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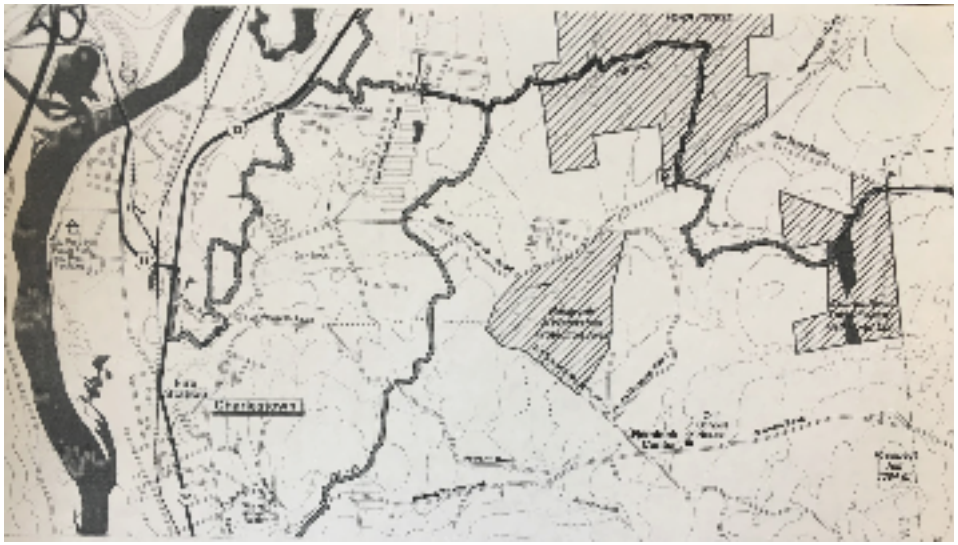
WATERSHED STUDY

this notebook belongs to:



Map of Charlestown, NH

Day 1

1. Learn about Watershed related vocabulary: (Make a picture dictionary)

bankfull channel width	meander
channel	riffle
corridor	sediments
culvert	slope
dredging	thalweg
floodplain	tributary
headwaters	watershed

2. Discuss the concept of a watershed, look at Charlestown watershed map (Fig. 1.A)
   - River systems drain a basin of land, from the highest elevation (rim) to the lowest valley.
   - River systems flow out of the mouth, and into a pond, river, lake, wetland, or ocean.
   - Look at the Charlestown map,
     - When the water leaves the river system, where does it go?
     - Where does it go after that?
     - Water in any watershed is part of the Hydrologic Cycle, which continuously circulates water through our atmosphere and Earth's crust.
   - Watershed conditions:

Changing Physical Conditions Along the River Continuum			
Conditions	*headwaters*	*tributaries*	*mainstem*
gradient (slope)	steep	moderate	low/flat
water velocity (speed)	fast to moderate	moderate to slow	slow
streambed	rocks	rocks, gravel, and/or sand	sand and/or silt
sinuosity (degree of meandering) -- assuming that the channel has not been straightened by humans	none (straight channel)	narrow, moderate, or wide meanders	moderate to wide meanders
water temperature	cold	cool	cool to warm

Argument Essay Writing Prep

Different members of a community have different perspectives on installing stream crossings. Things to consider:

- cost
- life-span (how long it will last, which affects the replacement cost)
- affects on fish and wildlife habitats
- affects on water quality
- affects on local roads, landowners, settlements, farms, etc…
- local, state, and federal requirements that need to be met to recieve a permit for the crossing

Imagine that a town has to replace a culvert on Trout Book, a popular fishing location. A busy road runs over the culvert. Review with students the following pros and cons of each type of crossing. Add to list as needed.

Type of Crossing	**Pros (+)**	**Cons (-)**
small culvert	• low cost • works for moving typical water volumes • minimal movement of earth required to install it • takes up a small "footprint"	• may not be able to handle storms, causing them to flood the land around it • may get blocked with debris or "blown out" during storms, causing flooding around it • water often becomes stuck - due to plugged culvert, interfering with migration of aquatic organisms
bottomless arch	• inexpensive, compared to a bridge • works for moving typical and greater water volumes • does not change the velocity of water • has natural streambed, which provides aquatic habitat and allows migration • does not become stuck or clogged up	• higher cost than small culvert • requires more movement of earth to install than small culvert • larger "footprint" than small culvert
bridge	• lasts longer than culverts • much less likely to wash out than culverts • does not change the velocity of water • has natural streambed, which provides aquatic habitat and allows migration • does not become clogged up • usually more sturdy than culverts and arches	• higher cost than either small culvert or bottomless arch • longer construction process

