Zebrafish Guided Experiment

The Impact of Chemicals - Middle School [Grade 6]

Grade 6 Science, English/Language Arts, Social Studies collaboration

Authors: InSciEd Out

Module Length (Days)	10
Module Lessons (#)	Science lessons - 4 (over 7 instructional days) ELA lessons - 2 (over 3 instructional days) Optional ELA lesson - 1 (over 2 instructional days)
Module Description	Explore the effects of caffeine and other chemicals on embryonic zebrafish. Make connections to humans using chemicals and the physical, mental, and ethical consequences. Student focus is on the process of developing research proposals and generating questions for other scientists. Fully develop an extension.

ELA: Day 1-2: Lesson 1; Photo Challenge, deductive reasoning

Day 8: Lesson 5; Dialogue: What effects do my choices have on my own development?

Science: Day 3-5: Lesson 2a, 2b, 2c; Guided Inquiry

Day 6: Lesson 3; Present Caffeine Findings to Peer Researchers and Evaluate Peer Presentations

Day 7: Lesson 4; Student Questioning Science Researchers on the Ethics/Role of using Animals as Model Organisms

Days 9-10: Lesson 6; How to Write a Science Proposal

Social Studies, ELA [OPTIONAL]

Day 9-10 : Lesson 7 A Community' Response to Funding Animal Research; Role-Playing Different Perspectives

Pre lesson (1-3 days prior to lesson 1 or prior to the observation module if included): Please complete the student content assessments linked here:

Lesson Title *Lesson # 1*	Photo Challenge: What Do All These People Have in Common? **English/Language Arts**		
Grade Level	6	**Length of Lesson Time:**	2 classes, 45 mins
Prerequisite Standards/ Skill	None		
Academic Standards/ CCF	**Minnesota Science Standards** **Minnesota ELA Standards** **Clinical Concepts of Focus** 3A: Good physical health can increase the risk of better mental health and vice versa. 3B: Lifestyle factors like exercise and diet have impacts on both mental and physical health. **Essential Questions** What attribute(s) does each member of the group share?		
Lesson Objectives	TSWBAT brainstorm commonalities from a group of preselected photos. TSWBAT identify how chemicals affect body systems and/or humans lives. TSWBAT find information about your person to bring back to class tomorrow.		
Language	*Academic Language*	*Science Language*	*Language Production Strategies*
	Commonalities Attribute Deductive reasoning		Discussion (small and large group) Student presentation of findings
Resources	*Materials & Technology*	*Documents & Handouts*	*Volunteers*
	1 Set of Pictures. One picture per student is needed. Pictures should be of famous and regular people whose lives have been altered or ended by chemical use. On the back of	Pictures of Humans Affected by Chemicals updated to fit your population and location (Appendix A) Must be printed before lesson	

	each photo, the person's name and occupation will be listed.		
Essential Features of Inquiry	Learner formulates explanations from evidence Learner communicates and justifies explanations		
Instructional Plan	***<u>Teacher Talk/Action</u>***	*<u>Student Talk/Action</u>*	*<u>Teaching Strategy/ Rationale</u>* *<u>Essential Feature of Inquiry</u>*
	Opening: Allow each student to choose a picture and examine it. Then have the students stand around the room holding their pictures in front of them so that the rest of the class can see. Have each student read the name and occupation of each photograph. **As a large group** generate a list of possible commonalities shared by all persons in the photographs. As a teacher do not affirm or reject any idea. Teacher will initiate the format for the discussion or let students control this based on how often the class has held large group discussions. Create a list of potential commonalities. Commonality should be broad enough to include all members of the group without being so broad to include everyone. Tell students the people in this group were chosen for a reason. Introduce the idea of deductive reasoning. Once the class generates a list, use deductive reasoning to narrow the list to 3-6 ideas. After brainstorming, each student should research their person. They need to be an	Define attribute Define commonality Brainstorm potential commonalities. Through discussion rule out some ideas and narrow the possible commonality. Each student will find information on their person to present in class tomorrow. Students will cite their sources.	Circle/Large Group discussion Brainstorm Research Small group discussion

	expert on that person. They will present this information in class, day 2. Day 2: Each student will present their person and the information they found about him/her in a small group. Cite the source. Then first in a small group discussion find the common attributes of each member. Each member will have an equal chance of presenting the small group's hypothesis to the large group. Each small group presents a hypothesis. Test against all members of the group. Each has to fit. Teacher helps students connect the links between the individuals. Students may discuss behavior, economic, physical, or other outcomes from chemical exposure. Teacher shares "The next few days in science, you will be adding chemicals many of us choose to use in our life to embryo water of zebrafish water. What do you think could happen?"	Large group discussion. Come to a consensus on the commonality shared with all members of the photo challenge.	Large group discussion
Evaluation	Predict what would happen if you expose zebrafish embryos to caffeine or other chemicals. Or What could our discussion have to do with science class?		

<table>
<tr><td>Lesson Title
Lesson # 2a</td><td colspan="3">Introduction: Guided Inquiry Caffeine
Science Lesson</td></tr>
<tr><td>Grade Level</td><td colspan="1">6</td><td>Length of Lesson Time:</td><td>3 classes, 45 minutes each
Day 3 (day 4 and 5 continuations of this Caffeine experiment.</td></tr>
<tr><td>Prerequisite Standards/ Skill</td><td colspan="3">Make observations and collect data with larval zebrafish
Use Kimmel chart</td></tr>
<tr><td>Academic Standards/ CCF</td><td colspan="3">Minnesota Science Standards
1.1.1 Students will be able to ask questions about aspects of the phenomena they observe, the conclusions they draw from their models or scientific investigations, each other’s ideas, and the information they read.
1.2.1 Students will be able to design and conduct investigations in the classroom, laboratory, and/or field to test students’ ideas and questions, and will organize and collect data to provide evidence to support claims the students make about phenomena.
2.1.1 Students will be able to represent observations and data in order to recognize patterns in the data, the meaning of those patterns, and possible relationships between variables.

