Criterion A. Explaining Phenomena or Designing Solutions

1. **Learn about the importance of explaining phenomena and designing solutions** in lessons designed for the NGSS here: www.nextgenscience.org/phenomena. Once you are comfortable with the role of explaining phenomena and designing solutions, use the table below to help gather evidence that either student problem-solving or sense-making of phenomena drives the lesson:

	NGSS designed lessons will look *less* like this:	NGSS designed lessons will look *more* like this:
Explaining Phenomena or Designing Solutions	Explaining phenomena and designing solutions are not a part of student learning or are presented separately from “learning time” (i.e. used only as a “hook” or engagement tool; used only for enrichment or reward after learning; only loosely connected to a DCI).	The purpose and focus of the lesson are to support students in making sense of phenomena and/or designing solutions to problems. The entire lesson drives toward this goal.
	The focus is only on getting the “right” answer to explain the phenomenon	Student sense-making of phenomena or designing of solutions is used as a window into student understanding of all three dimensions of the NGSS.
	A different, new, or unrelated phenomenon is used to start every lesson.	Lessons work together in a coherent storyline to help students make sense of phenomena.
	Teachers tell students about an interesting phenomenon or problem in the world.	Students get direct (preferably firsthand, or through media representations) experience with a phenomenon or problem that is relevant to them and is developmentally appropriate.
	Phenomena are brought into the lesson after students develop the science ideas so students can apply what they learned.	The development of science ideas is anchored in explaining phenomena or designing solutions to problems.

2. **Record evidence** about how explaining phenomena or designing solutions to problems are represented in the lesson. Describe in the response form below how this evidence is or is not an adequate indicator the criterion is being met. Include detailed suggestions for improvement.

Lessons designed for the NGSS include clear and compelling evidence of the following:	What was in the materials, where was it, and why is this evidence?	Evidence of Quality?	Suggestions for improvement
A. Explaining Phenomena or Designing Solutions: The lesson focuses on supporting students to make sense of a phenomenon or design solutions to a problem.	**INTRODUCTORY PAGE:** **Description of the physical phenomenon of laminar flow.** **Description of microfluidic channels including examples of dimensions and potential applications.** **Questions poised: Why would anyone want to use devices of such small dimensions?** **APPLICATIONS PAGE:** **Examples of solutions provided by microfluidic devices.** **Connection to people using engineering to solve biological problems.** **Quiz about basic microfluidics and laminar flow concepts.** **Problem solving: define the dimensions of channels in a microfluidic device.** **Challenge to define a problem that may be solved using microfluidics technologies.**	☐ None ☐ Inadequate ☐ Adequate ☐ Extensive	

3. If you are working in a group, **compare lists of evidence and reasoning and come to consensus** about whether this lesson met Criterion A.

Criterion B. Three Dimensions

1. **Document evidence of *specific grade-banded elements** * **of each dimension—including what evidence was in the lesson, where it occurs, and why it should be considered to be evidence**. To be considered as evidence, it should be clear how the student learning will develop or apply a specific element in a way that distinguishes it from other grade bands. Use the table below to help gather evidence about how each dimension is used in this lesson:

   * The term "element" indicates the bulleted DCIs, SEPs, and CCCs that are articulated in the foundation boxes of the standards. These elements are summarized in NGSS Appendices F & G for the SEPs and CCCs and *NSTA's DCI matrix for the DCIs. (Note that NGSS Appendix E contains summaries of the DCIs—not the DCI elements).*

	NGSS designed lessons will look *less* like this:	NGSS designed lessons will look *more* like this:
Three Dimensions	A single practice element shows up in the lesson.	The lesson helps students use multiple (e.g., 2–4) practice elements as appropriate in their learning.
	The lesson focuses on colloquial definitions of the practice or crosscutting concept names (e.g., "asking questions", "cause and effect") rather than on grade-appropriate learning goals (e.g., elements in NGSS Appendices F &G).	Specific grade-appropriate elements of SEPs and CCCs (from NGSS Appendices F & G) are acquired, improved, or used by students to help explain phenomena or solve problems during the lesson.
	The SEPs and CCCs can be inferred by the teacher (not necessarily the students) from the lesson materials.	Students explicitly use the SEP and CCC elements to make sense of the phenomenon or to solve a problem.
	Engineering lessons focus on trial and error activities that don't require science or engineering knowledge.	Engineering lessons require students to acquire and use elements of DCIs from physical, life, or Earth and space sciences together with elements of DCIs from engineering design (ETS) to solve design problems.

