Secret Sink

SUBJECTS: Science and Social Studies
GRADES: 6-8
DURATION: Two to three 45 minute periods (depending on amount of discussion)
ACTIVITY SUMMARY: Students will work together as city planners to design a community. They must take into account the needs of community members, businesses and the environmental impact on the land itself.

OBJECTIVES:
The students will be able to:

1. Problem solve while considering advantages and disadvantages for locations of economic activities in places and regions.

VOCABULARY: Karst, sinkholes, groundwater, spring, run-off, pollution, community

RESOURCES:
Let's Build a City: Crash Course Kids #48.1
https://www.usgs.gov/faqs/what-a-sinkhole

MATERIALS REQUIRED:

- scissors
- masking tape
- glue
- surface map that includes a river, spring, and sinkhole (one per group)
- Secret Sink Community Sheet (one per group)

BACKGROUND:

All land use can dramatically affect an area. This is particularly true in a karst area. A karst area is distinguishable by the lack of surface streams and an abundance of sinkholes and springs. Following the properties of gravity, water consistently travels to the lowest point, the water table. In most areas of the United States the water travels along the surface as a stream or river. But in a karst area the water is more likely to sink underground to form sub-surface streams or rivers. Underground water may travel many miles before exiting as a spring near or along a surface river.

In a karst landscape, water drains underground by flowing into depressions called sinkholes. Sinkholes are areas where underlying rock layers have given way, causing the upper layers of rock to develop cracks and collapse. Karst terrain is very susceptible to groundwater pollution due to many sinkholes on the surface that quickly drain water into underground rivers.

When discussing land development in a karst region, numerous issues should be addressed. All uses for land can dramatically affect an area, but the problems of groundwater pollution and an increasing human population have the most dramatic impacts on a given area. This is particularly true in a karst area where the abundance of sinkholes can funnel not only surface water but also all types of pollution into the groundwater. This run-off, or drainage of water and water-carried pollution, can create major community problems. Because of its numerous surface cracks and holes, a rainstorm within a karst terrain can swiftly wash soil, farming chemicals (including fertilizers, insecticides, pesticides, etc.), or animal waste from adjacent farmland into the underground waterways. Oil and gas residues can wash off area roadways or railway lines. Broken sewage or septic lines can carry human waste into the underlying water streams. The polluted waters can be brought into area homes without the necessary filtration or cleansing. This affects the health and well-being of the community.

A community's greatest challenge is to develop a relationship with its surroundings so both can thrive. Planning is the key to a successful partnership with the land. By understanding the workings of a karst terrain and the vital role that water plays in this environment people can make informed decisions to ensure that pre-existing plant and animal communities are not greatly disturbed. In the Secret Sink Community, industry, agriculture, and general services all must work together to produce a sustainable environment.

Natural Bridge Caverns, Inc.
26495 Natural Bridge Caverns Rd
San Antonio, TX 78266
210-651-6101
www.naturalbridgecaverns.com

PROCEDURE:

1. Tell the students that they are responsible for planning a new community in the Secret Sink region. All components of the community must be arranged so that it maximizes the usefulness of this region. Review what needs to be developed and the importance of not leaving out any aspects of the community.
2. Divide the class into groups of three to five students. Each group represents a town planning committee. Working together as a team, their job is to plan the "perfect" community – a community which provides a clean, healthy environment for all its residents as well as the pre-existing plant and animal life.
3. Review the components of the community*:
   Residents—live in the area
   Farmers—use the land to raise tobacco and livestock
   Industry—uses the land for economic growth and trade
   Small Business—provide local services
   National Park—preserves and protects the unique environment
   Transportation Department—issue appropriate transportation throughout the community. This can include highways, railroads and/or water transportation
   Environmental Groups—protect the sinkholes under any circumstances
   *Other groups can be added.
4. Before the students cut out the materials, brainstorm the pros and cons of land use in the Secret Sink community. Record the pros and cons on the board.
5. Pass out the surface maps, scissors, glue, and the Secret Sink Community Sheets. The surface maps will serve as a base for each group's community. Explain that the group will need to use all the building cutouts provided. These cutouts can be made smaller, or they can include more land, but all pieces must be used. The student may also develop other land uses. Do not paste items down at this time.
6. Have students work in their groups and begin to develop their ideal community. While doing this, keep in mind the priorities of each community group. Remember no land use is to be excluded, all community buildings must be used, plant and animal habitats need to be preserved, and everyone in your group should agree. Once all community members agree to the best layout, the pieces should be pasted or taped in place.
7. After each land use plan has been completed, each group now shares their "ideal" community with the rest of the class. During each presentation, community members should explain why they chose the placement of each component of their community. They should also explain how the placement of individual components helps protect, preserve, and maintain the health and well being of other community components.
8. As each presentation is completed, the teacher should tape or hang each completed community along the board or wall of the classroom. Place communities side by side, until each group has completed their presentations. Next, have the class focus on the string of communities found along the river. Point out that each represents a town, city, or farming community found along the Guadalupe River. Individual components of any one community may protect other components within its town limits, but how do they affect the next community downstream? Did the individual planning committees think about other communities while working the layout of their own town? Are there different choices that would have made a difference to neighboring communities?
   NOTE: There is no "perfect" community. Every community will affect the plant and animal habitats around it, but proper planning can help to alleviate many environmental consequences.
9. To show that our Secret Sink community is not isolated, use a U.S. map to show that the Guadalupe River flows into the Gulf of Mexico. Now, as we look at our community, how are we affecting other communities down river and around the world?