(Stream Crossing Experiment continued)

1. **Results**: Which structure minimized erosion? Check one.
   - ❏ small culvert
   - ❏ bottomless arch
   - ❏ bridge
   - ❏ not enough data
2. **Conclusions**: Review your original Question and Hypothesis, as well as Observations and Results. ***What do you know now (after your experiment) that you didn't know before?***

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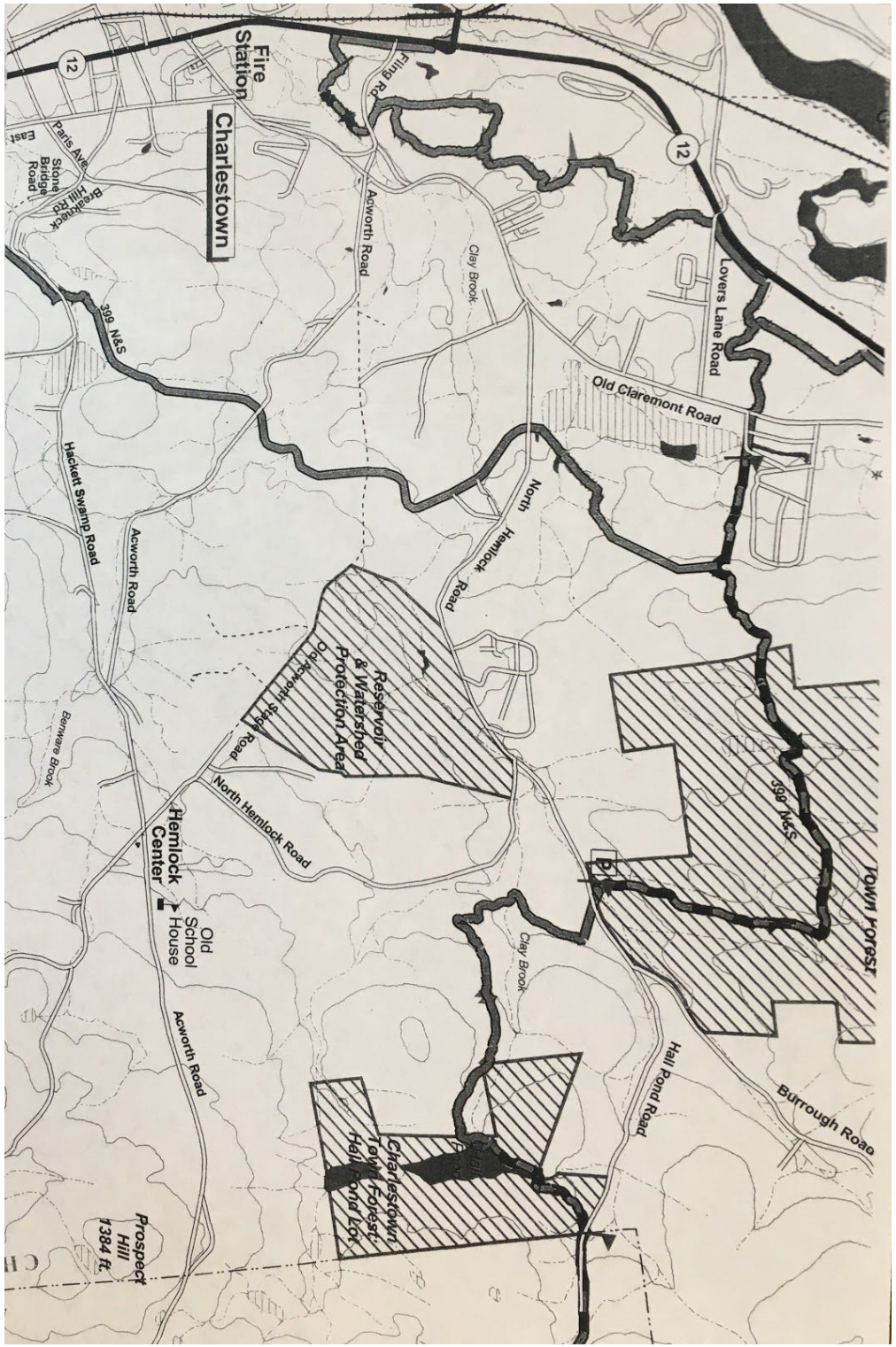
3. **New Questions ?**
   -
   -
   -

Fig. 1.A



Day 2

STREAM TABLE PLAY DAY!