Clinical Concepts of Focus
Lifestyle factors like exercise and diet have impacts on both mental and physical health.

Essential Questions
In what ways does caffeine affect the development of zebrafish embryos?</td></tr>
<tr><td>Lesson Objectives</td><td colspan="3">• TSWBAT identify how caffeine affects the development of zebrafish embryos.
• TSWBAT write a science laboratory report.
• TSWBAT observe and explain the effects of caffeine on young zebrafish.
• TSWBAT compare the effects of caffeine at different stages of embryo development.
• TSWBAT give examples of the effects of caffeine on children and adolescents.</td></tr>
<tr><td>Language</td><td><u>Academic Language</u></td><td><u>Science Language</u></td><td><u>Language Production Strategies</u></td></tr>
<tr><td></td><td>Development–based on observation lessons with zebrafish embryos

Embryo, Observe</td><td>Caffeine-a stimulant of the central nervous system
Solution- a homogeneous mixture of two or more substances</td><td>Write hypothesis

Observations drawn and labeled for explanation purposes</td></tr>
</table>

		Incubator- a machine that works like refrigerator or heater that maintain a steady temperature **petri dish**- small clear plastic dish used to hold water and embryos. **pipette**(greenie)- a tool used to "suck up" or remove embryos from water	
Resources	*Materials & Technology*	*Documents & Handouts*	*Volunteers*
	Per group: 4 small Petri dishes(10ml) with lids (3 caffeine groups plus a control group), Embryo water Caffeine solution (prepared with embryo water): 400μg/mL, 200 μg/mL, and 100μg/mL concentration in labeled bottles or petri dishes already set up for student use. 40 Embryos per group at the 256 cell stage or less ideally Labeling tape and permanent marker, Dissecting microscope and camera, Incubator set at 28 degrees C, Greenie pipette, Clock, Small embryo strainers Optional: Microscopes (class set), Chromebooks (class set) Animal use: If ISEF is the grounding oversight- this experiment falls under "non vertebrate". If Institutional IACUC	Effects of Caffeine Procedure Form **Caffeine Experiment Data Collection Forms:** (400, 200, 100 μg/mL and Embryo water only) Zebrafish scientist (if desired) Zebrafish Anatomy Poster x1 Kimmel Chart (1 per station)	
Essential Features of Inquiry	Learner Engages in Scientifically Oriented Questions. Learner Formulates Explanations from Evidence.		
Instructional Plan	*Teacher Talk/Action*	*Student Talk/Action*	*Teaching Strategy/ Rationale Essential Feature of Inquiry*
	(Teacher will need to have material set up for group use prior to the lesson.)	Students will set up the experiment. Students will make their own	Learner Engages in Scientifically Oriented Questions.

	Throughout the last few days in Language Arts you have learned about how chemicals can affect humans. What do you think are some commonly used chemicals that affect humans? The answer is Caffeine. Together, we will ask "**How does caffeine affect the development of zebrafish embryos?** Have students get into pairs or groups as determined by teacher Define individual and group roles and record on board. Individuals working alone are responsible for all roles. *All members* will be responsible for contributing to the success of the group by sharing and showing others their observations, helping to record data on the data collection sheet, and analyzing group data and drawing conclusions. *#1* This member will be responsible for the care and observation of the control group *#2* This member will be responsible for the care and observation of the 400μg/mL caffeine group *#3* This member will be responsible for the care and observation of the 200μg/mL caffeine group *#4* This member will be responsible for the care and observation of the 100μg/mLcaffeine group Pass out the Effects of Caffeine Procedure Form to each group. Review the form with the class and explain how they are going to set up their experiment by going over the steps in the Experiment Design portion of the form.	observations of Zebrafish embryos and record them on the Caffeine Data Collection form. The question you're attempting to answer is: **How does caffeine affect the development of zebrafish embryos?** Write a hypothesis that is observable and measurable.	Learner Formulates Explanations from Evidence.
Evaluation	Day 1-3: observations include measurements and specific details without inferences		

<table>
<tr><td>Lesson Title
Lesson # 2b</td><td colspan="3">Introduction: Guided Inquiry Caffeine Experiment Day 2
Science Lesson</td></tr>
<tr><td>Grade Level</td><td>6</td><td>Length of Lesson Time:</td><td>1 class, 45 mins</td></tr>
<tr><td>Prerequisite Standards/ Skill</td><td colspan="3">Guided Inquiry Caffeine Experiment</td></tr>
<tr><td>Academic Standards/ CCF</td><td colspan="3">Minnesota Science Standards
1.1.1 Students will be able to ask questions about aspects of the phenomena they observe, the conclusions they draw from their models or scientific investigations, each other's ideas, and the information they read.
1.2.1 Students will be able to design and conduct investigations in the classroom, laboratory, and/or field to test students' ideas and questions, and will organize and collect data to provide evidence to support claims the students make about phenomena.
2.1.1 Students will be able to represent observations and data in order to recognize patterns in the data, the meaning of those patterns, and possible relationships between variables.

Clinical Concepts of Focus
Lifestyle factors like exercise and diet have impacts on both mental and physical health.