EVALUATION: The teacher is able to evaluate the students by observing how the students interact with each other in their groups. Through the students' presentations and discussions, the teacher will be able to evaluate problem solving skills and how well they adapt to different perspectives.

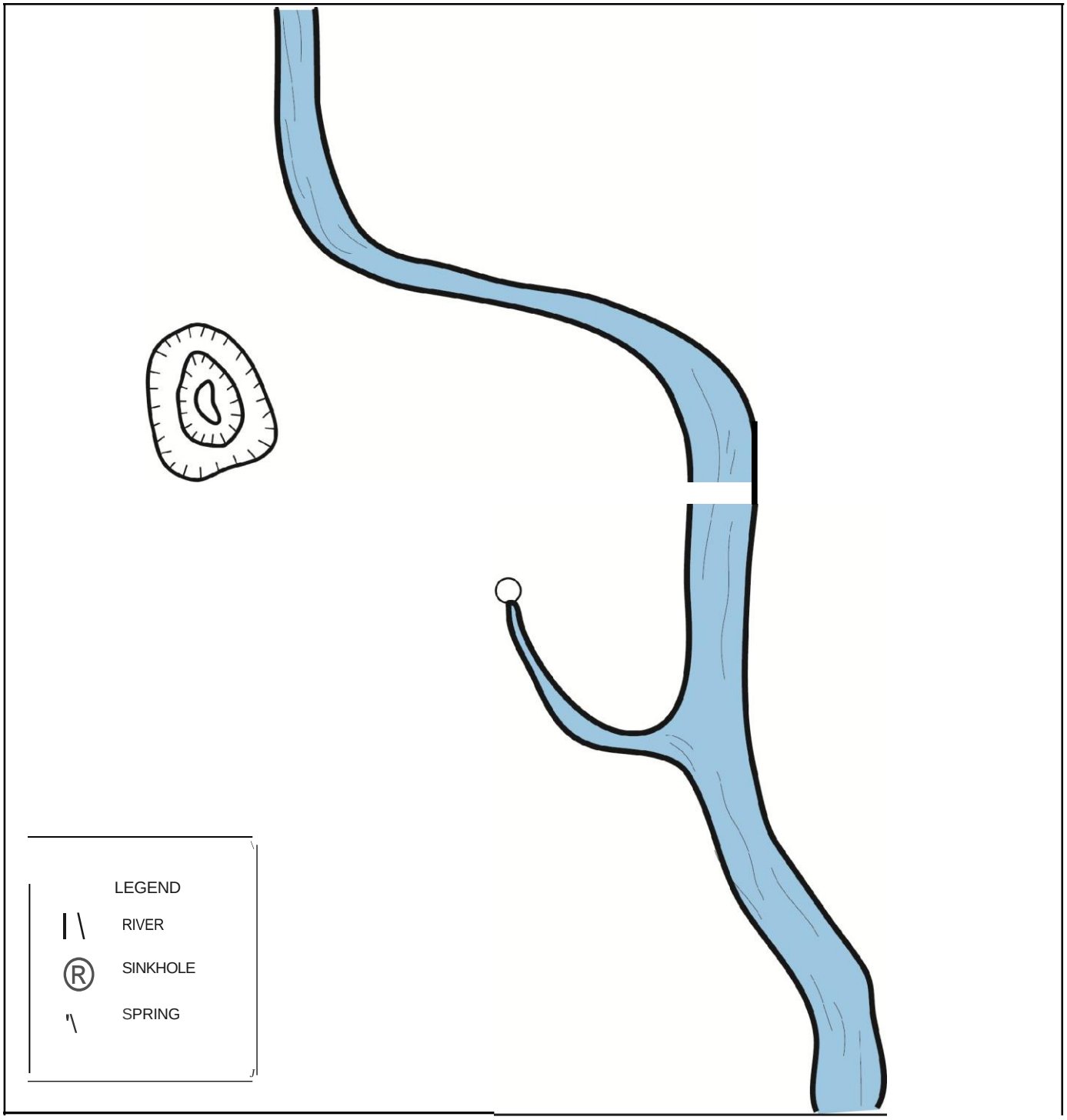
EXTENSIONS:

1. Relate Secret Sink to a sinkhole or other potentially hazardous area in or near your community. How is it being used?

What kinds of connections can you make?