2. **Record specifically where you find each dimension** in the lesson. Describe in the response form below how this evidence is or is not an adequate indicator the criterion is being met. Include detailed suggestions for improvement.

Lessons designed for the NGSS include clear and compelling evidence of the following:	What was in the materials, where was it, and why is this evidence?		Evidence?	Overall Evidence of Quality?	Suggestions for improvement
B. Three Dimensions: The lesson helps students develop and use multiple grade-appropriate elements of the science and engineering practices (SEPs), disciplinary core ideas (DCIs), and crosscutting concepts (CCCs) which are deliberately selected to aid student sense-making of phenomena or designing of solutions.	Document evidence for each dimension.		**Evidence?**	☐ None ☐ Inadequate ☐ Adequate ☐ Extensive	
	SEP	**WORKSHEET. Students ask what the flow will look like. Students make predictions about the results. They choose colors and run 3 different devices. They record and interpret data. Provide explanations of the results.**	☐ None ☐ Inadequate ☐ Adequate ☐ Extensive		
	DCI	**INTRODUCTION. ETS1: Engineering design: students learn about the use of small dimensions to achieve physical phenomena. ETS2: Students make connections between engineering (device design), Biology/Chemistry (blood or drugs) and Society (glucose monitoring, vaccination). PS1: Physical interactions of fluids in channels.**	☐ None ☐ Inadequate ☐ Adequate ☐ Extensive		
	CCC	**EXPERIMENT: 1. Cause and effect & 2. Scale: The flow in channels of small dimensions is laminar; colors do not readily mix when flowing next to each other at particular velocities. This effect can be used to design devices to synthesize medical treatments, diagnose diseases or separate cells and chemicals.**	☐ None ☐ Inadequate ☐ Adequate ☐ Extensive		

3. If you are working in a group, **compare lists of evidence and reasoning and come to consensus** about whether this lesson met Criterion B.

Criterion C. Integrating the Three Dimensions for Instruction and Assessment

1. **Learn more about the importance of the three dimensions working together** in this brief paper. Then, use your evaluation of the lesson for criterion B (three dimensions) to examine the lesson for places that students use the three dimensions together to explain a phenomenon or design a solution to a problem. Use the table below to help gather evidence about three-dimensional learning and assessment in the lesson:

	NGSS designed lessons will look *less* like this:	NGSS designed lessons will look *more* like this:
Integrating the Three Dimensions	Students learn the three dimensions in isolation from each other (e.g., a separate lesson or activity on science methods followed by a later lesson on science knowledge).	• The lesson is designed to build student proficiency in at least one grade-appropriate element from each of the three dimensions. • The three dimensions intentionally work together to help students explain a phenomenon or design solutions to a problem. • All three dimensions are necessary for sense-making and problem-solving.
	Teachers assume that correct answers indicate student proficiency without the student providing evidence or reasoning.	Teachers deliberately seek out student artifacts that show direct, observable evidence of learning, building toward all three dimensions of the NGSS at a grade-appropriate level.
	Teachers measure only one dimension at a time (e.g., separate items for measuring SEPs, DCIs, and CCCs).	Teachers use tasks that ask students to explain phenomena or design solutions to problems, and that reveal the level of student proficiency in all three dimensions.

2. **Record evidence** about how the three dimensions are integrated for instruction and assessment purposes. Describe in the response form below how this evidence is or is not an adequate indicator the criterion is being met. Include detailed suggestions for improvement.