Essential Questions
In what ways does caffeine affect the development of zebrafish embryos?</td></tr>
<tr><td>Lesson Objectives</td><td colspan="3">● TSWBAT identify how caffeine affects the development of zebrafish embryos.
● TSWBAT write a science laboratory report.
● TSWBAT observe and explain the effects of caffeine on young zebrafish.
● TSWBAT compare the effects of caffeine at different stages of embryo development.
● TSWBAT give examples of the effects of caffeine on children and adolescents.</td></tr>
<tr><td>Language</td><td><u>Academic Language</u></td><td><u>Science Language</u></td><td><u>Language Production Strategies</u></td></tr>
<tr><td></td><td>Development–based on observation lessons with zebrafish embryos

Embryo

Observe</td><td>Caffeine-a stimulant of the central nervous system
Solution- a homogeneous mixture of two or more substances</td><td>Write hypothesis

Observations drawn and labeled for explanation purposes</td></tr>
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		Incubator- a machine that works like refrigerator or heater that maintain a steady temperature **petri dish**- small clear plastic dish used to hold water and embryos. **pipette**(greenie)- a tool used to “suck up” or remove embryos from water	
Resources	*<u>Materials & Technology</u>*	*<u>Documents & Handouts</u>*	*<u>Volunteers</u>*
	Per group: 4 small Petri dishes(10ml) with lids (3 caffeine groups plus a control group) Embryo water Caffeine solution of 400μg/mL, 200 μg/mL, and 100μg/mL concentration in labeled bottles or petri dishes already set up for student use. (Solutions prepared with embryo water) 40 Embryos per group at the 256 cell stage or less ideally Labeling tape and permanent marker Dissecting microscope and camera Incubator set at 28 degrees C. Greenie pipette Clock Small embryo strainers Optional: Microscopes (class set) Chromebooks (class set) Animal use: If ISEF is the grounding oversight- this experiment falls under “non vertebrate”. If Institutional IACUC	Effects of Caffeine Procedure Form **Caffeine Experiment Data Collection Form**s: (400, 200, 100 μg/mL and Embryo water only) Zebrafish scientist (if desired) Zebrafish Anatomy Poster x1 Kimmel Chart (1 per station)	
Essential Features of Inquiry	Learner Engages in Scientifically Oriented Questions. Learner Formulates Explanations from Evidence		

Instructional Plan	*Teacher Talk/Action*	*Student Talk/Action*	*Teaching Strategy/ Rationale* *Essential Feature of Inquiry*
	Activate prior knowledge by asking questions: What did we do yesterday? What are we hoping to learn from this experiment? What is the job of group members 1, 2, 3, and 4? Today you will continue to monitor the development of the zebrafish embryos. Your group should get out your experimental groups (petri dishes containing embryos) from the incubator and use a microscope to continue to make observations and record your data on the data collection sheet. Be careful to observe both living and non-living embryos. Look for differences in their development. Any non-living embryos should be removed from the petri dish using a pipette.	Students will make their own observations of Zebrafish embryos and record them on the Data Collection Form. Students will identify and remove non-living embryos from the petri dishes.	Learner Engages in Scientifically Oriented Questions. Learner Formulates Explanations from Evidence. Cooperative groups Independent observations
Evaluation	Is there any overall effects you are seeing already? What other questions do you have?		

<table>
<tr><td>Lesson Title
Lesson # 2c</td><td colspan="3">Introduction: Guided Inquiry Caffeine Experiment Day 3
Science Lesson</td></tr>
<tr><td>Grade Level</td><td colspan="1">6</td><td>Length of Lesson Time:</td><td>1 class, 45 mins</td></tr>
<tr><td>Prerequisite Standards/ Skill</td><td colspan="3">Guided Inquiry Caffeine Experiment</td></tr>
<tr><td>Academic Standards/ CCF</td><td colspan="3">Next Generation Sunshine State Standards (Science)

Next Generation Science Standards

Minnesota Science Standards
1.1.1 Students will be able to ask questions about aspects of the phenomena they observe, the conclusions they draw from their models or scientific investigations, each other's ideas, and the information they read.
1.2.1 Students will be able to design and conduct investigations in the classroom, laboratory, and/or field to test students' ideas and questions, and will organize and collect data to provide evidence to support claims the students make about phenomena.
2.1.1 Students will be able to represent observations and data in order to recognize patterns in the data, the meaning of those patterns, and possible relationships between variables.

Clinical Concepts of Focus
Lifestyle factors like exercise and diet have impacts on both mental and physical health.

Essential Questions
In what ways does caffeine affect the development of zebrafish embryos?</td></tr>
<tr><td>Lesson Objectives</td><td colspan="3">● TSWBAT identify how caffeine affects the development of zebrafish embryos.
● TSWBAT write a science laboratory report.
● TSWBAT observe and explain the effects of caffeine on young zebrafish.
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<tr><td></td><td>Development–based on observation lessons with zebrafish embryos</td><td>Caffeine-a stimulant of the central nervous system</td><td>Write hypothesis</td></tr>
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	Embryo Observe	**Solution-** a homogeneous mixture of two or more substances **Incubator**- a machine that works like refrigerator or heater that maintain a steady temperature **petri dish**- small clear plastic dish used to hold water and embryos. **pipette**(greenie)- a tool used to "suck up" or remove embryos from water	Observations drawn and labeled for explanation purposes
Resources	*Materials & Technology*	*Documents & Handouts*	*Volunteers*
	Per group: 4 small Petri dishes(10ml) with lids (3 caffeine groups plus a control group) Embryo water Caffeine solution of 400μg/mL, 200 μg/mL, and 100μg/mL concentration in labeled bottles or petri dishes already set up for student use. (Solutions prepared with embryo water) 40 Embryos per group at the 256 cell stage or less ideally Labeling tape and permanent marker Dissecting microscope and camera Incubator set at 28 degrees C. Greenie pipette Clock Small embryo strainers Optional: Microscopes (class set) Chromebooks (class set) Animal use: If ISEF is the grounding oversight- this experiment falls under "non vertebrate". If Institutional IACUC	Effects of Caffeine Procedure Form **Caffeine Experiment Data Collection Forms:** (400, 200, 100 μg/mL and Embryo water only) Zebrafish scientist (if desired) Zebrafish Anatomy Poster x1 Kimmel Chart (1 per station)	
Essential Features of	Learner Formulates Explanations from Evidence.		

