ACTIVITY 6

Evaluating a Scientific Claim

GAME

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ACTIVITY SUMMARY

In this activity, students play a game that simulates an epidemiological investigation in the Southsand fever scenario. Students gather and analyze data about the fictional disease to determine the mode of transmission of Southsand fever. The task includes the slow, actively open-minded techniques they learned in the unit so far to investigate a series of hypotheses they develop. The activity concludes when students completely evaluate the evidence and construct a claim about how Southsand fever spreads.

ACTIVITY TYPE
GAME

NUMBER OF
40–50 MINUTE
CLASS PERIODS
2-3

KEY CONCEPTS & PROCESS SKILLS

1 Common scientific practices are designed to support slow thinking, which makes scientific conclusions more reliable.

2 An actively open mindset helps reduce errors from cognitive biases and cognitive shortcuts by deliberately seeking out new ideas and information that could change one's mind.

NEXT GENERATION SCIENCE STANDARDS (NGSS) CONNECTIONS:
Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. (*Science and Engineering Practice: Engaging in Argument From Evidence*)

Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. (*Science and Engineering Practice: Engaging in Argument From Evidence*)

CONCEPTUAL TOOLS

VOCABULARY DEVELOPMENT

disease transmission
(assumed prior knowledge)
the various ways that infectious diseases can spread

epidemiologist
a scientist who studies the patterns, causes, and control of disease in groups of people

hypothesis
(assumed prior knowledge)
a possible explanation for observations, facts, or events that may be tested by further investigation

TEACHER BACKGROUND INFORMATION

Disease Outbreak Response

Potential outbreaks can be identified by surveillance systems that monitor health-related events and data from sources such as hospitals, clinics, laboratories, healthcare providers, schools, public reports, or even social media trends. A public health team will respond to an outbreak in three major stages that identify the outbreak, find the cause of the outbreak, and then manage the outbreak. The order of these steps and the work needed for each step will vary depending on the outbreak. For example, public health teams will often implement prevention and control measures (e.g., recommending hand washing) before they know the exact cause or source.

Identifying the Outbreak

In the first stage, epidemiologists will compile a list of possible illnesses and establish a public health team. Next, they will establish if an outbreak is actually occurring by comparing the current case count to historical data. They consider the speed and severity of the illness to decide if it is an outbreak. If possible, a laboratory professional will also verify the diagnoses and identify the disease-causing agent. Once an outbreak is confirmed, a detailed case definition is established to identify which individuals are to be considered affected by the outbreak. A public health team then systematically collects and records information on affected individuals including demographics, symptoms, and potential exposures. All the relevant data for each case is compiled in a table called a line list. Biostatisticians will then analyze the data to identify patterns and trends such as similarities in age, location, or activities among cases.

Finding the Cause of the Outbreak

In the second stage, investigators attempt to pinpoint the source of the outbreak. This often involves constructing epidemiological curves, which visualize the distribution of cases over time. By examining these curves, patterns emerge that can suggest the nature of the outbreak, such as a point source, common source, or propagated outbreak. Environmental investigations may also be conducted to identify potential contamination sources. The public health team will develop hypotheses based on relevant information (e.g., usual sources of the disease-causing agent, the cluster or spread of the disease, age groups affected), and a biostatistician will evaluate the hypotheses by comparing the rates of affected

and unaffected populations with the same exposure factor. If there is a strong association between a given factor and the illness, further collection of environmental data or tests looking for the disease-causing agent can be used to confirm the epidemiology data.

Managing the Outbreak

In the third stage, the public health team attempts to control the spread of disease, prevent further cases, and identify measures to improve public health preparedness for future outbreaks. This can include the collaboration of various public health professionals. Infection prevention specialists will contact or visit source areas to inspect and recommend actions to prevent spread; behavioral scientists will consider human interactions to try to decrease exposure. Health communication specialists will create messaging and reach out to the public by providing information about prevention, symptoms, community resources, and treatment, if available. In the meantime, the public health team will initiate and maintain a surveillance system for the outbreak. By continuing to collect and analyze data, they monitor if the disease is decreasing and if the control measures are working.

MATERIALS & ADVANCE PREPARATION

FOR THE TEACHER

- VISUAL AID 6.1 "Scoring Guide: Engaging in Argument from Evidence (ARG)"
- ITEM-SPECIFIC SCORING GUIDE: Activity 6, Build Understanding Item 1
- VISUAL AID 4.1 "Actively Open Mindset"
- VISUAL AID 2.1 "Developing Communication Skills" (OPTIONAL)

FOR EACH GROUP OF FOUR STUDENTS

- SOUTHSAND CITY GAME BOARD
- SET OF INTERVIEW CARDS (12 cards)
- SET OF DATA CARDS (6 cards)
- SET OF EVENT CARDS (6 cards)
- NUMBER CUBE
- 4 GAME PIECES
- STUDENT SHEET 6.1 "Southsand Fever Hypotheses"
- STUDENT SHEET 6.2 "Evidence from Interviews: Infected People"
- STUDENT SHEET 6.3 "Evidence from Interviews: Healthy People"
- STUDENT SHEET 6.4 "Field Notes from Data Cards and Event Cards"

FOR EACH STUDENT

- STUDENT SHEET 6.5 "Comparing Infected and Healthy Individuals" (OPTIONAL)
- STUDENT SHEET 6.6 "Writing Frame: Activity 6, Build Understanding Item 1" (OPTIONAL)
- SCORING GUIDE: Engaging in Argument from Evidence (ARG) (OPTIONAL)

To prepare for the game, print the game board map (two separate pages) and the three complete sets of cards for each group. The cards can be printed double-sided to show the card type on the back or printed one-sided and labeled on the back by hand before use. The game board map can be taped or glued together. The game pieces can be sets of any four items that are distinguishable and easily available from home or the classroom such as colored beads, coins, paper clips, or old marker caps.

TEACHING NOTES

Suggestions for **discussion questions** are highlighted in gold.

Strategies for the **equitable inclusion of diverse students** are highlighted in light blue.

GETTING STARTED (20 MIN)

1 **Discuss the role of disease transmission in an outbreak.**

- Begin by asking, How are infectious diseases spread? Accept all responses at this time. Students may suggest that infectious diseases can spread from blood or other bodily fluids, direct physical contact, through the air on dust or in droplets (from coughing, for example), touching dirty surfaces, sexual intercourse, eating or drinking contaminated food or liquids, or by bites from insects or other animals. Build upon students' experiences with disease and allow them to brainstorm from lived experiences.
- Support students in sharing their knowledge about disease and validating their points of view by eliciting students' observations, experiences, and knowledge as assets to building understanding.
- If students are not familiar with the basics of disease transmission, review the process by referring them to the Science Review at the end of the activity in the Student Book. Some students may confuse infectious disease with contagious disease. If helpful, after brainstorming modes of transmission, have students review the Science Review from Activity 1. Clarify that infectious diseases are passed from any type of organism to another, whereas a contagious disease is an infectious disease passed from person-to-person.
- Students may also be confused by the difference between the organism that causes the disease (known as a pathogen, which is formally introduced in Activity 8) and the organisms through which the infectious disease spreads (called a vector). For example, fire blight is a disease that affects apple trees and pear trees; it is infectious because it spreads from tree to tree by wind or by insects or birds that visit between trees. However, the pathogen being spread from organism to organism that causes fire blight is a bacterium. The trees, insects, and birds are vectors.
- Ask, How would discovering the way an infectious disease is transmitted help to prevent more illness? Students may share that knowing how an infectious disease is transmitted helps to develop specific ways to stop it from spreading. This could either be ways of preventing infection (e.g., wearing masks, washing hands) or ways to reduce sick individuals from making others sick (e.g., isolating individuals at an early stage or developing vaccines). Let students know that in this activity, they are going to try to figure out how people in Southsand are getting sick.