Lessons designed for the NGSS include clear and compelling evidence of the following:	What was in the materials, where was it, and why is this evidence?	Evidence of Quality?	Suggestions for improvement
C. Integrating the Three Dimensions for Instruction and Assessment: The lesson requires student performances that integrate elements of the SEPs, CCCs, and DCIs to make sense of phenomena or design solutions to problems, and the lesson elicits student artifacts that show direct, observable evidence of three-dimensional learning.	**INTRODUCTION AND WORKSHEET:** **Using what they learned about microfluidics theory (DCI) including laminar flow and diffusion, students will assemble devices and pumps, select colors and prepare their experimental manipulations (SEP) The make predictions about the results and test them in 3 different devices. They collect information, producing drawings or diagrams and compare it to their predictions (DCI and CCC). At this time they refer back to the quiz to make sense of the results and compare ideas about potential uses of the technology to generate solutions to potential or perceived problems (CCC).**	☐ None ☐ Inadequate ☐ Adequate ☐ Extensive	

3. If you are working in a group, **compare lists of evidence and reasoning and come to consensus** about whether this lesson met Criterion C.

Published December 2016

Criterion D. Relevance and Authenticity

1. **Learn about the importance of making lessons relevant and authentic for all students** in NGSS Appendix D. Once you are comfortable with ideas for making lessons relevant and authentic for all students, examine the lesson through the "lens" of student engagement, and for clear evidence that the lesson supports connections to students' lives. Use the table below to help gather evidence about the relevance and authenticity of the lesson for students:

Relevance and Authenticity	NGSS designed lessons will look *less* like this:	NGSS designed lessons will look *more* like this:
	The lesson teaches a topic adults think is important.	The lesson motivates student sense-making or problem-solving
	The lesson focuses on examples that some of students in the class understand.	The lesson provides support to teachers for making connections to the lives of every student in the class.
	Driving questions are given to students.	Student questions, prior experiences, and diverse backgrounds related to the phenomenon or problem are used to drive the lesson and the sense-making or problem-solving.
	The lesson tells the students what they will be learning.	The lesson provides support to teachers or students for connecting students' own questions to the targeted materials.

2. **Record evidence** about how the lesson is relevant to students and motivates their learning. Describe in the response form below how this evidence is or is not an adequate indicator the criterion is being met. Include detailed suggestions for improvement.

Lessons designed for the NGSS include clear and compelling evidence of the following:	What was in the materials, where was it, and why is this evidence?	Evidence of Quality?	Suggestions for improvement
D. Relevance and Authenticity: The lesson motivates student sense-making or problem-solving by taking advantage of student questions and prior experiences in the context of the students' home, neighborhood, and community as appropriate.	**INTRODUCTORY PAGE:** **Students are confronted with real problems (drug making, glucose monitoring) that are solved using microfluidics. They are encouraged to apply this know-how to solve other problems. All students have received medication and vaccines, some have experience with glucose monitoring.** **WORKSHEET:** **All students have observed convective mixing, and will be surprised by laminar flow and the absence of immediate mixing. How can this phenomena be used (or is used) to synthesize, manipulate, test or diagnose? The simplicity of the devices can be used to demonstrate how simple constructions that make use of interesting physical phenomena can be used to solve apparently complex problems.**	☐ None ☐ Inadequate ☐ Adequate ☐ Extensive	

3. If you are working in a group, **compare lists of evidence and reasoning and come to consensus** about whether this lesson met Criterion D.

Published December 2016

Criterion E. Student Ideas

1. **Examine the lesson for opportunities for *all* students to communicate their ideas** and for the depth to which student ideas are made visible. Use the table below to help gather evidence about how each dimension is used in this lesson:

	NGSS designed lessons will look *less* like this:	NGSS designed lessons will look *more* like this:
Student Ideas	The teacher is the central figure in classroom discussions.	• Classroom discourse focuses on explicitly expressing and clarifying <u>student</u> reasoning • Students have opportunities to share ideas and feedback with each other directly.
	Student artifacts only show answers.	Student artifacts include elaborations (which may be written, oral, pictorial, and kinesthetic) of reasoning behind their answers, and show how students' thinking has changed over time.
	The teacher's guide focuses on what to tell the students.	The lesson provides supports to teachers for eliciting student ideas.