Inquiry			
Instructional Plan	*<u>Teacher Talk/Action</u>*	*<u>Student Talk/Action</u>*	*<u>Teaching Strategy/ Rationale Essential Feature of Inquiry</u>*
	Activate prior knowledge by asking questions: What did we do yesterday? What are we hoping to learn from this experiment? What is the job of group members 1, 2, 3, and 4? Today you will conclude our exploration of development of the zebrafish embryos. Your group should get out your experimental groups (petri dishes containing embryos) from the incubator and use a microscope to continue to make observations and record your data on the data collection sheet. Be careful to observe both living and non-living embryos. Look for differences in their development. Any non-living embryos should be removed from the petri dish using a pipette.	Students will make their own observations of Zebrafish embryos and record them on the Data Collection Form. Students will identify and remove non-living embryos from the petri dishes.	Learner Engages in Scientifically Oriented Questions. Learner Formulates Explanations from Evidence. Cooperative groups Independent observations
Evaluation	Data represented and conclusion stated.		

Lesson Title *Lesson # 3*	Present Caffeine Finding to Peer Researchers and Evaluate Peer Presentations **Science Lesson**		
Grade Level	6	**Length of Lesson Time:**	1 class, 45 mins
Prerequisite Standards/ Skill	Completed Caffeine experiment		
Academic Standards/ CCF	**Minnesota Science Standards** 1.1.1 Students will be able to ask questions about aspects of the phenomena they observe, the conclusions they draw from their models or scientific investigations, each other's ideas, and the information they read. 2.1.1 Students will be able to represent observations and data in order to recognize patterns in the data, the meaning of those patterns, and possible relationships between variables. 3.2.1 Students will be able to apply scientific principles and empirical evidence (primary or secondary) to explain the causes of phenomena or identify weaknesses in explanations developed by the students or others. 4.1.1 Students will be able to engage in argument from evidence for the explanations the students construct, defend and revise their interpretations when presented with new evidence, critically evaluate the scientific arguments of others, and present counter arguments. **Clinical Concepts of Focus** Lifestyle factors like exercise and diet have impacts on both mental and physical health. **Essential Questions** What makes an effective presentation of data/ideas?		
Lesson Objectives	TSWBAT demonstrate effective public speaking and listening skills. TSWBAT critically evaluate the performance of their group and other groups using a rubric.		
Language	*Academic Language*	*Science Language*	*Language Production Strategies*
	Conclusion Critique		
Resources	*Materials & Technology*	*Documents & Handouts*	*Volunteers*

[redacted]	Presentation Rubrics LCD projector and computer	Effects of Caffeine Procedure Form **Caffeine Experiment Data Collection Forms:** (400, 200, 100 μg/mL and Embryo water only) Rubric: Presentation of Caffeine Experiment Results	
Essential Features of Inquiry	Learner Formulates Explanations from Evidence Learner Communicates and Justifies Explanations		
Instructional Plan	*Teacher Talk/Action*	*Student Talk/Action*	*Teaching Strategy/ Rationale Essential Feature of Inquiry*
[redacted]	Today you will be presenting your data and conclusions from the Caffeine Experiment. Review expectations for audience behavior. Ask: What makes a presentation effective? Teacher will select the order of group presentations. Giving critical feedback (positive and negative feedback) is an important component of scientific research. Today you will practice giving specific critical feedback and receiving specific critical feedback.	Groups of students will present to their peer researchers. Students will evaluate their own presentations using a rubric.	
Evaluation	What did you learn about the effects of caffeine on zebrafish embryos? On humans? What did the presentations have in common? What were the differences between the presentations? How would you change your presentation?		

Lesson Title *Lesson # 4*	Student Questioning Science Researchers on the Ethics/Role of using Animals as Model Organisms **Science or ELA**		
Grade Level	6	**Length of Lesson Time:**	1 class, 45 mins
Prerequisite Standards/ Skill	Generate some data and scientific questions.		
Academic Standards/ CCF	**Minnesota ELA Standards** 6.9.1.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion. b. Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed. c. Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion. d. Review the key ideas expressed and demonstrate understanding of multiple perspectives through reflection and paraphrasing. **Essential Questions** What are the steps and attitudes that are required to become scientists?		
Lesson Objectives	TSWBAT conduct and interview with several scientists in their community. TSWBAT practice effective speaking and listening skills in a group setting. TSWBAT think critically about the use of model organisms. TSWBAT form their own opinions about using animals as model organisms.		
Language	*Academic Language*	*Science Language*	*Language Production Strategies*
	Ethics science researchers	model organism	Discussion with visitors
Resources	*Materials & Technology*	*Documents & Handouts*	*Volunteers*
	Student created questions for the researchers		3-6 Science Researchers

	Preselected student groups of 4-8 students (# students per group will depend on the number of scientists to interview)		
Essential Features of Inquiry	Connect with experts		
Instructional Plan	***<u>Teacher Talk/Action</u>***	***<u>Student Talk/Action</u>***	***<u>Teaching Strategy/ Rationale Essential Feature of Inquiry</u>***
	Welcome science researchers to the classroom and invite them to introduce themselves to the students, stating name and information about their career and/or education. Spread the science researchers around the room in stations so that groups of 4-8 students can talk with them at their station. Each group of students will have 10 minutes to talk/interview each science researcher. After 10 minutes, the teacher will announce it is time to switch groups. Student groups will move to a different researcher and interview them. Each group should interview 3-4 science researchers.	Students will ask questions they have created of each of the science researchers they interview.	Connecting with experts
Evaluation	Journal: What did you learn today from your interviews with the science researchers? Were all the researchers the same? How do you feel about using animals as a model organism?		