PROCEDURE SUPPORT (40-60 MIN)

2 Introduce the fictional scenario and review the procedure for Part A.

- The scenario presented in Step 1 can be shared with the class in multiple ways. Read the scenario aloud to the class or have individual students read it aloud while others follow along with the text (either as a whole class or in small groups).
- Reading the scenario aloud can better support comprehension for many students, including neurodiverse students and emerging multilingual learners who often have more highly developed listening and oral skills than reading comprehension skills. Alternatively, students can read the scenario independently.
- Let students know that by playing a game to discover the modes of transmission of Southsand fever, they will conduct an investigation similar to how epidemiologists study diseases in real life. Emphasize that the goal of the game is to figure out as a team of four how Southsand fever is spreading—not as individuals trying to win their own group's play.
- Students will need to work together effectively to conduct the investigation. To support students' discussion, you may wish to use optional Visual Aid 2.1, "Developing Communication Skills," to help guide student interactions. This visual aid (introduced in Activity 2) is a tool to help students effectively participate in class discussions by providing sentence starters that students can use to initiate a conversation and express their ideas. For more information about Developing Communication Skills, see Appendix 1: Literacy Strategies.
- Students begin by discussing how they think Southsand fever could possibly be spreading in the community. Student ideas will vary, depending on their background knowledge of infectious diseases. If appropriate, have students read the Science Review to help support their ideas.

Sample Student Response, Procedure Step 2

I think the disease is spreading through the air, like a flu or cold, but it is not a flu or a cold.

- In Procedure Step 3, show Visual Aid 4.1, "Actively Open Mindset," to remind students of the metacognitive prompts for an actively open mindset. While most students will focus on slow thinking, remind them that fast thinking can also be helpful.

Sample Student Response, Procedure Step 3

Hopefully, we will not use a lot of fast thinking and instead use more slow thinking as we figure out how people are getting sick in Southsand City. We should watch out for all the cognitive shortcuts and cognitive biases we learned about in the unit. One of the big ones we need to be careful of is confirmation bias because we all have ideas formed about how people are catching Southsand fever.

- Assign students to groups and distribute one copy each of the following student sheets to each group:
  - Student Sheet 6.1, "Southsand Fever Hypotheses"
  - Student Sheet 6.2, "Evidence from Interviews: Infected People"
  - Student Sheet 6.3, "Evidence from Interviews: Healthy People"
  - Student Sheet 6.4, "Field Notes from Data Cards and Event Cards"

  Explain that each group member will be in charge of recording information on only one of the four student sheets. Point out that this is similar to the way professional epidemiologists record a lot of data in order to find patterns in the data. An especially important sheet is Student Sheet 6.1, "Southsand Fever Hypotheses," as it is a way to record the groups' most plausible hypotheses and revise them as they collect evidence during game play. Sample Student Responses to all four student sheets are found at the end of this activity. (Note that for sample student response on Student Sheet 6.1, the listed relevant game cards in the last column relate to the hypotheses that are crossed-out as well as the ones that are not.)

- As groups record their ideas on Student Sheet 6.1, encourage them to discuss evidence they have that either supports or refutes each hypothesis. They should consider at least two hypotheses before they begin the game. Be sure to mention that scientists sometimes identify several hypotheses at the start of an investigation.
- Support students, particularly emerging multilingual learners, in sensemaking and language acquisition as they read the Science Review, Field Notes in Part A (from Student Sheet 6.4), and the card sets and game materials in Part B.

3 Students revise their hypotheses after each round of play.

- In Procedure Step 6, distribute all the materials for the game to each group: a Southsand City game board, 4 game pieces, a number cube, a set of Interview cards, a set of Data cards, and a set of Event cards. Expect that students will take 4–5 rounds of play to circumnavigate the game board and draw most of the cards.
- After each team completes one round of play, they should stop and reconsider their hypotheses based on the evidence they have collected in that round. Procedure Step 9 guides students through this slow-thinking process. Emphasize that all group members are responsible for checking that each hypothesis still fits the evidence, regardless of who records it on Student Sheet 6.1.
- The hypotheses across groups might vary. Sample student hypotheses are provided on Student Sheet 6.1 at the end of this activity. At the end of the rounds of play, ask, Would you like more evidence to help determine if your hypotheses are correct or not? Responses will undoubtedly be yes; students will want more evidence to figure out how the disease is transmitted. Reinforce this idea of adding evidence as part of using an actively open mindset.
- As they play, let students know that even though they have at least one plausible hypothesis at this point, it is important for them to stay open to new information, alternative ideas, and to evaluate new evidence fairly as they continue the game.

- As students work through the evidence, they may have difficulty deciding when they have enough evidence to rule out a certain hypothesis or deciding on a correct hypothesis when definitive evidence is lacking. To help students deal with uncertainty, you can prompt them to consider the following when comparing hypotheses:
  - how strongly each piece of evidence supports or rejects a hypothesis
  - the number of pieces of evidence and what the combination indicates

  You may want to pause the play around the middle of the game and lead a shareout about each group's leading hypothesis. This allows students to compare their ideas and hypotheses. Keep in mind that at the midpoint of the game, groups have different data, so they are likely to have different ideas as a result.

4 Support groups as they analyze epidemiological data in Procedure Part B.

- In Procedure Step 11, students use the data they collected in the game to calculate the rates of infected and healthy individuals exposed to each factor in Table 6.1. If you would like to provide a preconstructed table instead of having each student make their own in their science notebook as instructed, provide optional Student Sheet 6.5, "Comparing Infected and Healthy Individuals." A sample student response to this student sheet is shown at the end of this activity.

- If needed, support students by modeling the percentage calculation by dividing the number of *yes* responses for a given factor by the total number of individuals interviewed. For students with limited mathematical ability, you may want to provide the completed calculation, using the sample student response to Student Sheet 6.5

- Using Student Sheet 6.5, review the percentages of infected and healthy individuals exposed to each factor. To help students interpret the data, discuss how epidemiologists compare the rates of infected and healthy groups for each factor to identify the most probable cause of an illness. A higher rate of people exposed to a factor (such as being a construction worker) in the infected group makes it more likely that the factor is related to causing the disease, while similar rates in both groups (such as eating locally grown corn) make it less likely that the factor is related. If there are similar chances of either becoming infected or remaining healthy, that factor is probably not causing the disease.

- Let students know that the type of analysis they completed in Procedure Step 12 is similar to how epidemiologists look for patterns in data, albeit with much more data and computer assistance.

