their expertise rather than attempting to learn from them.	Recognizes the skillsets of others; does not actively seek their input or attempt to learn from them.	Works independently; does not recognize or familiarize self with the skillsets of others, or seek their input.

| **9e. Connect those seeking to learn something with those who have relevant experience** | Recognizes the skillsets of others and refers those seeking to learn to whomever is available with the highest skillset;

is aware of and regularly employs the use of learning resources that would facilitate reliable knowledge acquisition in the absence of/in addition to local, personal expertise;

is able to convey pros and cons of different resources. | Is familiar with several reliable resources to refer learners to (people and print/electronic resources);

May not be able to evaluate and recommend most appropriate resource for given specific situations. | Refers those seeking to learn to generic resources without specificity or attention to the quality of the content being conveyed;

May suggest asking other classmates/peers/experts, but is not familiar enough with others' skillsets to recommend anyone specifically based off the expressed need. | Attempts to assist others who are seeking to learn;

does not refer to external resources or recognize the expertise of others who might be better able to assist. |

Maker Literacies Competency #10: Understand ethical and intellectual property issues surrounding making.

	Expert	Proficient	Developing	Emerging
10a. scrutinize the ethical implications of making	Recognizes and discusses complex ethical issues when presented in a complex, multilayered context and can provide interrelationship among the issues.	Identifies/states a position on an ethical issue and can defend objections and different ethical perspectives and assumptions presented to their position.	States a position and is able to articulate the origin of core beliefs, but is not yet able to firmly grasp interrelationships of core beliefs, or able to state limitations or assumptions of different perspectives and beliefs.	Recognizes obvious (basic) ethical issues in making, such as fair use and intellectual property, but is unable to articulate the interrelationships between these issues.
10b. demonstrate an understanding of intellectual property rights and protections	Applies a nuanced understanding of intellectual property (IP) that reflects critical thought and evaluation of fair use, derivative works, trademark, public domain, patent law, creative commons, the 5Rs of open (retain, reuse, revise, remix, redistribute), entrepreneurial opportunities, commercialization, and information/IP ethics. Makes choices for their own projects/creations that are indicative of this careful consideration and can articulate the rationale for their choices.	Cites or attributes others' intellectual contributions as part of the ideation, creation, and/or dissemination of their project and/or artifact. Applies strategies that protect their rights as creators with consideration of their project goals.	Cites or attributes others' intellectual contributions as part of the ideation, creation, and/or dissemination of their project and/or artifact, but does not consider their own rights as creators/makers.	Does not consider their rights nor the rights of others as part of the ideation, creation, or dissemination of their project and/or artifact.
10c. weigh the costs & benefits of seeking intellectual property protections v. making project outputs open and freely available to others	Applies a nuanced understanding of intellectual property and open to determine which strategy best contributes to their personal and project goals. Makes choices for their own projects/creations that are indicative of this careful consideration and can articulate the rationale for their choices.	Analyzes how intellectual property protections vs open would contribute to their personal or project goals, but struggles to make a choice and/or articulate how they have made their choice.	Gauges overall costs and benefits too simplistically without the ability to adequately describe the rationale for their choices.	Does not critically evaluate costs and benefits of seeking intellectual property protections v. making project outputs open and freely available to others. Selects an approach based off of convenience or without analyzing the rationale behind their choice.

10d. examine the potential viability of both proprietary and open source systems to adopt/adapt	Able to accurately forecast the time and effort required to implement and adapt both proprietary and open systems. Analyzes the costs and benefits of open vs. commercial solutions contextualized to the goals and constraints for the project and makes an appropriate choice based off of all relevant factors.	Aware of time and effort required to implement and adapt both proprietary and open systems, as well as the benefits of experiential learning; evaluates how these costs and benefits compare to thoroughly researched commercial solutions, but may be overtly predisposed towards either open or buying.	Evaluates the suitability of proprietary vs open source systems simplistically as the retail value of a purchased solution vs. the material costs of an open solution, but fails to analyze other factors, such as time, ability, source adaptability, benefit of learning, etc.	Strong tendencies towards either proprietary or open source systems. Has not designed and made enough projects to accurately assess costs/benefits between these options.
10e. respect the intellectual property rights of other makers	Applies a nuanced understanding of intellectual property (IP) that reflects critical thought and evaluation of fair use, derivative works, trademark, public domain, patent law, creative commons, entrepreneurship, commercialization, and information/IP ethics that is respectful of other makers and their rights as creators.	Cites or attributes other makers' intellectual contributions as part of the ideation, creation, and/or dissemination of their project and/or artifact.	Only considers intellectual property rights of other makers with whom they personally interact, when it is convenient, or when concerned that they might get caught violating IP rights.	Does not consider the intellectual property rights of other makers when making choices for their projects.