<table>
<tr><td>Lesson Title
Lesson # 5</td><td colspan="3">Dialogue: What are the risks and/or benefits to using caffeine during my adolescence?
English Language Arts</td></tr>
<tr><td>Grade Level</td><td>6</td><td>Length of Lesson Time:</td><td>1 class, 45 mins</td></tr>
<tr><td>Prerequisite Standards/ Skill</td><td colspan="3">If you have not led a difficult dialogue, the norms established as a class need to be practiced with less controversial topics</td></tr>
<tr><td>Academic Standards/ CCF</td><td colspan="3">Minnesota Science Standards
4.1.1 Students will be able to engage in argument from evidence for the explanations the students construct, defend and revise their interpretations when presented with new evidence, critically evaluate the scientific arguments of others, and present counter arguments.

Minnesota ELA Standards
6.9.1.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacherled) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly
a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.
b. Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed.
c. Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.
d. Review the key ideas expressed and demonstrate understanding of multiple perspectives through reflection and paraphrasing.
e. Cooperate, mediate, and problem solve to make decisions as appropriate

Clinical Concepts of Focus

Essential Questions
Is it ok for kids to be drinking caffeine?</td></tr>
<tr><td>Lesson Objectives</td><td colspan="3">TSWBAT state their opinion clearly.
TSWBAT support their opinion with facts, reasons, examples, anecdotes, etc.
TSWBAT amend their opinion based on new information provided.
TSWBAT use academic language
TSWBAT actively listen to peers.
TSWBAT In your head or aloud, respectfully question other's opinions</td></tr>
<tr><td>Language</td><td><u>Academic Language</u></td><td><u>Science Language</u></td><td><u>Language Production Strategies</u></td></tr>
</table>

			Dialogue
Resources	*Materials & Technology*	*Documents & Handouts*	*Volunteers*
	Room Design: Sit in an area or in a manner that is unique to Dialogue. *(This is important to visually separate that what you are about to do, with what normally happens in your classroom.)* All students should be able to see all other student's faces.	Poster of class norms for difficult dialogues	Potentially a Dialogue Facilitator
Essential Features of Inquiry	Learner gives priority to evidence in responding to questions Learner connects explanation to scientific knowledge Learner communicates and justifies explanations		
Instructional Plan	*Teacher Talk/Action*	*Student Talk/Action*	*Teaching Strategy/ Rationale Essential Feature of Inquiry*
	Dialogue Norms: Sit in a circle or as class to this as possible. Disagree with an idea not a person *("I disagree with a previous speaker who said… because…")* Equal voices in room/shared air space (*It is important to have some sort of conversation or procedure for all to have the chance to share. Perhaps everyone has chance to speak once before the someone is called a second time*) No one is forced to contribute about sensitive topics, but all voices are encouraged/honored. What is said in the room, stays in the room. Actively listen. If a statistic or quote is stated, the speaker needs to include a source. *(Advanced dialogue)* Review the findings of caffeine exposure.	The teacher will serve as the facilitator of the discussion, calling on students equally and in some order. One student may serve as the timekeeper, if needed. Participate in the dialogue by: Actively listening Contributing to the discussion	Large Group discussion

	Pose the question: “Is caffeine safe for you to consume? Why or why not?” Give a good amount of time for the discussion to begin and evolve. *(10-20 min seems to be a good amount of time to start)* After time, probe the students to go deeper. If a conversation is one sided, the teacher should pose questions that allow students to see the question from a different perspective. The following questions are ideas; not all areas need to be explored, but it is important for students to think about multiple perspectives during the dialogue. Tailor the questions to fit your group of students, and your comfort level. For instance, “Is it right to sell energy drinks to children? How old? How might caffeine be changing the way we interact? **At the end ask:** What about other chemicals (caffeine, prescribed medications, over the counter medications, an unhealthy diet); should those carrying children have regulations on the use of other chemicals? This question might help prompt extension projects. **It is important that the teacher does not share his/her opinions either verbally or nonverbally about this topic at this time. The teacher is a part of the physical space but not the intellectual space of the dialogue.* Closure: Remind students that what is shared in the classroom stays in the classroom. Remind students that varying opinions are good, because the purpose is to grow in our thinking whether you changed your point of view or affirmed it.		
Evaluation	Write a response to the following: How did your opinion on this topic change or grow as a result of our Dialogue?		

<table>
<tr><td>Lesson Title
Lesson # 6</td><td colspan="3">How to Write a Science Proposal
Science Lesson</td></tr>
<tr><td>Grade Level</td><td colspan="2">6</td><td>Length of Lesson Time: 2 class, 45 mins each</td></tr>
<tr><td>Prerequisite Standards/ Skill</td><td colspan="3"></td></tr>
<tr><td>Academic Standards/ CCF</td><td colspan="3">Minnesota Science Standards
1.1.1 Students will be able to ask questions about aspects of the phenomena they observe, the conclusions they draw from their models or scientific investigations, each other's ideas, and the information they read.
1.2.1 Students will be able to design and conduct investigations in the classroom, laboratory, and/or field to test students' ideas and questions, and will organize and collect data to provide evidence to support claims the students make about phenomena.