5 Have a class discussion about how groups arrived at a final hypothesis.

- In Procedure Step 13, ask each group to share their final hypothesis(es) with the rest of the class. Ask, Can the class reach an agreement on a single explanation for transmission? Facilitate a discussion so groups can compare their ideas and try to reach a consensus. The sample size of the data is very limited, and making a strong conclusion is challenging. However, the following pieces of evidence may help clarify a claim they can make based on their final hypothesis:

- Many more people who worked outside became infected than those who have other types of jobs.
- Attending the kite festival is likely to be related to getting the disease because the difference in the number of people who attended the festival is higher than the number who attended and remained healthy.
- It is questionable if having a dog is likely to be related to causing the disease because the number of people who have dogs and became infected was higher than those who don't have dogs and became infected, but not by a large amount.
- Eating locally grown corn does not appear to be significant because there is the same percentage between infected and healthy individuals.

- In Procedure Step 14, hold a class discussion about how students did and did not engage in aspects of using an openly active mindset during the activity. Students may have experienced times in the game when they were aware that they jumped to a conclusion or used a cognitive shortcut or when they had confirmation bias.

Sample Student Response, Procedure Step 14

I tried not to use fast thinking during the activity, but the first card we drew made me jump to a conclusion. The first card made me think that the disease was foodborne. It was an availability shortcut because it was the first card we read. It was also one that supported what I thought was going on about Southsand fever before we started the game, so it also led to confirmation bias. After we paused the game, I slowed down my thinking, and that helped reduce cognitive shortcuts and cognitive biases.

SYNTHESIS OF IDEAS (20-30 MIN)

6 **Build Understanding item 1 can be assessed using Scoring Guide: Engaging in Argument from Evidence (ARG).**

- Remind students of the Engaging in Argument from Evidence (ARG) Scoring Guide. You may wish to project Visual Aid 6.1, "Scoring Guide: Engaging in Argument from Evidence (ARG)," for your students to review each level and clarify your expectations..
- Do not share the item-specific version of the Scoring Guide (Item-Specific Scoring Guide: Activity 6, Build Understanding Item 1) with students as it provides specific information on how to respond to the item prompt.
- Remind students that you expect to see them demonstrate growth in their understanding and explanation of engaging in argument from evidence and that they may want to review their responses to the assessment in Activity 3 (Build Understanding item 4). You may also want to let students know that they will have one more opportunity in the unit to be assessed (Activity 9, Build Understanding item 1).

- Sample responses for Levels 1–4 are provided in the Build Understanding section that follows. Review these responses to get an idea of what is expected for each level alongside the Item-Specific Scoring Guide. See Appendix 2: Assessment Resource at the end of the Teacher's Guide for more guidance and information on using the Scoring Guides and assessment system with your students.

- Depending on your students, you may want to have them provide feedback on one another's work for revision prior to turning in their work to you for scoring. Alternatively, consider having students turn in a rough draft to you for feedback and revision.

- The formal assessment opportunity can be completed by a variety of alternative options other than a written argument, including a presentation; creation of a graphic, poster, or video; or through a debate format. Consider whether any changes to the scoring guide or prompt will be necessary for students to complete an alternative assessment format.

7 Use Build Understanding item 2 to review the metacognitive aspects of the activity.

- Evaluate if your students can identify the essential ideas of the activity by reviewing their answers to Build Understanding item 2 as a class. Then ask, In what ways did slow thinking—such as using complex information, using math, considering the likelihood of an event, and considering alternate causes—help you to reach a final conclusion for your disease investigation? Students should realize that using:
  - percentages calculated from the data collected in the game helped to come up with the most likely factor related to causing the disease.
  - different kinds of evidence (data and observations from Interview cards, Data cards, and Event cards) increased the reliability of their conclusion by preventing it from being based on a single piece of information.
  - reasoning helped them to evaluate each piece of evidence as supporting or refuting different hypotheses and to combine evidence to reach a conclusion.

- Ask, In what ways did using an actively open mindset during your investigation help to prevent confirmation bias? Hopefully, students tried to use an actively open mindset during the game play to help them stay open to many different hypotheses and not to favor just one. In particular, this activity focused on the acquisition or need for new information when the evidence on hand is not enough to prove or disprove a hypothesis. Students should explain that an actively open mindset helped them prevent confirmation bias by encouraging them to:
  - stay open to many different hypotheses, rather than favoring a single one.
  - consider evidence for and against each hypothesis fairly and impartially.
  - be open to new information, even when that evidence directly refuted their current leading hypothesis.

  All of this should help students recognize that an actively open mindset motivates someone to follow the data wherever it leads, instead of just searching for information that confirms their existing beliefs.

- Finally, discuss with students what the epidemiologists would do after figuring out how Southsand fever is transmitted. Students should see that the next step would be to inform the public. This foreshadows Activity 10 when they will construct a Public Service Announcement (PSA) to do just that.
- Finish the activity by revisiting the Guiding Question, *How can an actively open mindset help to make a scientific claim?* Use responses to this question to formatively assess students' understanding of key concepts and process skills related to the purpose of using slow-thinking techniques and an actively open mindset.

SAMPLE STUDENT RESPONSES

BUILD UNDERSTANDING

① ARG Scoring Guide

How do you think Southsand fever is being transmitted? Develop an argument supported by evidence from your disease investigation. In your response:

- **a make a clear claim about how Southsand fever is or is not being transmitted.**
- **b support your claim, using at least 3 pieces of evidence gathered in the activity. Use reasoning to explain how each piece of evidence supports your claim.**
- **c describe and explain at least 1 piece of evidence against your claim or that supports an alternate claim. Use reasoning to explain why you still support your claim as the most likely.**

Student responses may vary but should include that the disease is spreading by breathing in dust particles that carry the disease instead of being spread from person to person.

Level 4 response

- **a** *My claim is that Southsand fever is being transmitted by breathing in dry soil particles in the air that contain the disease.*
- **b** *First, the interview data showed that the factor that made the biggest difference between the infected and healthy groups was being a construction or agricultural worker—82% (9 of 11) of people who got infected worked in one of those types of jobs, compared to only 36% of healthy people. Second, a survey found that 75% of patients with Southsand fever regularly work outdoors. Both of these strongly support the idea that working outside and near soil could be where people got infected because the numbers come from all the individuals interviewed, not just a few of them. Third, a couple of specific events also support my claim. For example, Lumi Hernandez and her dog both got sick after breathing in dust while on a hike. Similarly, a scientist became sick after digging up soil without wearing a mask. These are anecdotes, so they are weaker evidence than the interview information. But all together, it suggests that people are breathing in soil to get the disease, especially in dusty places such as construction sites.*
- **c** *An alternate claim is that the disease is spreading from person to person instead. The fact that most respiratory diseases are contagious supports this idea. However, other evidence does not support this claim. For instance, almost no healthcare workers have gotten sick with the disease over the last couple of months, even though they have treated a lot of very sick people. Likewise, the doctor got sick in the field while alone, so I still believe that it's most likely that the disease is spreading by breathing in soil particles.*

Level 3 response

a *I think it's being transmitted by people breathing in dust with the disease.*

b *My first piece of evidence is that Lumi and her dog got Southsand fever after going on a hike in dry soil and breathing in dust. Her dad never got sick later, even after she came home. This means that the disease is probably not spreading from person to person (is not contagious), and she got it from the dust. Second, a scientist was alone without wearing a mask and got sick when he was digging up soil samples. I think these are good pieces of evidence because both are firsthand accounts of what happened. My third piece of evidence is that most people who got Southsand fever were construction workers. All of this supports the idea that the disease could be spreading by breathing in the dust with the disease.*

c *One piece of evidence against my claim is that Chloe, a doctor in a hospital, caught Southsand fever. Since she works in a clean hospital and wears a mask, you wouldn't expect her to get sick from dust. However, she still could have been exposed to dust outside of work, just like Lumi was when she went on her hike.*