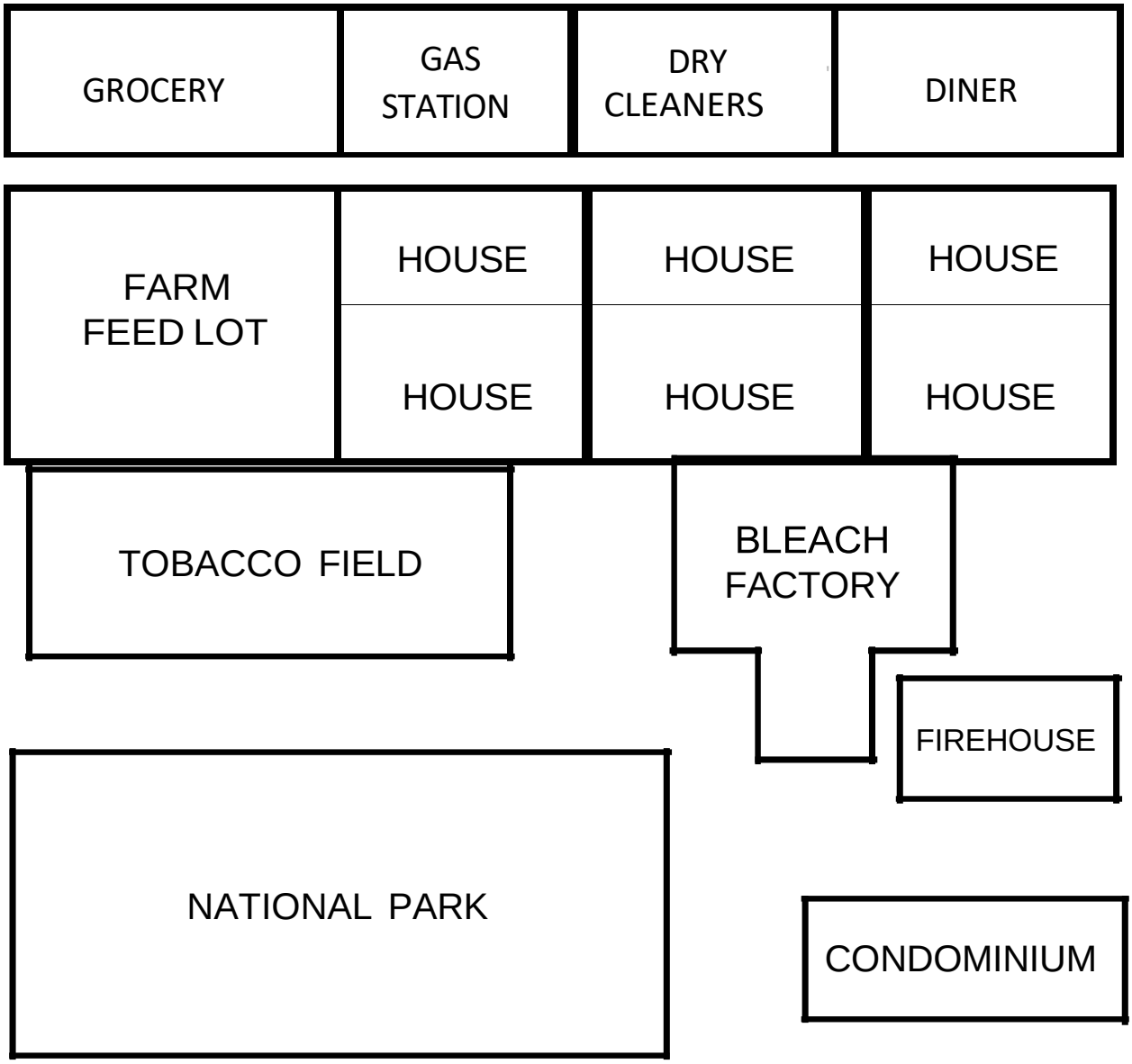
2. Find articles in local newspapers relating to sinkholes. What problems, concerns, and/or solutions are being discussed?
3. Attend a town meeting to see how your community discusses and plans for your area's development.
4. Brainstorm some changes that could be made within your school community. Prepare your ideas and present them to your school's student council.