Clinical Concepts of Focus

Essential Questions
Why do scientists write research proposals?</td></tr>
<tr><td>Lesson Objectives</td><td colspan="3">TSWBAT develop and write a proposal for research</td></tr>
<tr><td>Language</td><td><u>Academic Language</u></td><td><u>Science Language</u></td><td><u>Language Production Strategies</u></td></tr>
<tr><td></td><td>proposal</td><td></td><td>Written product with rubric</td></tr>
<tr><td>Resources</td><td><u>Materials & Technology</u></td><td><u>Documents & Handouts</u></td><td><u>Volunteers</u></td></tr>
<tr><td></td><td>Optional Chromebooks for proposal submission</td><td><u>Research Proposal Sheet</u>
Local science fair research proposal documents</td><td>Scientific researchers if available</td></tr>
<tr><td>Essential</td><td colspan="3">Student poses a question.</td></tr>
</table>

Features of Inquiry			
Instructional Plan	*Teacher Talk/Action*	*Student Talk/Action*	*Teaching Strategy/ Rationale Essential Feature of Inquiry*
	Today you will develop your own proposal for science research. Your proposal will be presented to peers (and science researchers) for feedback and approval. Following this experience, we will be doing novel research as a class. For now, I want to stay thinking as individuals. Handout and explain Research Proposal Form. Explain their proposal; it can be on anything they want. It can be related to zebrafish or it can be completely different. Periodically, have students present their ideas to peers. Peers are to help students explain their ideas better/provide critical feedback. Once complete, present the completed proposal to a small group for critical feedback.	Write a Research Proposal. Help peers by reading or listening to their proposals. Point out things you do not understand by asking questions and providing critical feedback.	Student poses a question.
Evaluation	Completed Research Proposal		

Lesson Title *Lesson # 7*	Optional: A Community' Response to Funding Animal Research; Role-Playing Different Perspectives **Science or ELA Lesson**		
Grade Level	6	**Length of Lesson Time:**	2 classes, 45 mins each
Prerequisite Standards/ Skill	Understand use of Model Organisms and the benefits and arguments against it		
Academic Standards/ CCF	**Minnesota ELA Standards** 6.3.1.3 Exchange ideas in discussion and collaboration, as listener, speaker, and participant, A) including the voices and perspectives of Dakota and Anishinaabe people as well other perspectives, identities, and cultures like and unlike their own, and B) expressing one's own ideas, stories, and experiences. 6.3.2.1 Communicate with others, applying knowledge of vocabulary, language, structure, and features of spoken language, considering audience and context. **Minnesota Social Studies Standards** 6.1.1.1 Analyze a state or local policy issue by identifying and examining opposing positions from diverse perspectives and frames of reference, interpreting and applying graphic data, determining conflicting values and beliefs, defending and justifying a position with evidence, and developing strategies to persuade others to adopt this position. **Clinical Concepts of Focus** 2C: Attitudes, beliefs, and actions--particularly concerning health--are shaped in part by other people and by societal norms. Remembering that every individual is unique can help combat stigma. **Essential Questions** How does a community of diverse opinions make a decision?		
Lesson Objectives	TSWBAT to identify situations in which bias occurs. TSWBAT analyze how selected members of society would react to situations involving using animals as model organism for scientific research. TSWBAT discuss the roles that political and religious organizations play in scientific research. TSWBAT justify their position using scientific reasoning.		
Language	*Academic Language*	*Science Language*	*Language Production Strategies*
	Role, economy, bias, poverty, costs		Write responses

			Argue/present ideas to group
Resources	*Materials & Technology*	*Documents & Handouts*	*Volunteers*
	Chromebooks or other technology	Each role will have groups of about 3 students to represent/defend the viewpoint Zebrafish (3) Science researchers from Mayo Clinic (3) Mayor and his staff running for re-election (3) Members of the Humane Society (3) Family genetically predisposed to cancer (3) Family mired in poverty (3) Owners of a Rochester microscope company (3) Member of the School Board (3) Greater Rochester Area Dakota (3)	
Essential Features of Inquiry	Learner communicates and justifies explanations		
Instructional Plan	*Teacher Talk/Action*	*Student Talk/Action*	*Teaching Strategy/ Rationale Essential Feature of Inquiry*
	Day 1 Opening: You are all members of the same community Rochester, MN. Today you will be given a role that exists in Rochester. You will have to identify how people in your role would feel and represent that position. The issue you will have dialogue about is: Are the costs of using animals as model organisms for research worth the benefits? You will receive your role by drawing it from a hat.		

	Procedure: **a. Teacher directed**: After you have your role you will have to meet with other students with the same role. The job of your group today is to identify how your group would feel about the question. Are the costs of using animals as model organisms for research worth the benefits? Your group will then be presenting your position at a community meeting tomorrow. After hearing and discussing all of the group's positions the community of Rochester will then be voting on whether or not to impose a special 1/8 of percent city tax to support animal research in the community. **Closure**: Tomorrow will be the community meeting. Make sure your group is prepared to defend your position and convince other to support you.	Students will meet with the group role members to identify the position of the group and answer the questions below. Are the costs of using animals as model organisms for research worth the benefits? Your Role: Position: Several reasons for your position: How will you convince other members of your community to agree with your position? What facts support your position?	Small group discussion and presentation
	Day 2 Opening: Teacher or student will serve as the facilitator of the community meeting. Welcome citizens of Rochester. I am pleased to have so many citizens in attendance today. Today, our community will be voting on bill that would increase city sales taxes by 1/8 of percent to support animal research. We will listen to and discuss all viewpoints presented by community members. After all groups have had a chance to speak and present their position we will vote on this issue. Each group will have 4 minutes to present the position to the community. Community	Groups will take turns presenting their positions and questioning/supporting the position of other groups.	Democratic Forum

	members will then be able to ask questions or make statements regarding the group's position. **Procedure:** **a. Teacher directed**: Meeting Facilitator will select groups to present their position and will keep track of time so that all groups are heard from. After all groups have presented, students will cast a secret ballot that will be counted instantly. **Closure**: Announce the results of the vote. Independent reflection	Listen to other's perspectives, seeking to understand their point of view. Determine whether you would vote for what is best for the community or for the individual.	
Evaluation	Reflection: Why did you vote for or against the tax? What groups were particularly effective and why. Is it hard to play a role if you do not personally agree with the position? In real life will you ever have to support something you disagree with? Can you give examples?		