Level 2 response

a *The disease is spreading because of the soil.*

b *The scientist got sick when he was digging, showing that soil was the cause. Also, there was a dust storm at the end of the kite festival, and lots of people got infected after that.*

c *However, the number of dogs getting infected by the disease has been increasing. Because of this, we can't be sure if the soil or pets is spreading the disease.*

Level 1 response

a *A disease can be tracked by interviewing patients and using data from lab tests.*

b *Most of the people in Southsand City work in construction or agriculture.*

c *However, only some of them eat corn from local farms, which could have had the disease.*

② **Identify at least two cognitive thinking skills that were helpful in conducting your investigation. Explain why each was helpful.**

I used math as a slow-thinking technique to calculate the exposure rates and determine which factor was the most likely cause. An actively open mindset was important for my final hypothesis because it kept me from just picking a favorite idea at the start. I tried to look at the evidence for and against every hypothesis fairly. This meant that I was willing to accept new information, even if it went against my current hypothesis.

③ **What is the difference between simply agreeing with evidence that supports your hypothesis and maintaining an actively open mindset?**

Keeping an actively open mindset is different from just agreeing with evidence because you don't just check if the evidence works. You make sure it actually supports your hypothesis, and you purposefully try to find evidence that might prove it wrong. It's about honestly considering other hypotheses to see if they make more sense than your own and being willing to change how sure you are about your idea as you find new facts.

CONNECTIONS TO EVERYDAY LIFE

④ **Imagine you were diagnosed with a medical illness. Why would it be important for you that the scientists studying that illness use slow thinking and an actively open mindset?**

It would be important for scientists to study that illness using slow thinking to make sure their research is accurate and using an actively open mindset to reduce cognitive bias. For example, if scientists were biased toward a certain treatment, they might not be open to testing other ones that could be more effective, or they might not try to study any side effects that could be there. This could result in a delay in getting the most safe and effective drug for patients.

⑤ **Describe a situation in your everyday life when using an actively open mindset could help you make a better decision.**

Right now, I am deciding on whether I want to apply to college or not. I think it is important to find out new information about what college would be like, where I might be able to get admitted, and if I can afford it. I have to be open to ideas other than the ideas of my counselors and parents and look for evidence for and against a decision. It will take some slow thinking!

STUDENT SHEET 6.1

SOUTHSAND FEVER HYPOTHESES

NAME

HYPOTHESIS 1	RELEVANT GAME CARD(S)

HYPOTHESIS 2	RELEVANT GAME CARD(S)

HYPOTHESIS 3	RELEVANT GAME CARD(S)

HYPOTHESIS 4	RELEVANT GAME CARD(S)

CONTINUED

HYPOTHESIS 5	RELEVANT GAME CARD(S)

HYPOTHESIS 6	RELEVANT GAME CARD(S)

HYPOTHESIS 7	RELEVANT GAME CARD(S)

HYPOTHESIS 8	RELEVANT GAME CARD(S)

SOUTHSAND FEVER HYPOTHESES

NAME SAMPLE STUDENT RESPONSE

HYPOTHESIS 1	RELEVANT GAME CARD(S)
~~*The food at the kite festival could be causing the disease.*~~ *The corn at the kite festival could be causing the disease.*	*Event 5 (supporting)* *Event 6 (refuting)* *Data 6 (refuting)*

HYPOTHESIS 2	RELEVANT GAME CARD(S)
~~*People are getting sick at the hospital.*~~	*Interview 1 (supporting)* *Interview 1 (refuting)* *Interview 12 (refuting)* *Data 5 (refuting)*

HYPOTHESIS 3	RELEVANT GAME CARD(S)
~~*It is spreading from person-to-person like at the kite festival .*~~ *The disease is spreading from person-to-person.*	*Data 6 (supporting)* *Data 5 (refuting)* *Event 2 (refuting)* *Event 4 (refuting)*

HYPOTHESIS 4	RELEVANT GAME CARD(S)
~~*The disease is spread by dogs.*~~ *Dogs can be infected by the disease but can't spread it to people.*	*Data 4 (supporting)* *Event 1 (supporting)* *Interview 8 (supporting)* *Event 3 (refuting)* *Data 1 (refuting)*

CONTINUED

HYPOTHESIS 5	RELEVANT GAME CARD(S)
~~*The disease could be caused by working in construction.*~~ ~~*The disease could be from breathing in dust outside.*~~	*Event 1 (supporting)* *Event 2 (supporting)* *Data 2 (supporting)* *Interview 1 (refuting)*

HYPOTHESIS 6	RELEVANT GAME CARD(S)
~~*The disease is being spread by chickens.*~~	*Interview 7 (refuting)* *Event 6 (refuting)* *Data 1 (refuting)*

HYPOTHESIS 7	RELEVANT GAME CARD(S)
~~*The disease is being spread to humans by rodents.*~~	*Interview 1 (supporting)* *Event 3 (refuting)* *Data 1 (refuting)*

HYPOTHESIS 8	RELEVANT GAME CARD(S)
~~*The disease is being spread by cats.*~~	*Event 3 (refuting)* *Data 6 (refuting)*

INFECTED INDIVIDUALS

INTERVIEW CARD NUMBER: NAME	ATE LOCALLY GROWN CORN? YES / NO	CONSTRUCTION OR AGRICULTURE JOB? YES / NO	ATTENDED KITE FESTIVAL? YES / NO	HAVE DOG(S)? YES / NO	NOTES
TOTAL YES RESPONSES					

INFECTED INDIVIDUALS

INTERVIEW CARD NUMBER: NAME	ATE LOCALLY GROWN CORN? YES / NO	CONSTRUCTION OR AGRICULTURE JOB? YES / NO	ATTENDED KITE FESTIVAL? YES / NO	HAVE DOG(S)? YES / NO	NOTES
1: Chloe Bennet	*no*	*no*	*no*	*no*	*works at hospital, has a cat, wears a mask*
2: Mr. Torres	*no*	*yes*	*yes*	*no*	*died, worked at same site as the Youngs*
2: Mrs. Torres	*no*	*yes*	*yes*	*no*	*owns and works on a cattle ranch*
3: Devin Patel	*no*	*yes*	*yes*	*yes*	*works at same site as the Youngs*
4: Isabella Young	*yes*	*yes*	*no*	*no*	
4: William Young	*yes*	*yes*	*no*	*no*	*died*
5: Michael Lee	*yes*	*yes*	*yes*	*yes*	
6: Sophia	*yes*	*yes*	*yes*	*no*	
6: Daniel	*yes*	*yes*	*yes*	*no*	
7: Mr. Moore	*no*	*yes*	*yes*	*no*	
8: Lumi	*yes*	*no*	*no*	*yes*	*works at a cafe, dog is infected*
TOTAL YES RESPONSES	*6*	*9*	*7*	*3*	