Secret Sink Map



Secret Sink

COMMUNITY SHEET



HIGHWAY

RAILROAD

TEKS ADDRESSED:

Science

6th Grade

1(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations

1(B) use scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems

1(C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards

1(D) use appropriate tools such as graduated cylinders, metric rulers, periodic tables, balances, scales, thermometers, temperature probes, laboratory ware, timing devices, pH indicators, hot plates, models, microscopes, slides, life science models, petri dishes, dissecting kits, magnets, spring scales or force sensors, tools that model wave behavior, satellite images, hand lenses, and lab notebooks or journals

1(E) collect quantitative data using the International System of Units (SI) and qualitative data as evidence

1(F) construct appropriate tables, graphs, maps, and charts using repeated trials and means to organize data

1(G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems

2(A) identify advantages and limitations of models such as their size, scale, properties, and materials

2(B) analyze data by identifying any significant descriptive statistical features, patterns, sources of error, or limitations

2(C) use mathematical calculations to assess quantitative relationships in data; and

2(D) evaluate experimental and engineering designs.

3(A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories

3(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats

3(C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence

5(A) identify and apply patterns to understand and connect scientific phenomena or to design solutions

5(B) identify and investigate cause-and-effect relationships to explain scientific phenomena or analyze problems

5(C) analyze how differences in scale, proportion, or quantity affect a system's structure or performance

5(D) examine and model the parts of a system and their interdependence in the function of the system

5(E) analyze and explain how energy flows and matter cycles through systems and how energy and matter are conserved through a variety of systems

5(F) analyze and explain the complementary relationship between the structure and function of objects, organisms, and systems; and

5(G) analyze and explain how factors or conditions impact stability and change in objects, organisms, and systems.

7th Grade

1(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations

1(B) use scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems

1(C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards

1(D) use appropriate tools such as graduated cylinders, metric rulers, periodic tables, balances, scales, thermometers, temperature probes, laboratory ware, timing devices, pH indicators, hot plates, models, microscopes, slides, life science models, petri dishes, dissecting kits, magnets, spring scales or force sensors, tools that model wave behavior, satellite images, hand lenses, and lab notebooks or journals

1(F) construct appropriate tables, graphs, maps, and charts using repeated trials and means to organize data

1(G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems

2(A) identify advantages and limitations of models such as their size, scale, properties, and materials

2(B) analyze data by identifying any significant descriptive statistical features, patterns, sources of error, or limitations

2(C) use mathematical calculations to assess quantitative relationships in data

2(D) evaluate experimental and engineering designs

11(A) analyze the beneficial and harmful influences of human activity on groundwater and surface water in a watershed

8th Grade

1(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations

1(B) use scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems

1(C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards

1(D) use appropriate tools such as graduated cylinders, metric rulers, periodic tables, balances, scales, thermometers, temperature probes, laboratory ware, timing devices, pH indicators, hot plates, models, microscopes, slides, life science models, petri dishes, dissecting kits, magnets, spring scales or force sensors, tools that model wave behavior, satellite images, weather maps, hand lenses, and lab notebooks or journals

2(A) identify advantages and limitations of models such as their size, scale, properties, and materials

2(B) analyze data by identifying any significant descriptive statistical features, patterns, sources of error, or limitations

2(C) use mathematical calculations to assess quantitative relationships in data

2(D) evaluate experimental and engineering designs

3(A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories

3(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats

3(C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence

TEKS CONTINUED
Social Studies

6th Grade

1(A) trace characteristics of various contemporary societies in regions that resulted from historical events or factors such as colonization, immigration, and trade
1(B) analyze the historical background of various contemporary societies to evaluate relationships between past conflicts and current conditions
3(A) identify and explain the geographic factors responsible for patterns of population in places and regions
3(B) explain ways in which human migration influences the character of places and regions
3(C) identify and locate major physical and human geographic features such as landforms, water bodies, and urban centers of various places and regions
4(A) explain the geographic factors responsible for the location of economic activities in places and regions
4(B) identify geographic factors such as location, physical features, transportation corridors and barriers, and distribution of natural resources that influence a society's political relationships
5(A) describe ways people have been impacted by physical processes such as earthquakes and climate
5(B) identify and analyze ways people have adapted to the physical environment in various places and regions
5(C) identify and analyze ways people have modified the physical environment such as mining, irrigation, and transportation infrastructure

7th Grade

8(B) locate and compare places of importance in Texas in terms of physical and human characteristics such as major cities, waterways, natural and historic landmarks, political and cultural regions, and local points of interest
8(C) analyze the effects of physical and human factors such as climate, weather, landforms, irrigation, transportation, and communication on major events in Texas
9(A) identify ways in which Texans have adapted to and modified the environment and explain the positive and negative consequences of the modifications
10(A) identify why immigrant groups came to Texas and where they settled

8th Grade

10(C) analyze the effects of physical and human geographic factors such as weather, landforms, waterways, transportation, and communication on major historical events in the United States
11(A) analyze how physical characteristics of the environment influenced population distribution, settlement patterns, and economic activities in the United States
11(B) describe the positive and negative consequences of human modification of the physical environment of the United States.