2. **Record evidence** about how student ideas are elicited from ALL student during the lesson. Describe in the response form below how this evidence is or is not an adequate indicator the criterion is being met. Include detailed suggestions for improvement.

Lessons designed for the NGSS include clear and compelling evidence of the following:	What was in the materials, where was it, and why is this evidence?	Evidence of Quality?	Suggestions for improvement
E. Student Ideas: The lesson provides opportunities for students to express, clarify, justify, interpret, and represent their ideas (i.e., making thinking visible) and to respond to peer and teacher feedback.	**WORKSHEET:** **Students make predictions about the results of the experiment, illustrate them in a diagram and provide a justification.** **They interpret the results and explain them by comparing them to their predictions.** **Students work in groups, exchange ideas about predictions and results.** **Teacher provides suggestions for possible observations and confirms experimental results.** **Teacher points out how the visible results represent the physical phenomena and can ask students to propose potential applications.**	☐ None ☐ Inadequate ☐ Adequate ☐ Extensive	

3. If you are working in a group, **compare lists of evidence and reasoning and come to consensus** about whether this lesson met Criterion E.

Published December 2016

Criterion F. Building on Students' Prior Knowledge

1. **Learn about the expected learning progressions of each of the three dimensions** in [NGSS Appendices E, F, and G]. Once you are familiar with the learning progressions, use the table below to help gather evidence about how the lesson builds on students' prior learning in each of the three dimensions:

	NGSS designed lessons will look *less* like this:	NGSS designed lessons will look *more* like this:
Building on Students' Prior knowledge	The lesson content builds on students' prior learning, but only for DCIs.	The lesson content builds on students' prior learning in all three dimensions.
	The lesson does not include support to teachers for identifying students' prior learning.	The lesson provides explicit support to teachers for identifying students' prior learning and accommodating different entry points, and describes how the lesson will build on the prior learning.
	The lesson assumes that students are starting from scratch in their understanding.	The lesson explicitly works together with students' foundational knowledge and practice from prior grade levels.

2. **Record evidence** about how the lesson builds on students' prior learning. Describe in the response form below how this evidence is or is not an adequate indicator the criterion is being met. Include detailed suggestions for improvement.

Lessons designed for the NGSS include clear and compelling evidence of the following:	What was in the materials, where was it, and why is this evidence?	Evidence of Quality?	Suggestions for improvement
F. Building on Students' Prior Knowledge: The lesson identifies and builds on students' prior learning <u>in all three dimensions</u> in a way that is explicit to both the teacher and students.	**INTRODUCTORY PAGE:** **Arithmetics, molecular movement, mixing, health care applications.** **Students use their understanding of dimensions and how to calculate them. They are also encouraged to imagine convective mixing and how laminar flow visibly departs from that experience. They think of capillarity and diffusion and how it may be used in diagnostic tests they have experienced.** **WORKSHEET:** **Evidence from experiment shows that fluids do not readily mix in laminar flow. Connections are made to blood circulation, movement of air in a building or the atmosphere, flow of liquids in small biological systems. Connection to drug manufacturing (e.g. new mRNA vaccines).** **MICROFLUIDICS TOPIC: point of entry to fluid mechanics, nanotechnology, drug manufacturing, chemical engineering, biological transport, bioengineering (e.g. tissue printing).**	☐ None ☐ Inadequate ☐ Adequate ☐ Extensive	

3. If you are working in a group, **compare lists of evidence and reasoning and come to consensus** about whether this lesson met Criterion F.

Published December 2016

NGSS Lesson Screener: A Quick look at NGSS Lesson Design

Reviewer Name or ID: ________________________________ Grade: ________ Lesson/Unit Title: ____

Reminder: The purpose of the NGSS Lesson Screener is to give a quick look at a lesson. There are significant aspects of what would be expected in a fully-vetted NGSS-designed lesson that are not addressed in this tool and it should not be used to fully vet resources or claim that the lessons are designed for NGSS. Refer to the *EQuIP Rubric for Lessons & Units: Science*, or the Primary Evaluation of Essential Criteria (PEEC) for full evaluations.

Overall Screening Summary:

Published December 2016