HEALTHY (UNINFECTED) INDIVIDUALS

INTERVIEW CARD NUMBER: NAME	ATE LOCALLY GROWN CORN? YES / NO	CONSTRUCTION OR AGRICULTURE JOB? YES / NO	ATTENDED KITE FESTIVAL? YES / NO	HAVE DOG(S)? YES / NO	NOTES
TOTAL YES RESPONSES					

HEALTHY (UNINFECTED) INDIVIDUALS

INTERVIEW CARD NUMBER: NAME	ATE LOCALLY GROWN CORN? YES / NO	CONSTRUCTION OR AGRICULTURE JOB? YES / NO	ATTENDED KITE FESTIVAL? YES / NO	HAVE DOG(S)? YES / NO	NOTES
1: Ethan Rodriguez	*yes*	*no*	*no*	*no*	*works at hospital, has a cat, wears a mask*
7: Mrs. Moore	*no*	*yes*	*no*	*no*	*was bitten by a rat a week ago*
8: Mr. Hernandez	*yes*	*yes*	*no*	*yes*	*dog is infected*
9: David	*yes*	*no*	*no*	*no*	*works at grocery store, 2 cats*
9: Kelsey	*yes*	*no*	*no*	*no*	*teacher, 2 cats*
10: Mr. Brown	*no*	*no*	*yes*	*no*	*died, worked at same site as the Youngs*
10: Mrs. Brown	*no*	*no*	*yes*	*no*	
10: Ava Brown	*no*	*no*	*no*	*no*	
11: Zoey Williams	*no*	*yes*	*yes*	*yes*	*has 3 dogs*
12: Mrs. Walker	*yes*	*no*	*yes*	*yes*	*works at hospital, 2 dogs*
12: Lucas	*yes*	*yes*	*yes*	*yes*	*works in cornfield, 2 dogs*
TOTAL YES RESPONSES	*6*	*4*	*5*	*4*	

FIELD NOTES FROM DATA CARDS AND EVENT CARDS

NAME

EVIDENCE CARD (TYPE AND NUMBER)	SUMMARY

EVIDENCE CARD (TYPE AND NUMBER)	SUMMARY
Event 1	*Lumi and her dog both breathed in dust while hiking. Her dog got sick 4 days later, and Lumi got sick 5 days later.*
Event 2	*A scientist was digging up dirt alone. Afterward, he got sick from the disease, but the doctors and nurses that treated him later never got sick.*
Event 3	*A vet never gets the disease from any dogs or cats even though he got bitten and scratched and never wore a mask. Five researchers who handled infected rats without wearing masks never got the disease.*
Event 4	*A doctor pricks himself with a scalpel that has the blood of a sick person on it, but he does not get sick.*
Event 5	*There is a big dust storm at the end of the kite festival. A public health worker finds that the corn at the kite festival was stored in a warm, humid silo, so it could have been contaminated.*
Event 6	*Food-safety inspectors don't find any contamination of chicken or corn from farms that provided food for the kite festival. No chickens on the farms show symptoms of the disease.*
Data 1	*Chickens cannot be infected with Southsand fever. A test shows that rodents, cats, and dogs can't spread the disease to each other.*
Data 2	*75% of patients with Southsand fever work outdoors, 20% work indoors, and 5% work in both locations.*
Data 3	*Southsand fever cases started in July after a heavy rain earlier in the year and then a drought. Cases started occurring during the dry summer months.*
Data 4	*Cases of Southsand fever in dogs have increased over the past 8 weeks.*
Data 5	*Out of 85 people who worked at the hospital without wearing masks, only 1 person got the disease.*
Data 6	*Southsand fever is a respiratory illness. Most respiratory diseases are contagious and not caused by eating contaminated food.*

COMPARING INFECTED AND HEALTHY INDIVIDUALS

FACTOR	INFECTED INDIVIDUALS (%)	HEALTHY INDIVIDUALS (%)
ate locally grown corn		
works outside		
attended the kite festival		
has dog(s)		

COMPARING INFECTED AND HEALTHY INDIVIDUALS

FACTOR	INFECTED INDIVIDUALS (%)	HEALTHY INDIVIDUALS (%)
ate locally grown corn	*6/11 = 0.55 x 100%* ***= 55%***	*6/11 = 0.55 x 100%* ***= 55%***
works outside	*9/11 = 0.82 x 100%* ***= 82%***	*4/11= 0.36 x 100%* ***= 36%***
attended the kite festival	*7/11 = 0.64 x 100%* ***= 64%***	*5/11= 0.36 x 100%* ***= 45%***
has dog(s)	*3/11 = 0.27 x 100%* ***= 27%***	*4/11= 0.36 x 100%* ***= 36%***

CLAIM (statement about how the disease is spreading)

My claim is:

EVIDENCE (data and observations related to the claim)

The first piece of evidence that supports my claim is

The second piece of evidence that supports my claim is

The third piece of evidence that supports my claim is

CONTINUED

REASONING (how or why each piece of evidence supports the claim)

First piece of evidence: My reasoning is that

Second piece of evidence: My reasoning is that

Third piece of evidence: My reasoning is that

Lastly, evidence against my claim or that supports an alternate claim is

However, I still support my claim as the most likely because

CLAIM (statement about how the disease is spreading)

My claim is:

that Southsand fever is spreading when people breath in soil particles in the air with the disease pathogen.

EVIDENCE (data and observations related to the claim)

The first piece of evidence that supports my claim is

that most people who got sick (82%) were construction or agricultural workers, while very few people who stayed healthy had those same types of jobs (36%).

The second piece of evidence that supports my claim is

that the scientist was alone without a mask and got sick after digging up soil. Also, although he died later, none of the people without masks at the hospital who treated him got sick.

The third piece of evidence that supports my claim is

that Lumi and her dog got Southsand fever after going on a hike in dry soil and breathing in dust. Also, her father, Mr. Hernandez, did not get sick afterward, even though she must have been around him.

CONTINUED

REASONING (how or why each piece of evidence supports the claim)

First piece of evidence: My reasoning is that

that Southsand fever is spreading when people breath in soil particles in the air with the disease pathogen.

Second piece of evidence: My reasoning is that

the scientist getting infected after digging alone is good evidence that also supports my claim. He could have easily breathed in the soil with the pathogen while he was digging. And he could not have gotten sick from person-to-person transmission because no one else was around him at the time.

Third piece of evidence: My reasoning is that

Lumi's hike also fits my claim because she definitely inhaled dust and got sick a few days later, which matches how long it took for the scientist to show symptoms of Southsand fever. Also, because Lumi's dad never got sick and they live together, it is more evidence that the disease is probably not spreading from person-to-person.

Lastly, evidence against my claim or that supports an alternate claim is

that both Lumi and her dog got sick with the disease after their hike. Based on this, an alternate claim is that she got sick from her dog having the disease instead of breathing in the dust.

However, I still support my claim as the most likely because

as far as we know, the scientist was alone and away from both people and dogs before getting Southsand fever. Also, there was not a big difference between people who got sick who had dogs (27%) and those who stayed healthy and had dogs (36%). This is pretty good evidence that having a dog probably does not cause someone to get sick.

VISUAL AID 6.1 | SCORING GUIDE: ENGAGING IN ARGUMENT FROM EVIDENCE (ARG)

WHEN TO USE THIS SCORING GUIDE:

This Scoring Guide is used when students are developing effective evidence-based arguments.