Important Procedures to remember:

Crossing Structure	**Observations**
bottomless arch	1. low flow
	2. medium flow
	3. high flow
bridge	1. low flow
	2. medium flow
	3. high flow

Stream Crossing Experiment Part 2

Look at the 3 kinds of stream crossing structures: small pipe culvert, bottomless arch, and bridge.

1. **Question**: Which crossing structure will minimize erosion along the stream?
2. **Hypothesis**:
   - ❏ small culvert
   - ❏ bottomless arch
   - ❏ bridge

   I chose this structure because

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3. **Experiment**: Install each crossing structure, one at a time, and run the stream table. Write 3 observations for each structure below, one observation for each flow level.

Crossing Structure	**Observations**
small pipe culvert	1. low flow
	2. medium flow
	3. high flow

Day 2

STREAM TABLE PLAY DAY!

Observations:

Thoughts:

Questions:

STEPS OF SCIENTIFIC INQUIRY

ASK QUESTION
First step. Use observations and predictions to come up with an initial QUESTION.

HYPOTHESIZE/PREDICT
A hypothesis is a possible explanation for an observation that CAN BE TESTED.
*IF _____, THEN _____, BECAUSE _____.

TEST HYPOTHESIS
Test whether or not predictions are true. Modify/change hypothesis/retest. Experiment/build a model, etc...)

ANALYZE RESULTS
Look for trends/relationships in data. Sort, graph, or organize data in some way.

DRAW CONCLUSIONS
Once you have relationships among data, draw conclusions: summarize information gained from testing hypothesis.

COMMUNICATE RESULTS
Share info with others - present, write, speak, etc…

FURTHER SCIENTIFIC INQUIRY (next question?)
Use what you learned to learn more! What do you want to know next?

(Stream Crossing Experiment Continued)
Create a straight channel in the stream table - the same width as the small pipe. Install pipe in flowing water. Pack sediments agains the pipe on either side (put a road with cars on it across the top!). Run water at low volume, make observations (1); turn up volume, and make additional observations (2). Turn up to high volume (storm surge) and make a third observation (3).
3B. Install the large culvert. Watch the stream flow through it. Write or draw 3 observations.

large culvert observations
1.
2.
3.

4. Results: Which size culvert caused the <u>least</u> erosion?
- ❏ small culvert
- ❏ large culvert
- ❏ not enough data

5. Conclusions: Review your observations and results. What do you know now that you didn't know before the experiment? Write 3 conclusions.

a. _____

_____

b. _____

_____

c. _____

_____

Day 7

Stream Crossing Experiment

1. Observe the following diagrams of various stream crossings:
    a. Small Pipe 
    b. Bottomless Arch 
    c. Bridge 
2. HYPOTHESIZE which crossing structure will minimize erosion:

I predict that the (circle one): [small culvert / large culvert] will best

minimize erosion because:

Create a straight channel in the stream table - the same width as the small pipe. Install pipe in flowing water. Pack sediments agains the pipe on either side (put a road with cars on it across the top!). Run water at low volume, make observations (1); turn up volume, and make additional observations (2). Turn up to high volume (storm surge) and make a third observation (3).

3A. Install the small culvert. Watch the stream flow through it. Write or draw 3 observations.

small culvert observations
1.
2.
3.

Day 3

Corridors and Channels

Why Meanders Form 1.1

1. Teacher will create a *straight channel*, and let water flow for a few minutes.
    - Observations:

3 Notes about observations:

-
-
-

2. Class discussion notes;

Day 3

Corridors and Channels

The Changing Channel 1.2

1. Teacher will turn off stream table and create a *straight channel*.
2. When told, place sticks along the channel on boths sides to define the width and path of the channel.
3. Take a photo of the channel.
4. Predict where it is safe to build houses along the stream, and place houses in those spots. Sketch the stream table below:

5. We will continue to run the water (at varied levels of force), and take a picture every 3 minutes.
6. Answer the following:
    a. Did the stream behave as predicted? <u>Why or why not</u>?

    b. Did any houses get dangerously close to the stream or even fall in the stream? Explain:

Day 6

Gravel Mining

1. We will turn on the water in the stream table and allow *meanders* to form.
2. Discuss *gravel mining* - pretend like your hand is a backhoe.
3. Teacher will (in a few minutes) scoop out some sediment -
    a. What will happen now to the water *velocity*?

    b. What will happen to the streambed?

    c. What will happen to the banks of the stream?

    d. What will happen to the area downstream of the dredged area?