Post assessments: Please complete the student post assessments following the final lesson (or after the extension lesson if included). Assessments are linked here:

Effects of Caffeine Procedure Form

1. **Define the problem you are going to investigate.**

2. **Develop a hypothesis:**

3. **Design and conduct an experiment:**
    a. Each group will receive a large petri dish with at least 40 embryos.
    b. Label 4 Petri dishes with developmental age (#of cells) of embryo and concentration of Caffeine solution. Also include your group name on the dish. The dishes will be your control embryo water dish, 400μg/mL caffeine, 200μg/mL caffeine, and 100μg/mL caffeine solution.
    c. Using a pipette remove the embryos from the large petri dish and place 10 embryos in each labeled 10 ml petri dish.
    d. Carefully extract most of the water from the petri dishes before adding the solutions. Make sure not to remove the embryos.
    e. Before filling the dishes with the caffeine solutions, make note of the time as each group of embryos will only be in the solutions for 20 minutes
    f. Fill the petri dishes with the indicated solutions so the bottom of the dish is completely covered with the solution, about 10ml per dish. You will now have 20 minutes to observe the embryos and record observations for each group on the data collection sheet.
    g. Put the petri dishes in the incubator.

    Controlled, manipulated, and responding variable:

4. **Collect data from your experiment using the Data Collection Form:**

5. Draw conclusions from your experiment based on your data:-Explain the results of your experiment using data you collected to support your conclusion(s). Was your hypothesis supported by your data? Is there anything you thought had an effect on the results of your experiment? What would you do differently if you were to do your experiment over?

Caffeine Experiment Data Collection Form: Control Group

Number of living embryos		Specific Daily Data	Living/nonliving #s	Drawings of Living Embryos
Day 1	Angle of Development	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Yolk Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Eye Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
Day 2	Angle of Development	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Yolk Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Eye Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Heart Rate	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
Day 3	Angle of Development	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Yolk Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Eye Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Heart Rate	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		

Caffeine Experiment Data Collection Form: 100μg/mL Caffeine Solution Group

Number of living embryos		Specific Daily Data	Living/nonliving #s	Drawings of Living Embryos
Day 1	Angle of Development	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Yolk Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Eye Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
Day 2	Angle of Development	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Yolk Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Eye Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Heart Rate	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
Day 3	Angle of Development	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Yolk Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Eye Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Heart Rate	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		

Caffeine Experiment Data Collection Form: 200μg/mL Caffeine Solution Group

Number of living embryos		Specific Daily Data	Living/nonliving #s	Drawings of Living Embryos
Day 1	Angle of Development	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Yolk Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Eye Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
Day 2	Angle of Development	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Yolk Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Eye Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Heart Rate	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
Day 3	Angle of Development	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Yolk Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Eye Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Heart Rate	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		

Caffeine Experiment Data Collection Form: 400μg/mL Caffeine Solution Group

Number of living embryos		Specific Daily Data	Living/nonliving #s	Drawings of Living Embryos
Day 1	Angle of Development	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Yolk Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Eye Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
Day 2	Angle of Development	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Yolk Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Eye Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Heart Rate	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
Day 3	Angle of Development	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Yolk Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Eye Size	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		
	Heart Rate	1. _______ 2. _______ 3. _______ 4. _______ Ave:______		

Rubric: Presentation of Caffeine Experiment Results

Task	Score 3	Score 2	Score 1	Your Score
Presentation	All group members contribute to the presentation. Presenters use eye contact, are easy to hear and understand. Presentation is 3-4 minutes long.	Most group members contribute to the presentation. Presenters eye contact or speech need improvement Presentation is 2-3 minutes long.	One or two group members contribute to the presentation. Presentation is less than 2 minutes long. Presenters are hard to understand and/or hear.	
Visual display of results from experiment	All students are able to see and understand the visuals. The visual accurately displays the data the group collected. Group member (s) clearly explains the visual.	Visual display is not visible or understandable to the entire audience. The visual does not display all data or explanation is vague.	Visual display is of poor quality or is not visible. Data the group collected is not displayed or explained.	
Content of presentation	Group clearly states the problem and hypothesis. The results and conclusions of the experiment are well thought out and explained. Group provides at least one question that arose during the experiment.	Group states the problem, hypothesis, results and conclusion.	Group fails to state either the problem, hypothesis, results, or conclusion.	

Student Research Proposal

What are you going to study?

What question do you want answered?

Why are you going to study this? What do you hope to learn?

How are you going to study it? What will you need to have? What will you do?

What are some ways you could collect observations and data while you are studying this?

Appendix A Citations – Adapt the list below for your classroom (grade, age, relevance, recent cases, etc.)

Vogt, MaryEllen, and Jana Echevarria. *99 Ideas and Activities for Teaching English Learners with the SIOP Model*. Boston: Pearson Allyn and Bacon, 2008. Print.

Pictures/Persons for Photo Challenge Print the person and their name. You can include their job/ what they are known for as well. Do not print the reasons they are in the group. Depending on class size, pick a variety of people based on reasons they are in the group. Be sure to represent men and women, old/young, etc.			
Reason they are in the group	Person	Job, known for	picture/article taken from
Illegal steroids	Barry Bonds	baseball player, homerun record	http://www.time.com/time/specials/2007/article/0,28804,1640086_1640085_1640075,00.html
Steroids, legal at the time	Arnold Schwarzeneggar	body builder, governor, actor, author	http://www.girondatalks.com/portals/86/arnold-schwarzenegger-vince-gironda.jpg
Chemical awareness advocate	Viveka Bohn	Environmental Advocate, Sweden	http://www.iisd.ca/sd/conprod10Y/images/5sept/fifth.jpg
Has MCS (Multiple Chemical Sensitivity), exposed to farm chemicals as a child, lasting effects	Nancy Morris		http://www.getipm.com/articles/mcs-seattle.htm
Discovered link between thalidomide and birth defects	Francis Oldham Kelsey	Pharmacologist for FDA, President's award for Distinguished Federal Civilian Service	http://en.wikipedia.org/wiki/Thalidomide
Mother took thalidomide	Thomas Yendell	Painter	http://www.healthline.com/galeimage?contentId=gecd_02_00375&id=gecd_02_img0212
Mother took thalidomide	Thomas Quasthoff	Opera singer, musician	http://www.petererskine.com/ThomasQuasthoff
Affected physically and mentally as a child by Chernobyl plant explosion	Sasha Levkin	Disabled adult, Chernobyl Children's group	http://chernobyl.typepad.com/chernobyl_childrens_proje/images/2008/04/17/sashahero.jpg https://www.youtube.com/watch?v=Ou7Eiuql3fY
Technically an outlier	Dr. *Alice Stewart	Epidemiologist	http://www.newscientist.com/nlh/0805/stewart.html