WHAT TO LOOK FOR:

- Response includes a clear and relevant claim.
- Response includes sufficient evidence, including multiple lines of evidence when appropriate.
- Reasoning is logical, sufficient, and connects the evidence to the claim.

LEVEL	GENERAL DESCRIPTION		
	CLAIM	EVIDENCE	REASONING
Level 4 **Complete and correct**	The student's claim is clear and relevant.	The student's evidence supports the claim; is relevant, accurate, and sufficient; AND the student evaluates the strength of the evidence in supporting the claim.	The student's reasoning is appropriate, logically connected to the claim, and sufficient.
Level 3 **Almost there**	The student's claim is relevant BUT incomplete.	The student's evidence is relevant, accurate, and sufficient.	The student's reasoning is appropriate and logically connected to the claim BUT is not sufficient.

LEVEL	GENERAL DESCRIPTION		
	CLAIM	EVIDENCE	REASONING
Level 2 **On the way**	The student's claim seems relevant BUT is unclear.	The student's evidence is relevant BUT is incomplete and/or contains inaccuracies.	The student's reasoning is incomplete or not logically connected to the claim.
Level 1 **Getting started**	The student's claim is irrelevant.	The student's evidence is irrelevant or does not support the claim.	The student's reasoning does not logically support the claim and does not connect the claim to the evidence.
Level 0 **Missing or off task**	The student provided no claim.	The student provided no evidence.	The student provided no reasoning.
X	The student had no opportunity to respond.		

ITEM-SPECIFIC SCORING GUIDE | ACTIVITY 6, BUILD UNDERSTANDING ITEM 1

WHEN TO USE THIS SCORING GUIDE:

This Scoring Guide is used when students are developing effective evidence-based arguments.

WHAT TO LOOK FOR:

- Response includes a clear and relevant claim.
- Response includes sufficient evidence, including multiple lines of evidence when appropriate.
- Reasoning is logical, sufficient, and connects the evidence to the claim.

LEVEL	ITEM-SPECIFIC DESCRIPTION		
	CLAIM	EVIDENCE	REASONING
Level 4 **Complete and correct**	The student's claim is clear and relevant.	The student's evidence supports the claim, is relevant, accurate, and sufficient, AND the student evaluates the strength of the evidence in supporting the claim.	The student's reasoning is appropriate, logically connected to the claim, and sufficient.

The student's response includes:

- a clear claim about how the fictional disease is being transmitted, specifying either how it spreads or how it does not spread.
- at least 3 pieces of evidence from the activity that includes at least 1 quantitative comparison of infected versus healthy groups.
- an accurate description of the strength of each piece of evidence.
- a thorough description of at least 1 piece of evidence that contradicts their claim or supports a different transmission method.

LEVEL	ITEM-SPECIFIC DESCRIPTION		
	CLAIM	EVIDENCE	REASONING
Level 3 **Almost there**	The student's claim is relevant BUT incomplete.	The student's evidence is relevant, accurate, and sufficient.	The student's reasoning is appropriate and logically connected to the claim BUT is not sufficient.
	The student's response includes: • a claim about how the fictional disease is being transmitted, specifying either how it spreads or how it does not spread. • a description of at least 3 pieces of evidence from the activity, but may not include a quantitative comparison of infected versus healthy groups. • at least 1 piece of evidence that contradicts their claim or supports a different transmission method. • a description of the strength of each piece of evidence that may not be accurate.		
Level 2 **On the way**	The student's claim seems relevant BUT is unclear.	The student's evidence is relevant BUT is incomplete and/or contains inaccuracies.	The student's reasoning is incomplete or not logically connected to the claim.
	The student's response includes: • an unclear claim about how the fictional disease is being transmitted. • 1 or 2 pieces of evidence from the activity to support their claim. • at least 1 piece of evidence that contradicts their claim or supports a different transmission method.		

LEVEL	ITEM-SPECIFIC DESCRIPTION		
	CLAIM	EVIDENCE	REASONING
Level 1 **Getting started**	The student's claim is irrelevant.	The student's evidence is irrelevant or does not support the claim.	The student's reasoning does not logically support the claim and does not connect the claim to the evidence.
	The student's response includes: • a claim that is unrelated to how the fictional disease is transmitted. • evidence that is irrelevant to transmission of the disease. • no evidence that contradicts their claim or that supports a different transmission method.		
Level 0 **Missing or off task**	The student provided no claim.	The student provided no evidence.	The student provided no reasoning.
X	The student had no opportunity to respond.		

INTERVIEW 1

HOUSEHOLD

Chloe Bennet: INFECTED
Ethan Rodriguez: HEALTHY

- Ethan ate locally grown corn recently, but Chloe has not had any for a very long time.
- Ethan works as a nurse, and Chloe is a doctor at the hospital. Both always wear masks at work.
- Did not attend the kite festival.
- No dog but they have a cat.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 5: SKILLS TO EVALUATE THINKING, ACTIVITY 6: INTERVIEW CARDS

INTERVIEW 2

HOUSEHOLD

Mrs. Torres: INFECTED
Mr. Torres: INFECTED, died of Southsand fever

- Neither had eaten any locally grown corn recently.
- Mr. Torres works at the same construction site as William and Isabella Young. Mrs. Torres owns and works on a cattle ranch.
- Both attended the kite festival.
- No dog.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 5: SKILLS TO EVALUATE THINKING, ACTIVITY 6: INTERVIEW CARDS

INTERVIEW 3

HOUSEHOLD

Devin Patel: INFECTED

- He had not eaten locally grown corn recently.
- He works at the same construction site as William and Isabella Young.
- He attended the kite festival.
- Has a dog.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 5: SKILLS TO EVALUATE THINKING, ACTIVITY 6: INTERVIEW CARDS

INTERVIEW 4

HOUSEHOLD

Isabella Young: INFECTED
William Young: INFECTED, died of Southsand fever

- Both ate locally grown corn recently.
- William is a construction worker. Isabella is a site inspector at the same construction project.
- Neither attended the kite festival.
- No dog.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 5: SKILLS TO EVALUATE THINKING, ACTIVITY 6: INTERVIEW CARDS

INTERVIEW 5

HOUSEHOLD

Michael Lee: INFECTED

- Ate locally grown corn.
- Works for a construction company that digs wells.
- He attended the kite festival.
- Has a dog.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 5: SKILLS TO EVALUATE THINKING, ACTIVITY 6: INTERVIEW CARDS

INTERVIEW 6

HOUSEHOLD

Sophia: INFECTED
Daniel: INFECTED

- Both ate locally grown corn.
- Both are farmers who recently bought land for a new corn farm.
- Both attended the kite festival.
- No dog.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 5: SKILLS TO EVALUATE THINKING, ACTIVITY 6: INTERVIEW CARDS

INTERVIEW 7

HOUSEHOLD

Mr. Moore: INFECTED
Mrs. Moore: HEALTHY

- Neither ate any locally grown corn.
- They both work on a chicken farm. Mrs. Moore was bitten by a rat on the farm a week ago.
- Mr. Moore attended the kite festival alone.
- No dog.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 5: SKILLS TO EVALUATE THINKING, ACTIVITY 6: INTERVIEW CARDS

INTERVIEW 8

HOUSEHOLD

Mr. Hernandez: HEALTHY
Lumi: INFECTED

- Both ate locally grown corn.
- Mr. Hernandez works in construction downtown. Lumi works at a cafe.
- Neither attended the kite festival.
- The family has a dog that is infected.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 5: SKILLS TO EVALUATE THINKING, ACTIVITY 6: INTERVIEW CARDS

INTERVIEW 9

HOUSEHOLD

David: HEALTHY
Kelsey: HEALTHY

- Both ate locally grown corn.
- David works at a grocery store, and Kelsey is a teacher.
- They did not attend the kite festival.
- No dog but they have 2 cats.