4. Record observations below:

Discuss, as a class, what happened.

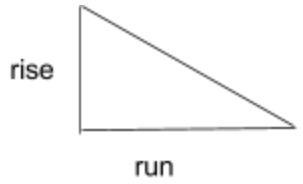
Day 5

Length and Slope continued

Determine the slopes of Channels 1 and 3 using this formula:

SLOPE = RISE / RUN

(divide the rise by the run)



The *run* of Straight Channel 1 is 48" and the *run* of Straight Channel 3 is 60". The Riser Board (rise) for each channel is 2.4"

So, the % angle (<u>not</u> degree) for Straight Channel 1 is:

2.4" / 48" =

And the % angle for Straight Channel 3 is:

2.4" / 60" =

As a class, discuss results.

1. Which channel has a steeper slope?

2. Which channel would have a greater velocity?

3. Which channel carries more force and causes more erosion?

Day 3/4

Corridors and Channels

The Stream Anatomy Lesson 1.3

After the stream has run for a while, the teacher will hand out "stream anatomy" name tags. Place your name tag where it belongs (based on vocabulary picture dictionary!)

Discuss, as a class, the placement of the name tags. Are they in the correct spot? Why or why not?

Using this vocabulary, sketch the stream table and label all parts:

Day 4

Marble Races

Marble Races

1. Teacher will show Channel Board A1,2 and B1,2 and assign the following roles:
    a. Starter:
    b. Marble releasers: 1) 2)
    c. Marble catchers: 1) 2)
    d. Timers: 1) 2)
2. Using your Meanders and Velocity Student Activity Sheet (below), follow steps of scientific inquiry to explore slope, mass, and velocity in streams using 3 quesitons.
3. Starters, releasers, catchers, and timers get into position.
4. Hold marbles at top, starter says "Go!," release marbles, catch/time. Rotate rolls.
5. Complete activity sheet (below).

<u>Meanders & Velocity Student Activity Sheet</u>

Questions, Hypothesis, Experiments, Results

1st **Question**: What would happen if you raced…

- a small marble down the 48" straight channel, and
- a small marble down the 60" meandering channel?

Hypothesis: I predict:

_____

_____

I think this because

_____

_____

Experiment: Run the race

Data Collection:	small marble 48" straight channel	small marble 60" meandering channel
Trial 1: Time (in s.)		
Trial 2: Time (in s.)		
Average Time (in s.)		

Results:

Day 5

Thalwegs and Riffles

When a marble travels down the meandering channel, where within the channel does it travel? Does it move down the middle of the channel, or does its course vary?

Watch as the smallest marble travels down the meandering channel. Write observations below:

Length and Slope

1. If you straightened out the Meandering Channel 2, how long would it be? Use a piece of string and a meter stick to measure the meandering channel, and compare it to the straight channel:
2. Look at Straight Channel 3 on Board B (this is Meandering Channel 2 straightened out). Put Channel B board next to Channel A board and prop both up on Riser Board so they are the same *elevation.*
3. Compare the *slopes* (the amount of drop in elevation) of both channels.
    a. **Which one is steeper?**
    b. **How might slope affect water velocity and its erosive forces?**

(Question 3 continued)

Data Collection:	small marble 48" straight channel	small marble 60" straight channel
Trial 1: Time (in seconds)		
Trial 2: Time (in s.)		
Average Time (in s.)		

Results:

Conclusions:
Review your predictions, data, and results for each race.
What do you know now that you didn't know before these experiments?

What can you conclude about different size marbles in straight and meandering channels? Think about *velocity* (speed) of the marbles and the *mass* (size and weight) of the marbles.

New Question ? :

2nd **Question**: What would happen if you raced…

- a large marble down the 48" straight channel, and
- a large marble down the 60" meandering channel?

Hypothesis: I predict: _____

_____

I think this because _____

_____

Experiment: Run the race

Data Collection:	large marble 48" straight channel	large marble 60" meandering channel
Trial 1: Time (in seconds)		
Trial 2: Time (in s.)		
Average Time (in s.)		

Results:

3rd **Question**: What would happen if you raced…

- a small marble down the 48" straight channel, and
- a small marble down the 60" straight channel?

Hypothesis: I predict: _____

_____

I think this because _____

_____

Experiment: Run the race

EXTRA NOTES

EXTRA NOTES