Discovered link between x-rays and birth defects			
Acid attack	Anne Phong Nguyen	Volunteering to help burn survivors	http://interplast.blogs.com/interplast/sara_andersonhsiao/
Died of lung cancer	Marlboro Man	Being the image of rugged masculinity for an ad campaign	http://130.18.140.19/mmsoc/subliminal/marlboro.jpg
Exposed to Agent Orange as a soldier,	Mubarak Islam Rashid	Formerly in the military; advocate for soldiers	http://www.vn-agentorange.org/
Exposed to Agent Orange as a child and her offspring suffer, too	Thi Hoan Tran, also found as Tri Hoan Tran	Advocate	https://www.c-span.org/person/?124078/ThiHoanTran
Found chemical in drinking water caused cancers and defects in Hinckley, CA	Erin Brockovich	Work in law office, mother	http://www.brockovich.com/images/photos/p-solo2.jpg
Crashed into by drunk driver	Tiffani Ragan *Use a local person who was affected by a drunk driver*	Development Operations Coordinator, MADD advocate	http://www.kvue.com/news/top/stories/102609kvue_MADD_programs-cb.2562e74fa.html
Exposed to chemotherapy treatment	Carl Zimmerman *Use a local person who battling cancer with chemotherapy*		http://www.pbase.com/etlea/faces_of_mh
Exposed to chemicals on the job	Kevin Novinger	Automobile painter	Painter picture taken from: http://www.freefoto.com/images/13/51/13_51_51---Painter-Painting-a-house_web.jpg https://www.nytimes.com/1982/03/21/us/auto-painter-s-suit-says-he-was-poisoned-on-job.html
Extras to add when needed:	The following are all actors, musicians or athletes who used various chemicals		

1. Michael Jackson picture taken from: http://www.inquisitr.com/wp-content/Michael-Jackson1.jpg
2. Patrick Swayze picture taken from: http://blog.taragana.com/e/wp-content/uploads/2009/09/patrick-swayze1.jpg
3. Janis Joplin picture taken from: http://www.interestment.co.uk/wp-content/uploads/2009/06/janis-joplin.jpg
4. Jimi Hendrix picture take from: http://www.myclassiclyrics.com/artist_biographies/jimi_hendrix_biography.htm
5. Kurt Cobain picture taken from: http://weinterrupt.com/wp-content/uploads/kurt-cobain-photo.jpg
6. David Crosby picture taken from: http://rogerbourland.com/blog/wp-content/uploads/2006/08/David-Crosby-wm01.jpg
7. Chris Antley picture taken from http://graphics8.nytimes.com/images/2008/06/05/sports/crown190.jpg
8. Heath Ledger picture taken from: www.nilacharal.com/enter/celeb/heath_ledger.asp
9. Lindsay Lohan picture taken from: http://www.singerpictures.com/lindsay-lohan-pictures.html
10. Babe Ruth picture taken from: http://www.encyclopedia.com/topic/Babe_Ruth.aspx
11. Anna Nicole Smith picture taken from: http://www.starpulse.com/Actresses/Smith,_Anna_Nicole/gallery/JTM-009240/
12. Keith Richards picture taken from: http://www.learntheguitarnow.com/learn-guitar-blog/2009/01/figjam-guitarists.html
13. DJ AM picture taken from: http://thisislavie.com/wp-content/uploads/2008/11/dj-am-undefeated-tshirt.jpg
14. Amy Winehouse picture taken from: http://www.babble.com/CS/blogs/famecrawler/2009/04/3amy-winehouse.jpg

Appendix B: effects of caffeine on humans

Caffeine is in coffee, tea, energy drinks, chocolate and lots of other food and drinks.

It has effects on:

- Brain: less tired, better concentration, grumpy, can't sleep (insomnia), feel worried/anxious
- Heart: faster heart rate: palpitations (an unpleasant awareness of your heartbeat)
- Digestive system: increased need to poop.
- Urinary system: increased need to pee.
- General: can affect how certain medicines work in your body – may increase or decrease the effect of certain medicines

If you have a lot of caffeine regularly and then stop, you can get a headache or feel tired, sad, grumpy. It might be more difficult to concentrate. This is called caffeine withdrawal.

Caffeine affects different people differently. Part of the reason for this is that when it is absorbed from your stomach/intestines, it passes through your liver where different enzymes work on it to break it down. Different people's enzymes work slightly differently, so some people break down caffeine more easily than others. Enzymes are chemicals in the body that make chemical reactions happen in the body.

How much caffeine is safe? No one really knows… in adults it is probably safe to have less than 400mg every day (about 2 cans of Monster) but in children/teenagers it is variable and depends on how big you are.

If discussed: excessive caffeine intake in pregnancy can cause narrowing of the blood vessels in the placenta (lining of the womb in pregnancy that transports nutrients from the mum to the baby) which can reduce the baby's growth.