INTERVIEW 10

HOUSEHOLD

Mr. Brown: HEALTHY
Mrs. Brown: HEALTHY
Ava Brown: HEALTHY

- All three had not eaten any locally grown corn for months.
- None of them work in construction or agriculture.
- Parents attended the kite festival, but Ava did not.
- No dog.

INTERVIEW 11

HOUSEHOLD

Zoey Williams: HEALTHY

- Did not eat locally grown corn.
- Works at the cattle ranch for Mrs. Torres.
- Attended the kite festival.
- Has 3 dogs.

INTERVIEW 12

HOUSEHOLD

Mrs. Walker: HEALTHY
Lucas: HEALTHY

- Both ate locally grown corn at the kite festival.
- Mrs. Walker works in the emergency department of the hospital. Lucas is a cornfield worker.
- Both attended the kite festival.
- They have 2 dogs.

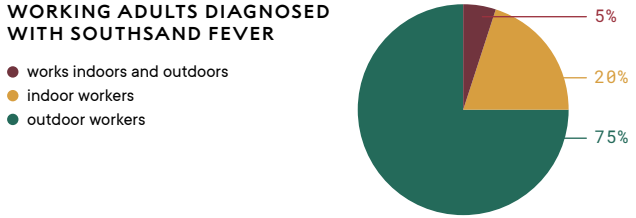
DATA 1

A team of scientists confirms that chickens do not carry the disease.

The team also ran experiments to see if sick rats, sick cats, and sick dogs can pass the illness to healthy animals of the same kind. Even though they touched each other and breathed the same air, the healthy rats, cats, and dogs did not catch the disease. Scientists conclude that Southsand fever does not transmit between animals.

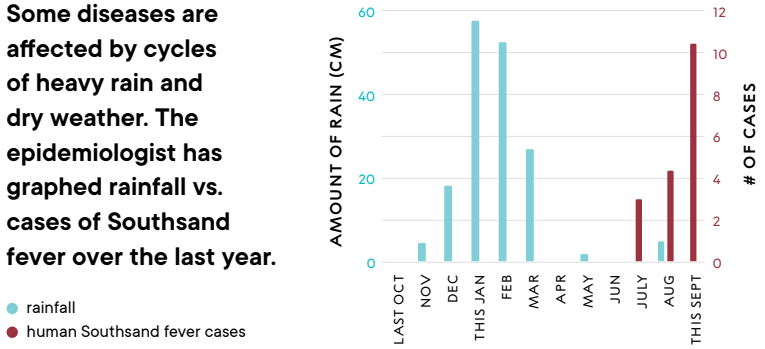
DATA 2

Data from the hospital showing the percentage of adult patients with Southsand fever who primarily work indoors, outdoors, or in both types of locations.



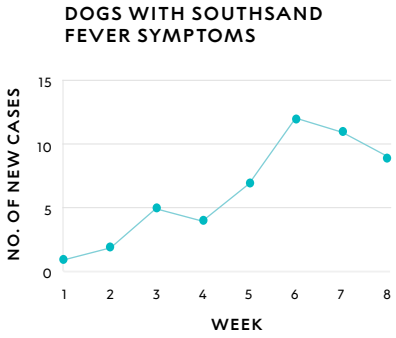
DATA 3

Some diseases are affected by cycles of heavy rain and dry weather. The epidemiologist has graphed rainfall vs. cases of Southsand fever over the last year.



DATA 4

Scientists have tracked new cases of Southsand fever in dogs over the past 8 weeks.



DATA 5

Since the first sign of the disease, 219 people from the community have been treated at the hospital. Some of the patients had severe symptoms and could not stop coughing. Despite this, almost no members of the hospital staff have gotten Southsand fever. Of the 85 medical workers who don't regularly wear masks, only 1 has contracted the disease.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 5: SKILLS TO EVALUATE THINKING, ACTIVITY 6: DATA CARDS

DATA 6

A majority of respiratory illnesses are contagious. Many of them, such as the common cold, influenza, and COVID-19, are caused by viruses and spread easily from person to person through respiratory droplets or contact with contaminated surfaces. In contrast, respiratory diseases caused by eating contaminated food are very rare.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 5: SKILLS TO EVALUATE THINKING, ACTIVITY 6: DATA CARDS

EVENT 1

Lumi Hernandez thinks that her dog got her sick. She often goes hiking with her dog in the hills. After a recent drought, the trails have been really dry. She and her dog go for a walk and breathe in a lot of dust while walking. Her dog had symptoms of Southsand fever 4 days later, and Lumi had symptoms 5 days later.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 5: SKILLS TO EVALUATE THINKING, ACTIVITY 6: EVENT CARDS

EVENT 2

A scientist is digging soil samples alone and without wearing a mask. He is infected with Southsand fever 5 days later and dies. None of his family, friends, or doctors got sick afterward.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 5: SKILLS TO EVALUATE THINKING, ACTIVITY 6: EVENT CARDS

EVENT 3

A local veterinarian has treated 10 infected dogs and 5 infected cats over the last month, and he never wore a mask. He is bitten by one of the dogs and scratched by one of the cats, but he never contracts Southsand fever.

A university research lab conducted recent studies of rodents that were sick with Southsand fever. Five research employees failed to wear masks while handling infected rodents, and the employees never contracted the disease.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 5: SKILLS TO EVALUATE THINKING, ACTIVITY 6: EVENT CARDS

EVENT 4

A doctor accidentally pricks himself with a scalpel that was contaminated with the blood of someone who died from Southsand fever. However, the doctor does not get sick with the disease.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 5: SKILLS TO EVALUATE THINKING, ACTIVITY 6: EVENT CARDS

EVENT 5

A huge dust storm caused the kite festival to end in the late afternoon.

Afterward, a public health worker discovers that locally grown corn served at the festival had been stored in a warm, humid silo. These are good conditions for certain diseases to grow in food.

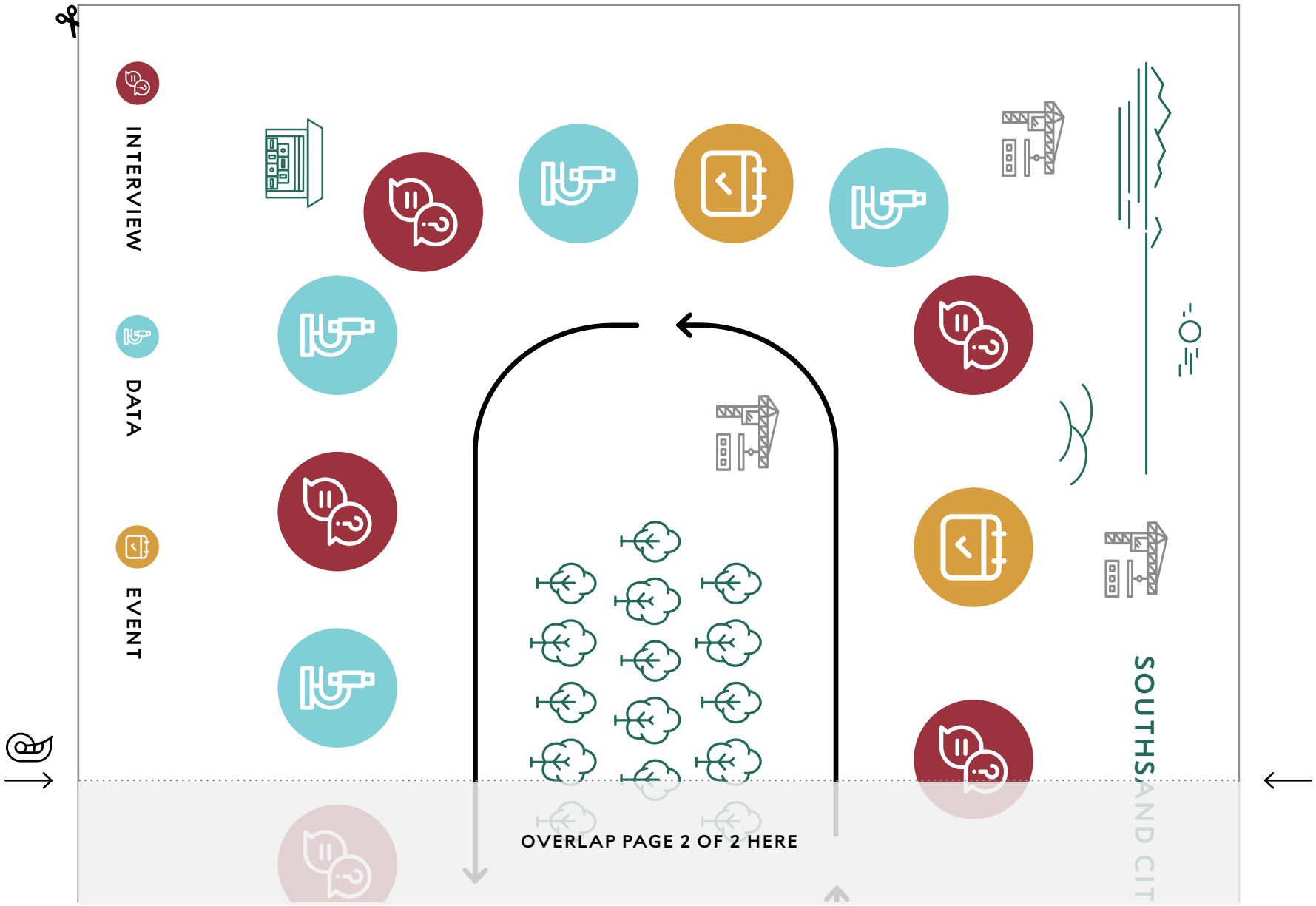
SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 5: SKILLS TO EVALUATE THINKING, ACTIVITY 6: EVENT CARDS

EVENT 6

Food-safety inspectors did not find any signs of contamination in the chicken or in the corn sourced from the local farms that provided the food at the kite festival.

Also, no chickens from any local farms showed symptoms of the disease.

SCIENTIFIC THINKING FOR ALL: A TOOLKIT
UNIT 5: SKILLS TO EVALUATE THINKING, ACTIVITY 6: EVENT CARDS


INTERVIEW
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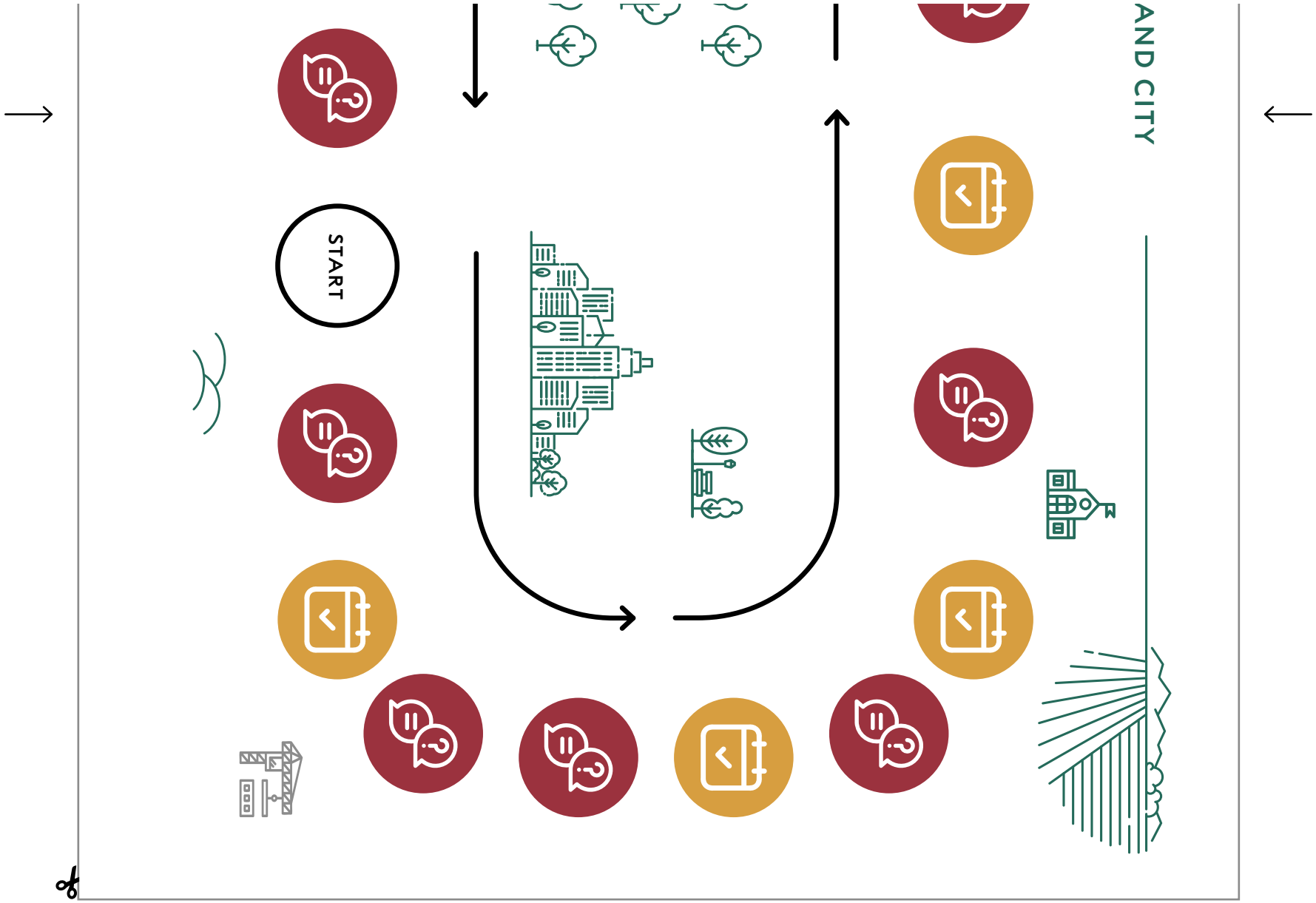
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